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Lifts (elevators) — Requirements for lifts used to assist in building evacuation

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National foreword

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 178, *Lifts, escalators, and moving walks*.

Introduction

This Technical Specification has been prepared in response to ISO/TC 178 Resolution 273/2007 in which the Technical Committee requested that WG 6 undertake to write a specification for lift features that if incorporated into an appropriate lift would enable it to be used in safety to evacuate persons from a building that was suitably designed.

This work results from a detailed study undertaken by TC 178/WG6 into the feasibility of using lifts for evacuation of persons. The study ISO/TR 25743 indicated that it was feasible to use lifts, provided that certain features were incorporated in the lift and also in the building.

Lift engineers and other specialists have been involved in the production of this specification.

It has been recognized that lift engineers are not experts in building design or fire engineering. The writing of this Technical Specification does not indicate if it is acceptable or permitted to use lifts for building evacuations. It only indicates the features required should those persons responsible wish to make such a decision. This Technical Specification does not define, in any detail, building features that will have to be provided in conjunction with a lift intended to be used for evacuation. Its aim is to make clear to those persons involved in building design and fire engineering the issues that they shall address to enable the lift to be used safely.

There are many reasons why a building might need to be evacuated, such as a fire, explosion, chemical or biological attack, flooding, storm damage, earthquake, etc. Not all of these are relevant to every building and other hazardous situations, while existing, are so unlikely to occur that they can be disregarded. Designers of buildings have to determine if a particular hazard is sufficiently great as to require addressing.

If, for example, a small office block is being designed that will be located in a mid-town area, it is within the realm of possibility that it could be subjected to an explosion or chemical attack (terrorism). It is not, however, very likely to be the case unless it has some particular reason to make it vulnerable. In most cases, the risk of these events is probably so low as to make it unnecessary for them to be addressed.

If the building is to be the headquarters of National Security, this will increase the likelihood of it being subjected to some form of attack. It might be necessary to consider the effects of an explosion in or close to the building or a chemical agent being introduced into the building.

Clearly, a building constructed in an area where earthquakes do not normally occur need not have provisions made for such an event.

If a building is to be built in the centre of a major city to form a prestigious landmark, it might be essential to consider all likely events that could occur.

The designer of the building has to determine, by risk assessment or other methods, what hazardous events needs to be reasonably addressed. Once this is completed, ISO/TR 25743 can be used to understand the lift and building features that might be required for each evacuation scenario envisaged.

A lift or lifts can enable disabled persons to evacuate a building in relative ease, but if it is thought, lifts could play a role in general evacuation, they might or might not make a significant contribution to reducing the general evacuation time. It will depend on the building size, number of lifts, etc.

This Technical Specification defines lift requirements to address common hazards that all users could be exposed to if lifts are used for evacuation.

Even if it is thought that lifts could play a part in a general evacuation, it might prove to be uneconomical. It is not suggested for lifts to replace or change the requirements for escape stairs, and that using lifts instead of stairs can increase evacuation times in many building designs. The intention is to allow lifts to play a positive role in assisting and improving the efficiency of the building evacuation strategy.

This Technical Specification is divided into sections covering the key items that have to be addressed. There is no priority intended from the order in which the items are listed.

Lifts (elevators) — Requirements for lifts used to assist in building evacuation

1 Scope

This Technical Specification details requirements for passenger carrying lifts, which are installed in buildings having a suitable comprehensive building evacuation strategy. It does not define building requirements that will have to be provided as part of the overall evacuation strategy for the building.

Excluded from this Technical Specification are the following:

— details of a building evacuation strategy;

— details of building features to reduce risks or eliminate hazards;

— national building requirements which might demand special features.

2 Normative references

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

ISO 4190-5, *Lift (Elevator) installation — Part 5: Control devices, signals and additional fittings*

3 Terms and definitions

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

3.1
Alternative Evacuation Exit Floor
AEEF
level defined by the building designer to be used for evacuation when systems or management determine it should be used

3.2
Building Management System
BMS
system capable of making appropriate decisions based on information sent to it

3.3
chemical incident
introduction of a gas, chemical, bacterial agent, or substance into the building

3.4
building management
persons or organization responsible for ensuring the day-to-day safe efficient running of the building and for ensuring the building is safely evacuated in line with the evacuation strategy

3.5
ETA
estimated time of arrival of the lift

3.6
fire
combustion of material producing, heat, sometimes smoke, and/or flame

3.7
Fire Command Centre
FCC
room or area provided in the building where information is displayed showing the status of a fire detection system and lifts, etc. and where management can receive audible and visual information to determine what actions to take if lifts are to be used

3.8
fire compartment
fire separated area
area within a building bounded by walls, floor, and ceiling constructed from fire resisting material so as to provide resistance to fire for a defined period

3.9
fire warden
person appointed by the building management to assist in managing the evacuation of a floor or area of building during an emergency

3.10
hazardous area
area where due to heat, smoke, gas, etc. the environment is considered dangerous to persons

3.11
hazard detection system
system of sensors capable of automatically detecting fire, smoke, gas, etc

3.12
impaired mobility
difficulty in using stairs because of a physical impairment

3.13
lift evacuation time
time a person spends using a lift to evacuate

Note 1 to entry: It is expressed in s.

Note 2 to entry: This is measured from initiation of evacuation service for a given floor plus the time spent travelling to the floor plus the time to open doors, load the car return nonstop to main exit for evacuation, open doors, and empty lift car.

3.14
Main Evacuation Exit Floor
MEEF
floor designated by the building designer where persons should exit lifts to leave the building

Note 1 to entry: This might or might not be the normal exit floor or ground floor of the building.

3.15
required lift evacuation handling capacity
number of persons who can be moved to the main evacuation exit floor in a five-minute period, expressed as a percentage of the total number of persons to be evacuated by lifts

Note 1 to entry: This is not to be confused with normal lift handling capacity.

3.16
required lift evacuation time
time measured from start of the lift evacuation service to completion of the evacuation of a floor or number of floors

3.17
safe area
safe floor
area of the building, where it is known that heat, smoke, etc. are not present and where it will be safe for people to wait, travel in, or leave the lift

3.18
total lift evacuation time
time required to move all persons requiring evacuation by lifts to the *Main Evacuation Exit Floor* (3.14)

Note 1 to entry: This time is measured from start of evacuation service with lift(s) at MEEF to evacuation of all persons and return of lifts to the MEEF.

3.19
building sign
information display provided by the building, not the lift, informing building users of the location of evacuation lifts available for use

4 Automatic evacuation lift specification

4.1 Determining the number and size of lifts

To calculate the number and size of lifts required to provide an adequate evacuation service, the handling capacity of a given lift or group of lifts shall be determined. To calculate lift handling capacity, the lift designer will require certain information as detailed in Annex B.

Any other building specific information that might affect the handling capacity or assist the lift designer in understanding the issues related to the evacuation strategy should also be provided.

It shall be recognized that there is always a reasonable possibility that a lift or lifts might not be available for some reason. This might occur due to planned maintenance, repairs, etc. An allowance should be made in the handling capacity calculations to take account of this. This shall be done by assuming that in a building with multiple lifts, at least one lift will not be available at any given time and should therefore be removed from any calculation.

In determining the size of the lift, it should be assumed that if a lift car arrives at a floor and there is not enough space for people to enter, there is a risk of panic and/or overloading. This might occur where a wheelchair is in the lift consuming a relatively large amount of floor area in relation to its load. To avoid this situation, the size of lift car chosen should be suitable to accept a wheel chair while still providing room for a number of additional occupant(s).

A lift contractor will be able to calculate the number of lifts and their speed provided that the information contained in Annex B is provided.

4.2 Protection of lift equipment

Lift shafts and machine rooms or machinery spaces located outside the shaft should be fully enclosed. The temperature in the enclosures should be maintained to acceptable levels for the equipment, as determined by the lift supplier in consultation with the building management.

Water can come from a number of sources including fire hoses although it is not anticipated that hoses will be deliberately directed at the lift or its equipment.

To avoid unnecessary failures from the ingress of water, a number of provisions shall be made. Sensors in the lift pit shall monitor for the presence of water. For example,

a) if water is detected below the level of pit equipment, sheave, etc. so as not to affect operation; for this condition, a warning shall be sent to the FCC and any BMS, but lifts shall continue to operate, and/or

b) if the water reaches sheaves or other equipment, the lift shall be removed from service (see 4.5).

4.3 Waiting and travelling environment for users

To ensure the safety of users, lift machine spaces, lift shaft, and landing areas outside the lift should be monitored for the presence of smoke or high temperatures likely to harm persons or cause failures of the lift equipment.

The lifts shall not monitor these conditions but respond appropriately to information sent to them by those providing the monitoring equipment.

When an unsafe condition is detected at a floor, the lift shall be prevented from stopping at the relevant floor or floors.

If an unsafe condition is detected in the well or machinery space, the lift shall be removed from service at the first available safe area.

The lift shall inform the FCC and any BMS that it is no longer available for service.

4.4 Removal or suspension of lifts from evacuation service

Where a lift receives a command from a BMS or manual signal to stop or suspend service to a floor or area of the building, any stop shall be a controlled stop at a safe area. A controlled stop means allowing the lift to slow down and stop at a floor in the normal manner.

Where a lift or lifts are instructed to suspend service, the lift(s) shall inform the FCC and any BMS once it is no longer available for service.

4.5 Lift system reliability

Lift reliability is an important issue but it should be noted that this specification already calls for many features that will increase reliability, such as water protection. The lift will also have an automatic recovery system that minimizes the risk to passengers if a stoppage occurs. For this reason, no further additional provisions are required.

Loss of a bank of lifts is much more serious but is only likely to occur due to loss of the power supply. For this reason, it is vital that secondary (emergency supplies) are provided (see Annex A).

4.6 Automatic recovery system

Whenever a lift containing passengers has stopped for some reason, it needs to be, if possible, automatically recovered to a safe floor. If it is not close enough to a safe floor to open its doors, it should be provided with a means to enable it to attempt an automatic recovery and during this process both car and landing doors should be locked closed and passengers should be informed that a recovery is taking place.

Whenever a car stops, it is a natural reaction for passengers to try and pull the car door open. For this reason, car doors should be locked shut during automatic recovery operation. The doors should remain locked shut until it is determined that the car has recovered to a floor.

During any recovery or attempted recovery, passengers shall be kept informed of what is going on. This information shall be both audible and visual.

A recovery attempt might fail for some reasons, therefore, passengers should be informed of any recovery or failure to recover. If it is not possible to recover the lift and passengers are trapped, they should be provided with visual and audible information that the alarm has been automatically raised and they will be rescued shortly. They shall also be able to communicate with those in charge of evacuation.

If a lift fails for some reason, it shall

a) determine if the lift contains passengers and is outside a door zone,

b) automatically lock the car doors if outside the door zone,

c) inform the FCC and any BMS that it has stalled with passengers and will attempt a recovery to the main floor,

d) inform passengers that automatic recovery is to take place, and

e) establish a hands-free communications link between itself and the FCC.

Those in charge of evacuation or a BMS shall inform the lift system of an alternate safe floor if the main floor is unsafe.

If this information is not received within 20 s, recovery shall be made to the main floor. The automatic recovery system shall permit recovery under the following conditions:

— failure of a control system;

— failure of the drive system excluding the machine;

— failure of a landing or car door lock circuit, provided that the closed condition of doors is monitored. This means additional monitoring of the position of door panels is required;

— failure of a safety circuit controlling car speed or over speed. This means the self-rescue system shall employ its own independent speed-monitoring device.

If automatic recovery fails for any reason, the lift shall automatically inform those in charge of evacuation and any BMS.

NOTE A failure of the main driving motor or brake is not considered likely and therefore not addressed.

4.7 Remote lift car surveillance

At times of emergency, it is vital to be able to see that lifts do not contain trapped passengers who might be incapacitated.

A means to display the entire floor area of the car shall be provided.

Whenever the means is made operative, a sign shall illuminate in the car stating “LIFT UNDER SURVEILLANCE” and an audible message shall be given stating the same message.

The means shall be activated automatically whenever the lift is running on evacuation service. At least one viewing terminal shall be located in the FCC and clearly marked “LIFT CAR SURVEILLANCE” with the lift designation identified.

4.8 Communication system requirements

As a minimum, a two-way communication system shall be available for passenger use to permit direct communications between the lift car and an FCC (see 4.13). National regulations might have additional requirements for the communication system.

Each lift shall be provided with a communication system allowing communication between the FCC, any lift machine room or emergency and inspection panel in the case of machine room-less lift.

Operation of the communication device in the lift car shall be simply by means of a single button, operation of which shall connect the system to the FCC. Further operation of the device in the lift car shall be hands-free and permit simultaneous two-way speech.

The button shall be mounted in the lift car-operating panel or adjacent to it (within 100 mm). Its size, marking, and location should meet the requirements for buttons within ISO 4190-5.

It shall be possible to establish communication with the car from the machine room, any emergency and inspection panel or FCC, again by use of simple buttons.

4.9 Lift signs and passenger announcements

Where a lift is being automatically removed from service, passengers and those waiting on landings shall be clearly informed of the situation. This information shall be given visually and audibly within the lift car and on the landing adjacent to the relevant lift. Audible information shall be repeated at short intervals (every 5 s to 10 s), until the announcement is no longer required.

Information shall be provided whenever a car is loading, unloading, performing an automatic recovery, parking, or instructed to run to a particular floor, at any floor, and wherever passengers shall exit.

Audible information shall be adjustable in volume between 35 db (A) and 80 db (A) but shall be initially set at 75 db (A). The provision of signs and announcements shall be coordinated with those responsible for building signage. All lift car and landing displays should satisfy ISO 4190-5, if necessary.

The position of each lift car shall be displayed on the landing at the floor(s) where evacuation service is being provided.

Whenever a lift is instructed to do something, such as run an evacuation service, park, go to the MEEF or AEEF, etc. it shall inform any FCC or BMS of what it is doing and confirm when it has completed the task. Its operational status shall be observable at the FCC and known at any BMS at all times normal or standby power is available.

On or close to the car operating panel, a sign shall clearly show the lifts' unique designation. This information shall be permanent and with characters at least 25 mm high.

The same designation shall be displayed on the landing adjacent to the lift entrance.

4.10 Prevention and detection of car overloading

The car shall be provided with a load device set to operate at approximately 80 % of duty load. When operated, it shall cause an audible and visual warning to be given stating CAR FULL and the car shall travel non-stop to the MEEF/AEEF and on arrival, inform passengers to "EXIT THE LIFT".

If car is overloaded, the overload device shall operate and shall cause doors to remain open until the overload condition is cleared.

It is assumed that the car load and size shall be one selected from the ISO 4190-1 range of sizes where the car floor area is restricted in relation to the load, thus discouraging overloading.

4.11 Initiation of evacuation service

Evacuation service can be initiated by a device such as a button or lever, key, etc. or from a signal sent by a BMS or hazard detection system. Where a button or other manual activated device is used, it shall be protected against unauthorized use.

Its purpose shall be clearly marked with a symbol and/or the words "LIFT EVACUATION SERVICE".

4.12 Description of evacuation service

4.12.1 Any lift will be automatically removed from evacuation service if, where provided, it is turned to firefighters service.

4.12.2 On receipt of a signal, any designated lift(s) travelling away from the main evacuation exit floor (MEEF) shall slow down and stop in a controlled manner at the first available opportunity, reverse direction without opening its doors, and proceed directly to the MEEF or AEEF as instructed. During this return journey, audible and visual information shall be provided in the lift car stating "LIFT RETURNING TO EVACUATION FLOOR, LEAVE LIFT WHEN DOORS OPEN".

4.12.3 Lifts travelling towards the MEEF or AEEF shall continue uninterrupted to the exit floor. Cancel car calls and return without delay to the designated evacuation exit floor. During this return journey, audible and visual information shall be provided in the lift car stating: "LIFT RETURNING TO EVACUATION FLOOR, LEAVE LIFT WHEN DOORS OPEN".

4.12.4 On arrival at the MEEF, the doors shall open and stay open for approximately 15 s. During this period, signs on the landing and in the car shall display the words "LIFT ON EVACUATION SERVICE, DO NOT ENTER". An audible announcement shall repeat this message.

4.12.5 Stationary lifts not at the required evacuation floor that receives an evacuation signal shall display and announce "LIFT REQUIRED FOR EVACUATION SERVICE". The lift shall then close its doors without delay. Door open buttons and passenger detection devices shall remain operative during door closing. However, passenger detection devices might be disabled if doors are closed at reduced speed to limit their kinetic energy. Lifts already at an evacuation floor, on receiving an evacuation signal, shall open their doors, announce, and display "LIFT ON EVACUATION SERVICE".

4.12.6 When the door time expires, the doors shall close and the lift shall travel non-stop to whatever floor it has been instructed to evacuate. The instruction can come from either a BMS or manual input at a FCC.

4.12.7 Upon arrival at the floor, the doors shall stay open to provide adequate time for loading, including those with disabilities.

During this period, landing and car visual and audible information shall be given stating "ENTER CAR".

4.12.8 The car shall close its doors and return to the MEEF/AEEF, as soon as the loading time period has expired or when the car is fully loaded. On return to the MEEF/AEEF, if the car is not fully loaded, additional stops are permitted at floors that have received an evacuation signal (see 4.8).

4.12.9 When loading is completed, if the doors are obstructed, any door close protection devices other than the door open button shall be disabled and doors closed at reduced speed. An audible and visual warning shall be given stating "DOORS CLOSING".

4.12.10 During the journey to the MEEF/AEEF, visual and audible information should be provided in the car, stating "LIFT RETURNING TO EVACUATION FLOOR, LEAVE LIFT WHEN DOORS OPEN".

Upon arrival at the MEEF/AEEF, the doors shall open and stay open for approximately 15 s, then the doors shall close and the operation should be repeated.

During each journey, the car door(s) should be locked to prevent forced opening. In the event of the car stopping between floors, the doors should remain locked until the car is recovered to within 200 mm of a floor.

The evacuation service shall continue to be provided to the floor to be evacuated until the lift is instructed to provide evacuation service to a new floor. When this occurs, the car shall make one return journey to the MEEF prior to travelling to the new floor requiring evacuation service.

Whenever a given floor is being provided with evacuation service, building signs on the landing shall state "LIFT EVACUATION SERVICE". This information shall also be given audibly and visually.

Lift landing signs on the floor with evacuation service should display the ETA of the next lift to arrive, if possible.

If at any time during the lift evacuation service, an instruction is received by the lift system to suspend the service, lift cars being loaded or travelling towards the MEEF/AEEF shall complete their journey. Any lifts travelling away from the MEEF/AEEF shall stop at the first available opportunity, reverse direction without operating doors, and return non-stop to the MEEF/AEEF.

Building signs on landings and lift information displays, both in lift cars and at landings, shall provide audible and visual information on all floors stating “LIFT EVACUATION SERVICE SUSPENDED”.

Evacuation service shall be terminated by either a manual reset by an authorized person or from a BMS. If the service has been started due to a signal from a hazard detection system, cancellation of the signal from the hazard detection system shall not cause evacuation service to stop.

When an instruction is received to stop evacuation service, the service shall end for a given lift the next time that lift returns to the MEEF/AEEF and opens its doors fully.

4.13 Removal of lifts cars from service

4.13.1 There can be times when it is no longer desirable for the lifts to remain in service. As an example, if a poisonous substance is in the building, it can be advantageous to stop lift operation rather than run them for evacuation service. Management or civil authorities might determine that the building is not yet to be evacuated. What is to be done in such circumstances shall be determined by the building designer in the evacuation strategy. If lifts are not to be used, they should be removed from service, if possible, at a safe area.

4.13.2 To satisfy this requirement, the lift(s) shall, on receipt of a signal from the BMS or FCC, inform passengers at landings stating “LIFT REMOVED FROM SERVICE, DO NOT ENTER”.

4.13.3 If the lift is travelling at the time, audible and visual information shall be provided stating “LIFT REMOVED FROM SERVICE AT NEXT STOP”. On arrival at the next stop, the car and landing doors shall open and passengers are to be informed to “EXIT LIFT” by visual and audible means.

4.13.4 If the lift is at a landing with its doors open, the door should be made to close; any passenger detection system should be disabled. While closing at slow speed, a visual and audible warning shall be given stating “EXIT THE LIFT, CAR DOORS CLOSING” When closed, the lift should travel to, and park at a safe floor, normally the MEEF or AEEF.

4.13.5 If a “REMOVE FROM SERVICE SIGNAL” is received while the lift is in travel, the lift shall complete its current journey, provided that the destination is a safe area. If the destination floor is not a safe floor, the lift shall be instructed to park at a new safe area, normally the MEEF or AEEF.

4.13.6 On arrival at the safe floor, the door shall open and any passengers shall be informed visually and audibly stating “REMOVED FROM SERVICE, EXIT LIFT”.

4.13.7 After a short delay of approximately 10 s to allow passengers to exit, a sign on the landing and in the car shall illuminate, stating “LIFT REMOVED FROM SERVICE, DO NOT ENTER”.

4.13.8 Door should be parked open to allow emergency service personnel to see if the lift is empty. If local building code requires the doors to be closed, the doors shall close but the door open button in the car shall remain operative.

4.13.9 The lift shall notify the BMS or FCC of its safe arrival at the parking floor and its status, e.g. lift removed from service at floor number *x*.

NOTE Removed from service means “removed from evacuation service”.

4.13.10 If the lift is instructed to be removed from service but fails to arrive at its designated parking floor within a defined time, then it shall automatically alert the BMS and FCC and notify its location. The defined time is the time to run non-stop from bottom to top multiplied by two.

4.13.11 It shall be possible to reinstate the lift to evacuation service by operation of a simple key or button within the FCC or via instruction from a BMS.

4.13.12 It shall be possible to return lifts to normal service only by way of a key switch.

4.14 Change of main evacuation exit floor (MEEF)

4.14.1 There can be times during an evacuation when it is determined that, for some reason, the MEEF is no longer suitable or safe for use. If this arises, it should be possible to either manually or automatically define an alternate floor, AEEF.

4.14.2 On receipt of the appropriate signal, all lifts shall use AEEF. Lifts already travelling towards the first allocated MEEF shall slow down and stop at the newly designated AEEF if it is in the current travel path of the lift.

4.14.3 If it is not in the current path of the lift, it shall slow and stop at the first available safe area. Reverse direction without opening doors and run non-stop to the AEEF. During this stop and reversal of direction, passengers should be informed to wait while car travels to a new safe area (e.g. "DO NOT ATTEMPT TO LEAVE THE LIFT, LIFT IS PROCEEDING TO A NEW FLOOR"). The reversing procedure should be conducted without delay.

4.14.4 If the MEEF becomes unsafe, as indicated by the BMS, and a new safe floor is not given to the lift system, the evacuation service shall be cancelled in accordance with 4.13.

4.15 Cancellation of evacuation service

4.15.1 On cancellation of a signal from the device that initiated the service and receipt of a signal from an "EVACUATION SERVICE CANCELLATION" switch, all lifts not at the main landing shall complete any allocated task and return to the main landing.

On arrival at the main landing, the doors shall open and then the lift evacuation for that particular lift shall be cancelled.

Any lift already at the main landing shall, on opening its doors, cancel its evacuation service.

4.15.2 If during the cancellation of the service a further evacuation initiation signal is received, any lift not at the main landing shall be returned to the main landing and again start to operate the evacuation service.

Determination of how the lift is placed back into normal service should be described in the evacuation strategy.

5 Information to be provided to the building owner

5.1 Upon completion of all work, the lift manufacturer shall provide to the building owner a manual describing how the lift system is to operate on evacuation service, the importance of proper comprehensive maintenance, and the level of checks the owner should make to ensure the systems continues reliable operation.

5.2 A draft copy of this manual shall also be provided to the building design team at the earliest opportunity.

NOTE This Technical Specification does not explain the evacuation strategy as that is the responsibility of the building design team.

6 Other information to be provided

See Annex B for information to be provided by the lift manufacturer to the building design team and information required by the lift designer from the building design team.

Annex A
(informative)

Building design considerations for automatic lift evacuation specification

A.1 Introduction

It shall be recognized that, depending on the given emergency, different lift routines might be required. For example, if a fire is detected, it might be planned to use the lifts for general evacuation and the lifts might be given a particular area of the building for evacuation, whereas if gas is detected, it can be more important to stop lift operation that might cause spreading of the gas through the building. It is important that the designer considers carefully the types of emergencies that should be managed by building systems and lifts in an automated manner.

It can be acceptable to manage many of the possible events without a sophisticated automated system by using building management procedures instead.

The building designer shall determine the types of event that will be detected automatically and with what degree of precision. If a simple fire detection system is installed, which is only capable of sending one signal (fire in building), then it will not be possible to run complex lift evacuation routines. It will probably be necessary in many cases to employ a detection system that can detect if a fire is present and where exactly in the building it is. Such information can then be used to direct lifts to critical area or keep them away from hazardous ones.

A.2 Examples

The following examples further clarify this important point.

EXAMPLE 1 A 12-storey office building is to be erected in the middle of Paris. The building, once completed, will be let to various tenants. Fire is always one possibility to be considered. The building is close to a river but at an elevated position, that makes flooding from the river impossible. Paris is not an earthquake risk area; and although a terrorist attack is possible in any building, as a general office building, it has no reason to be more attractive to terrorists than any other in Paris. The building does not have a gas supply, so it would appear that the main risks to be managed in an automated manner are fire and false alarms.

EXAMPLE 2 A 9-storey office building is to be erected in the centre of London for the ministry of national defence. The building is on the banks of the river Thames, and the risk of flooding exists, although environmental experts consider this to be a once in 50 year risk (low risk). If it were to occur, there would be at least 7 h prior warning so the building could be easily evacuated prior to this event. Any automated system need not manage this event as it can be left to building management procedures. Earthquakes do not occur in London, but as it is a ministry building, the risk from a bomb threat can thought to be significant, but again does not need an automated system of detection. This bomb event can also be managed by building management procedures. The introduction of a biological agent in to the building is also thought to be significant although not to the point of requiring automatic detection. Detection will be left to building management procedures but once a chemical is detected, evacuation could be automated.

A.3 General building provisions for lifts

It is assumed the lift or lifts and their machinery will be within an enclosed fire resistant lift well, forming a fire compartment in accordance with local building regulations. In addition, the enclosure will be capable of preventing the transmission of heat, smoke, or flame into the well for a period of at least 1,5 × the anticipated time to complete a full evacuation using 80 % of the available evacuation lifts where multiple lifts are provided.

These provisions are not only critical for safety of users but also for reliability of the lift.

Where the lift pit is in an area liable to flooding, provision shall be made to remove water from the pit. This provision shall consist of either a suitable drain or a sump with an automatic water level detector and pump. Such equipment shall be located outside of the pit to permit non lift persons from having to enter the lift shaft to maintain the equipment.

A.4 Operational reliability

Lifts used for evacuation service should be part of the building's normal vertical transportation system so that they are in regular use on a daily basis.

It is the responsibility of the building owner to ensure that the lift and associated equipment is operational and safe for use.

It is not unreasonable to expect that in a building with six lifts, one could be out of service if for no other reason than planned maintenance, planned repair, or safety inspections. This should be anticipated in any design calculations, see 4.5.

A.5 Identifying hazards to be managed

The building designer would have to determine the likely reasons why a given building might need to be evacuated. There are at least five basic categories, and these are the following:

a) false alarms or evacuation practice;

b) fire: this term includes flame, heat, and/or smoke;

c) flood: this can be internal flooding from burst tanks, etc., rising groundwater from underground rivers, or external flooding from a river close by. Severe external flooding might undermine foundations, causing a risk of structural failure;

d) structural vibration: earthquake, explosion, lighting strike, vehicle collision, or impact from other objects. These events can cause large shocks to the building structure and are detectable as vibrations within the structure. Depending on the severity of the shock, lift equipment can be displaced from its normal location making operation of the lifts problematic, dangerous, or impossible;

e) chemical incident: this term is used to describe chemical, bacterial agent, substance, or gas being introduced into the building by a terrorist or some other means. It is very unlikely to affect lift operation but might make some areas or all the building hazardous.

Having identified the likely reasons why the building might need to be evacuated, it shall then be determined how or if it should be evacuated for each of the events.

A.6 Detection of hazardous events

A.6.1 General

Some events will be easy to detect using known technology. An example of this is fire where there are plenty of systems in existence for the fire expert to select. It should be remembered however, that it will not be enough to detect the existence of a fire but it should be also possible to detect its location in relation to lifts, lift equipment, and power supplies.

Some emergencies will normally come to light as a result of people reporting them (e.g. bomb warnings).

The building designer should determine those events that needs to be automatically detected and how they will be best detected. It has to be recognized that the more sophisticated the detection system is, the more information it is likely to provide. Better information leads to better decision making as long as information overload is avoided.

The need for evacuation can arise due to events in an adjacent building. Automatic monitoring of such events is not thought to be necessary and normally not practical. Usually, such information will come direct from persons who have observed an event such as fire or smoke, etc.

Recognizing that some events will never be detected automatically, any BMS or FCC should be provided with some form of manual device to activate the appropriate evacuation service if required by those in charge of the building.

The BMS should send instructions to the lift as soon as possible.

A.6.2 Detecting flooding

Flooding, where rivers can wash away building foundations, is clearly much more serious than internal flooding and where such a risk exists, early warning of flooding is vital but need not be automatic. A strategy should be put in place to enable the earliest possible risk of such flooding to be detected. This is primarily a building management issue and not an emergency. Once risk of flooding is identified and assuming time permits, the lifts should be allowed to assist any evacuation until such time as conditions make the risk unacceptable.

Internal flooding from rivers rising in basement areas can also be serious but this is not, however, an emergency. Passengers in a lift are at risk of drowning if they are in the lift when it enters a flooded basement. Where basements or other areas are at risk of unpredictable flooding due to the proximity of a river, etc., sensor should be provided to detect rising water levels and to suspend lift service from the area.

Local internal flooding can result from failure of pipes and tanks, etc. and the damage can be considerable. Using the lifts to evacuate able-bodied persons should not be necessary, as this is not an emergency and it is unlikely that any evacuation shall be swift. Even if able-bodied persons use the stairs, it might still be necessary to use the lifts for others and in this case, it is important to know the lifts have not been affected by water. Sensors could be located in the lift well to detect such problems, but in most cases, a visual inspection of lift landings will indicate if water is entering the lift well. In cases where it is found to be entering the lift well, the lifts should not be used and a provision should be made to enable lifts to be removed from service in a relatively dry area.

Water can also be discharged accidentally or deliberately from sprinkler systems located within the lift well. Such systems should not discharge until lifts are parked in safe areas and power is turned off.

A.6.3 Detection of chemical incidents

The presence of an explosive gas, chemical, or a biological agent in a building does not, in itself, damage the lift(s). The risk is that the operation of the lift might cause an explosive gas to ignite or in the case of a biological agent, it can help to spread it around the building.

If an explosive gas is present in the building, the risk of ignition from operation of the lift is no more or less than the operation of any other electrical plant in the building. The only difference is that if the power is turned off to items such as air conditioning, it does not trap people as it would if the power was turned off to the lift.

Unless the circumstances are very unusual, it is assumed lifts should be allowed to stop normally at the end of their journey and then be automatically parked. Building management or the emergency services should be able to turn off the power if they think it advantageous after lifts have parked. This parking sequence should be simple to initiate by way of a key switch or button in the FCC.

In the case of a biological agent, it should be determined what the best strategy would be. In some instances, it would be best to stop the lifts because this would slow down the rate of spread of the agent. The decision to act in relation to lifts should be left to the building management or emergency services. If they decide to remove lifts from service, they should be able to give a simple instruction by operation of a key switch or button to cause all lifts to park automatically at an agreed parking floor or give a simple instruction to run evacuation service.

While the detection of gas, chemicals, or biological agents is not impossible, it can prove to be very difficult and costly. It should be determined by experts if such sophistication is justified for the particular building and how it could be achieved.

If an automatic means of detection is not provided, then it should be assumed that such an event will only come to light if reported in some way to the building management.

Even if it is left to the building management, a provision can be made to allow the information to be put into an intelligent BMS manually by the building management to determine the best action to take.

A.6.4 Detecting structural damage

If it is determined that events such as earthquake or explosion need to be automatically detected, then specialists in this field shall determine how this is to be done. The information from monitoring systems can either be fed to a BMS that will then automatically send out an appropriate signal to the lifts or the information can be displayed on a display panel to inform the building management of the situation.

When considering the detection of shock in the building structure, consideration should be given to detecting it at three intensities. This will enable the lifts to be operated if the intensity is below some threshold rather than just removed from service. For example, if building management or instruments detect a problem in the structure and it is over level *X*, a BMS could instruct lifts to shut down at defined parking locations away from potential danger area. If the event is detected to be over *Y* intensity, then lifts could be shut down immediately. If the level of shock is only low in value, lifts could be operated after the shock has passed.

The values defined for *X*, *Y* shall be defined in conjunction with the lift manufacturer, as only they will know what their equipment can withstand. This information should be passed on to the building designer and those designing detection systems. If the lift is stopped immediately because the shock is greater than some defined level, it is likely that passengers will be trapped between floors. They should therefore be informed automatically that once the shock has passed, they will be automatically rescued. Once the shock has passed, any lift car with passengers trapped that will not automatically rescue itself should automatically raise the alarm in the FCC and BMS. It should also inform passengers of the situation.

A.6.5 Detecting fire

A.6.5.1 General

Methods of fire detection are well established. If lifts are to operate a safe evacuation service, good monitoring of the fire in relation to lift equipment is essential. The equipment used for this should be specified by those responsible for the design of the building detection system and not the lift manufacturer.

A.6.5.2 Smoke

To ensure the safety of users and lift equipment, lift machine rooms, lift well, and landing areas shall be provided with a means to detect and monitor for the presence of smoke. When detected, this information shall be transmitted to a BMS system, fire detection system, or displayed at a suitable location (FCC) where those in charge of the building shall take suitable action. All such detection devices should form an integral part of the building detection system and not be a stand-alone part of the lift system.

A.6.5.3 Heat

Temperature in any safe area provided for a person to wait (lobby, refuge etc.) and lift well should be continuously monitored to determine if it is safe and remains safe for persons. When an unsafe temperature is detected, the information should be sent to a BMS or FCC. The BMS or FCC should determine what is to be done next and send the appropriate signals to the lift (e.g. remove lift from service at floor x with doors parked open or closed as required by local code).

A.6.5.4 Location of an event in relation to lifts

In detecting an event like a fire, it will be important to know its location in relation to any lift intended for evacuation use.

For example, it will not be enough to detect if a fire is in the building. It will be essential to know its location in relation to the lifts. Is the fire in the lift well, lift car, lift machine room, lift power supply, etc.? Is it remote enough from lifts and their equipment to be insignificant to lift operation? Remember that fire includes flame, heat, and smoke. Is the fire in another fire compartment? Is it‘s unlikely to be affecting lift operation at this time? In high-risk buildings, it can be advantageous to also determine the rate of spread of fire and its direction.

Experts in fire detection systems, including lift experts, should be consulted to determine the best solution for the design in question.

The more sophisticated the detection system employed, the more precise will be the level of information available to make decisions and the more meaningful these decisions will be. If a sophisticated system of information gathering is used, it should also be determined how this is best displayed or used. A small amount of information can be simply displayed by lights on a console but where complex information is gathered, this will probably need to be fed to an intelligent BMS that will determine what exactly is going on.

The building designer shall determine the degree of sophistication required, taking into account the importance of the building, type of occupancy, etc. It is important to remember that if the type of emergency cannot be determined with any accuracy, it will not be possible to make sound decisions regarding the type of lift operation required.

Lifts will only do as commanded, if the lift is required to respond in different ways to different type of emergencies, the lift system will have to be controlled according to the type of emergency taking place.

A.7 Type of evacuation

A.7.1 General

The evacuation strategy developed for each anticipated event should lead to an obvious evacuation type. Lifts will not be able to evacuate all floors at once so to some degree, a systematic evacuation will be governed by the capacity of lifts and the number of persons to be evacuated. Lift engineers can calculate the number of persons that can be moved for a given set of circumstances but the first thing to determine is the number of persons to be evacuated within the required evacuation time. Fire engineers and other experts shall determine these figures. It shall also be determined what proportion of wheel chair and others with impaired mobility there might be and if there is likely to be a floor or building area with a particular concentration of them.

If lifts are not to serve all floors, then some form of priority shall be determined. This is not a lift design issue but one for those developing the evacuation strategy for the building.

A person trapped above a fire is likely to be at greater risk than those below a fire. If the emergency is related to the structure of the building, it is likely everyone is exposed to the same risk although the problems of escape are greater for those high in the building, as it will take them longer to descend. This is a complex issue and can only be determined on a building by building basis taking into account the emergencies the designer wishes to manage with the assistance of lifts.

In many instances, some sort of phased evacuation will be desirable while at other times, a full evacuation can be essential. Phased evacuation involves the evacuation of certain areas first, usually those floor areas at greatest risk followed by other key areas.

A.7.2 Examples

EXAMPLE 1 The building has 30 floors and is served by a single bank of lifts, it might be reasonable to assume that persons below the 10th floor, other than those with a disability, can walk down emergency stairs. Assuming the emergency is in fact a fire on 17th floor, the lifts could be instructed to manage 17th floor first, then 18th floor and 19th floor, then 15th and 16th floors, then other floors, as determined by the emergency and the evacuation strategy.

EXAMPLE 2 The building has 80 floors with 4 banks of lifts. The first bank serves ground floor to 20th floor. The second bank serves ground floor non-stop to 21st floor and all floors to 40th. The third bank serves ground floor non-stop to 41st floor and all floors to 60th. The last bank serves ground then non-stop to 61st floor then all floors to 80th.

If the emergency affects 65th to 70th floors, these floors are covered by the 4th bank of lifts.

Assuming that building sensors have not detected problems or hazards in the 4th bank of lifts that serve 61st to 80th floors, they could be used to evacuate persons from 65th to 70th floors.

The lifts could start by serving 70th floor, then 69th floor, then 68th floor, and so on, down to 65th floor. Persons on 71st floor to 80th floor and 64th floor to 61st floor could be told to use the stairs down to 60th floor where they can then use lifts to take them to the ground floor. Any persons unable to use stairs could be served by one of the lifts while the floors with the emergency are being cleared.

The 3rd bank of lifts serving 41st floor to 60th floor could provide service starting from 60th floor and working down to 41st floor. As 60th floor will not only have its normal residents but also persons coming down from above, one or two cars could be instructed to give priority to 60th floor and run a shuttle service between 60th floor and ground floor.

40th floor to 21st floor could be evacuated by their lifts starting at 40th floor and working down to 21st floor. Persons other than disabled on 1st floor to 20th floor could be told to use the stairs.

Cleary, the possible combination and best way to serve the building will be dependent on many factors, such as the building layout, size, number of persons to handle, type of emergency in progress, etc. The lifts can be made to operate in almost any sequence but those designing the evacuation strategy, not the lift manufacturer, should determine this sequence. This issue should be addressed in the building evacuation strategy.

This evacuation strategy shall also take into account what to do when the number of lifts available is less than the number anticipated.

Small, simple buildings will require only simple routines that are easy to determine. Large complex buildings will require sophisticated and complex building management software capable or making decisions based on many factors. Lift engineers should be consulted to explain what is possible from their system and should not be asked to determine what is required. Others specialists should do this.

A.8 Determining if evacuation is required (building management)

A.8.1 General

This is not a decision to be made by lift engineers but by other experts and those responsible for building management. Those tasked with making such decisions needs to be provided with clear information from building systems or other sources that lets them know what is going on, where it is going on, and how serious it is. In some emergencies, it can be better not to evacuate the building, i.e. to minimize the spread of harmful substances. If the building is not to be evacuated, it shall be determined what action, if any, is to occur (Are the building occupants to be informed? Are the lifts to remain in use or are lifts to be moved to a particular location? etc.).

Those who will be responsible for making the evacuation decision shall have as much information and as close to real time as possible if good decisions are to be made. It should be recognized that the conditions in the building or the status of lift(s) can change over time. A threat of attack might eventually become an actual attack. In large buildings, an evacuation can take some time and it should not be assumed that continued use of a particular lift or lifts is guaranteed. Serious thought should be given to how information will be displayed to those managing the building especially where a BMS systems is capable of providing a large amount of information. It should be possible to see at a glance if lifts are operating correctly and what service they are running.

There shall always be provision made to allow the building management or authorities to override any automatic evacuation signal that is generated by a smart BMS. Irrespective of the systems employed, the evacuation decision cannot be made by a lift system and therefore, other experts in this field shall determine what risks will constitute the need for evacuation and the type of evacuation (partial or full).

If a bomb warning is received in a high security building, evacuating the staff to waiting areas outside the building while it is searched might expose them to a greater risk. Much will depend on the source of the bomb warning and level of building security. The bomb might actually be planted outside the building rather than in it and persons might then evacuate into its blast path.

There might be occasion when building management or the authorities advise that evacuation of the building is not advisable even though there is an emergency; it will depend on the circumstances, type of emergency, and information available.

If the building is thought to contain some form of virus brought in by terrorists, it might be desirable to keep people in the building until the situation is under control. This is preferable than allowing them to leave and possibly spread the virus.

If conditions change, then new information will be required for building management, users, and lift system. Lifts might need to be removed from or brought back into evacuation service.

A.8.2 Should lifts be used for this evacuation?

If for some reason, a significant number of lifts are not available for use, then it can be prudent to remove all lifts from automatic evacuation service rather than have a few. If users are told the lifts are not available for use, most people will make their way from the building via emergency stairs. If too few lifts are in service, delays will result that could be dangerous or cause panic.

In such circumstances, it is probably desirable to run a limited service for the evacuation of those that have difficulty negotiating the stairs. Any such service needs to be managed by lift attendants who will drive the lift, manage possible crowding, and assist those who need it. The decision to operate some form of service when not all lifts are available is a decision for those managing the building evacuation.

A.8.3 Waiting and travelling environment for users (safe areas)

Lifts can be available for use but if they are to be used, will they pass through an area where a hazard exists, such as smoke? To determine this, the location of the lift shall be known and compared with information from sensors in the lift well together with other building information. This information needs to be combined in a BMS that will determine if lifts can run without passing through hazardous areas.

Those persons designing detection systems for fire (smoke and heat) should not just consider detecting if such things exist, but at what level or intensity they are.

It all depends on the intensity of the smoke and/or chemicals it contains. In small to medium sized buildings, it might be sufficient for the building designer to sense for smoke and heat and determine that if it operates a sensor, lift service will be suspended. In larger buildings, it can be advantageous to measure the intensity instead of just looking for the presence of a hazard. The building designer shall determine this issue and the equipment required for sensing. Behaviour of the lift on receipt of a signal is easy to organize once the required reaction of the lift to a signal is known.

The building designer shall establish safe areas. These areas are to enable potential lift users to wait in relative safety, free from dangerous temperatures or the effects of smoke. They might take the form of lobbies on landings or any other form satisfying the safety criteria. Any destination (exit floor) shall also be continuously monitored during an evacuation to ensure lifts are not sent to an area that has become hazardous over time.

A.8.4 Building evacuation information

When evacuation is required, information shall be provided through the building systems informing persons which lifts to use during the particular emergency. This information shall be in both audible and visual format. Any signs shall be located in conspicuous positions and shall meet the requirements of any relevant national legislation. The information will need to be dynamic in form so that if necessary information on new escape routes or alternate lifts to use can be given. This dynamic feature is vital in the event that the first selected escape lifts and routes become untenable over time.

Audible and visual information is required in waiting area so users know lift(s) are being removed from service to a safe area. Lifts should automatically inform the BMS or FCC if they are shutting down, etc. for any reason. Any safe areas should also contain an emergency communication system.

Similar information should be given on routes to the lifts. This will avoid persons having to retrace their steps if the lifts are not operating.

If potential lift users are directed to other lifts, these shall also be suitably designed for evacuation use and put to evacuation service.

A.8.5 Determining if evacuation is complete

The evacuation strategy shall consider how it will be determined that a given floor evacuation has been completed and that the floor is clear of people. Lift systems are not capable of determining with certainty if a floor has been cleared of all persons and until this known evacuation service should not be suspended.

Determining if the evacuation of the building has been completed is vital. It is difficult to know how this can be determined with any amount of certainty, unless reports are obtained direct from each floor confirming everyone has left. The lifts can do a number of simple things that will indicate that there appears to be no one left to evacuate but they cannot establish this with certainty. Lift cars can wait at a floor with doors open to see if a car button is pressed or if a load can be detected entering the lift but these are crude measures and do not answer the question with any certainty.

Cameras could be provided on landings and floors to allow building staff to view floors. Unless it can be determined with certainty that all persons have been evacuated from a floor, the lifts serving that floor cannot be redirected to new floors to serve. The most obvious way to resolve this issue is to have fire wardens on each floor that will notify management or the BMS when they have checked the situation. Cameras could be a back-up to this.

A.8.6 Emergency power provisions

Loss of a bank of lifts is serious but is only likely to occur due to loss of the power supply. Secondary (emergency) power should be provided that has sufficient capacity to run all the evacuation lifts at full speed for the required evacuation time plus a margin for error (see 4.8).

A.8.7 Operating instructions

Detailed instructions shall be provided to the building operator by the building designer in the form of a manual. The manual shall explain the evacuation strategies to be used, how any detection systems operate, how they shall be maintained, and how the lift will operate on evacuation service. It should also provide advice on periodic checks the owner can make to ensure that the system is working correctly and explain the importance of a suitable testing and maintenance system being in place.

A.8.8 Maintenance provisions

At any time the building alarm or hazard detection systems are tested by the building owner, observation of the operation of the evacuation service should be made with a record retained.

Annex B
(informative)

Information to be provided

Table B.1 — Information required by lift designer from the building design team

N°	Information to be provided	Comments	Joint decisions
1	Envisaged required handling capacity of the lifts for normal building use (% of population to be handled)		
	Total number of persons above the MEEF		
	Total number of persons below the MEEF		
	The designation of the lifts that can be considered for use during the evacuation		
2	Number of persons to be handled by each lift or group of lifts during evacuation		
3	Number or percentage of persons likely to be in wheelchairs requiring evacuation using lifts		
4	Number of persons with a mobility impairment likely to require evacuation using lifts		
5	Identify any areas of the building likely to have a significant number of wheelchair users and the anticipated number		
6	The building evacuation strategy (partial or full)		
7	The type of building management system, if any		
8	The type of interface envisaged between any BMS and lifts		
9	Type and sophistication of the fire detection system		
10	Types of hazard that, when detected, will require an automated response from the lift system		
11	The evacuation sequence and floor priority to be served		
12	Type of any building intercom system and their unit locations		
13	Location of fire command centre		
14	Requirements related to information and signage on landings, etc.		
15	Required lift evacuation time		
16	Any other relevant information		

Table B.2 — Information to be provided by the lift manufacturer to the building designer

N°	Information to be provided	Comments	Joint decisions
1	Number of persons that will be moved to the evacuation exit floor from the top floor per 5 min		
2	Time to evacuate all persons		
3	The number of lifts, load, and speed required to achieve the evacuation time specified		
4	The type of interface and information required between lift and building system, if provided		
5	Any other relevant information		
6	Requirements related to information and signage on landings etc.		

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