



TS 04955.3:2.0

Standard

Services, Systems and Equipment

Part 3: Lifts

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Preface

This standard is the second issue as TS 04955.3.

This document forms part of the TS 04955 series of documents related to services, systems and equipment.

This document describes the minimum performance requirements for design, construction, installation, testing and commissioning of publicly accessible lifts installed in transport facilities and related transport infrastructure.

This version has been updated to make this document applicable to metro.

This document should be read in conjunction with TS 04955.1.

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1 Scope

This standard specifies the foundational requirements for design, construction, delivery, installation, testing, and commissioning of passenger lifts and goods passenger lifts in public transport facilities and related transport infrastructure within the Transport network.

This document outlines the minimum requirements for lift installations which take into account the following:

- customer use and amenity
- site-specific requirements and fit-for-purpose application
- technical requirements and interfaces
- equipment intended life cycle.

This document does not cover lifting platforms, hoists, EWPs and the like.

2 Application

This document applies to personnel involved in the provision of passenger and goods passenger lifts within the Transport network.

This document applies to the whole-of-life of lifts including planning, design, construction, commissioning, operation, maintenance and decommissioning.

This document applies to all new installations.

This document applies to upgrades, additions, or changes to existing installations.

This document should be read and applied in conjunction with TS 04951.1, TS 04955.1 and relevant legislation, Australian standards and other TfNSW standards.

3 Referenced documents

The following documents are cited in the text. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document applies.

International standards

EN 81-71 *Safety rules for the construction and installation of lifts – Particular applications to passenger lifts and goods passenger lifts – Part 71: Vandal resistant lifts*

Australian standards

AS 1428.1 *Design for access and mobility – Part 1: General requirements for access – New building work*

AS 1428.2 Design for access and mobility – Part 2: Enhanced and additional requirements – Buildings and facilities

AS 1735.1.1 Lifts, escalators and moving walks – Part 1.1: General requirements

AS 1735.1.2 Lifts, escalators and moving walks – Part 1.2: Safety rules for the construction and installation of lifts – Lifts for the transport of persons and goods – Passenger and goods passenger lifts

AS 1735.1.3 Lifts, escalators and moving walks – Part 1.3: Safety rules for the construction and installation of lifts – Examinations and tests – Design rules, calculations, examinations and tests of lift components

AS 1735.12 Lifts, escalators and moving walks – Part 12: Facilities for persons with disabilities (EN 81-70:2018, MOD)

AS 1735.12:2020 Lifts, escalators and moving walks – Part 12: Facilities for persons with disabilities (EN 81-70:2018, MOD)

AS 1735.20 Lifts, escalators and moving walks – Part 20: Safety rules for the construction and installation of lifts – Lifts for the transport of persons and goods – New passenger and goods passenger lifts in existing building

AS 1768 Lightning protection

AS 4431 Safe working on new lift installations in new constructions

AS 60529 Degrees of protection provided by enclosures (IP Code)

AS/NZS 2293.1 Emergency lighting and exit signs for buildings – Part 1: System design, installation and operation

AS/NZS 2293.2 Emergency lighting and exit signs for buildings – Part 2: Routine service and maintenance

AS/NZS 3000 Electrical Installations (known as the Australian/New Zealand Wiring Rules)

AS/NZS 3008.1.1 Electrical installations – Selection of cables – Part 1.1: Cables for alternating voltages up to and including 0.6/1 kV – Typical Australian installation conditions

AS/NZS 61000.6.8 Electromagnetic compatibility (EMC) – Part 6.8: Generic standards – Emission standard for professional equipment in commercial and light-industrial locations (IEC 61000-6-8:2020 (ED 1.0) MOD)

Transport for NSW standards

TS 00050 Video Surveillance System Architecture

TS 03677 (T HR EL 12004 ST) Low Voltage Distribution and Installations Earthing

TS 03743 (T HR EL 12005 ST) Bonding for 1500 V DC Traction Systems

TS 03954 *Low Voltage Electrical Installations*

TS 04936 (T HR SS 80003 ST) *Infrastructure Emergency Lighting*

TS 04951.1 *Functional Spaces – Part 1: Principles*

TS 04955.1 *Services, Systems and Equipment – Part 1: Principles*

TS 04989 *Public Transport Closed Circuit Television Functional Requirements Standard*

TS 04992 *Surface Transport Fixed Infrastructure Physical Security Standard* (This document is not publicly available; to obtain access email standards@transport.nsw.gov.au)

Other referenced documents

Australian Building Codes Board, *National Construction Code, Volume One*

4 Terms, definitions and abbreviations

The following terms, definitions and abbreviations apply in this document:

ARD automatic rescue drive

asset custodian the TfNSW Division accountable for the end to end life cycle management and performance of assets (including asset condition, risk and reporting) on behalf of the asset owner to achieve agreed customer and community outcomes

asset steward – operate or maintain the entity responsible for the day to day operations and maintenance of assets once commissioned. May be a part of the asset custodian division or a separate entity. Operator and maintainer of the assets might be separate entities

EWIS emergency warning and intercommunication system

EWP elevating work platform

facility a zonal area (within a precinct boundary) that contains buildings, systems, plant and associated infrastructure assets to support the operation and maintenance of transport services

FRNSW Fire and Rescue NSW

goods passenger lift lift mainly intended for the transport of goods, which are generally accompanied by persons (Source: ISO 8100-1:2019)

HVAC heating, ventilation and air conditioning

MRL machine room less

MTBF mean time between failures

MTTR mean time to repair

NCC *National Construction Code*

PVB polyvinyl butyral

PWM pulse width modulation

RAM reliability, availability and maintainability

repair direct action taken to effect restoration (Source: IEC 60050-192); the actions restore (but do not enhance) the functionality of the item

SWG standard wire gauge

TfNSW Transport for NSW

Transport network the transport system (transport services and transport infrastructure) owned and operated by TfNSW, its operating agencies or private entities upon which TfNSW has power to exercise its functions as conferred by the Transport Administration Act or any other Act

UPS uninterruptible power supply

VVVF variable voltage, variable frequency

5 Functional outcomes

5.1 General requirements

Each new lift and lift equipment that is partially or completely replaced as part of the existing equipment renewal shall, as a minimum, comply with AS 1735.1.1, AS 1735.1.2, AS 1735.1.3, AS 1735.12, AS 1735.20 and AS 4431. Requirements of the NCC apply.

Design, operation and maintenance parameters shall be agreed with the asset custodian, asset steward – operate or maintain, and suppliers, as a minimum, to ensure that the proposed equipment is fit for purpose. This includes agreed design criteria, features, capacities, operational capacities, and reliability targets. Coordination with structure, architecture and services shall also form basis of selection of the lifts. Examples of coordination include as a minimum:

- confirmation of fire engineering operations in event of fire alarms
- heat outputs of equipment and required ventilation
- structural fixtures and loadings
- electrical supply requirements.

In addition to the requirements in TS 04955.1, the following shall be provided in all publicly accessible lifts:

- universal access (for able bodied and mobility-impaired passengers) including audio, visual and tactile information, architectural and visual cohesion
- standardisation with the TfNSW existing lifts to ensure consistency across the Transport network

- remote alarm monitoring
- passive security through visibility and clear lines of sight such as lift glazing
- vandal and misuse resistance
- ability to transport heavy goods and equipment, for example EWP's or scissor lifts, to the maximum rated load on the load notice or other load figure approved by operator and maintainer, where nominated
- protection against power supply loss so that conveyance does not stop mid-level.

Stretcher access shall be provided in lift cars. The minimum size requirements for lift cars to accommodate stretchers are specified in NCC.

Advertising screens shall not be provided within publicly accessible lifts.

The procurement and installation of lifts shall comprise all labour and materials necessary to form a complete installation of lifts. Furthermore, the completion of tests, adjustments and commissioning shall be undertaken to achieve an effective working installation. This shall be with regard to:

- dimensional compatibility
- technical interfaces such as power supplies, security (CCTV), fire alarm, remote alarm, EWIS and finished floor levels, and other similar interfaces
- programming of sequential operations to interface with the work and ensure coordination between trades and any other work relevant to the lifts.

5.2 Requirements for new and existing installations

The following shall apply to new and existing installations:

- New installations – Where a lift is provided as part of a new facility, a proposal shall be submitted early in the design phase to ensure optimal coordination and integration of the new equipment into the transport facility design.
- Existing installations – Where a lift is retrofitted to existing facilities, or a modernisation or replacement of an existing lift takes place, the following shall be carried out:
 - a condition survey of the existing shaft and pit shall be carried out to examine existing accommodation (structure), and evaluate whether any remedial work is required to accommodate the new equipment
 - a survey of the location for the proposed new shaft shall be carried out, and relevant work required to accommodate the new equipment identified.

All machinery and shaft equipment that are visible to the public shall be easily accessible to facilitate safe and easy cleaning. The machinery, ropes or belts (or both), sheaves and other

equipment in the machinery spaces shall be arranged to be easily accessible to facilitate safe inspection and maintenance.

Lifts shall be designed for heavy-duty public systems suitable to operate within their specific environment and location. The following should be taken into account:

- conditions of use (for example mass transit system)
- facility location environmental exposure (for example temperature and humidity extremes) and
- people and goods loading intensity.

5.3 Reliability, availability and maintainability

Lift systems and equipment shall meet the RAM targets given in Table 1.

Table 1 – Operational considerations

Reliability (MTBF)	Availability	Maintainability (MTTR)
≥2000 hours	≥99.8%	≤1.5 hours

Availability is calculated as shown in Equation 1.

$$\text{Availability} = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}} \times 100\%$$

Equation 1 – Availability

All lifts shall be suitable and arranged for continuous operation based on 24/7 operation, based on a life expectancy of 30 years. The lifts shall be capable of achieving 240 starts per hour.

Design life for individual components shall be as detailed within TS 04955.1.

The following major and critical components shall be proactively maintained to deliver reliable service and intended life expectancy, As a minimum the recommendations of the equipment manufacturer shall be met.

Major and critical components shall include, but not be limited to:

- car and landing door tracks, headers, guides, and operating mechanisms
- emergency light and alarm units
- lift hoist ropes or belts (or both)
- governor ropes.

5.4 Waterproofing

All lifts shall be installed in accordance with the following waterproofing requirements:

- Lift shaft pits shall be designed with external positive waterproofing membrane.
- Chemical waterproofing additives to the concrete mix shall be used in addition to external positive waterproofing membrane.
- Detailed local meteorological data shall be taken into account to establish site-specific weather conditions including but not limited to statistical rainfall frequency, intensity and prevailing wind directions. Such data shall form an input into the design of lift shafts and canopies.
- Where water ingress into the lift pit can occur regularly due to natural occurrences, provision of a sump pump and sufficient sump depth shall be provided. For example, excess water ingress through lift pit construction underground through natural ground (at locations where water table is high). Where ingress is unlikely or would be infrequent, a blind sump shall be provided to allow a portable pump to evacuate. Where blind sumps are provided, float switches shall be linked to the lift controls to move the lift to higher levels and park the lift until the water is removed.
- The whole lift shaft structure including the roof shall be watertight.
- The lift shaft structure shall not permit condensation to build up internally. The lift shaft shall be provided with necessary construction materials to achieve this, for example sarking.
- All lift canopies shall be designed and constructed to prevent water entry to the lift shaft wall and wetting the lift controller and components. Refer to TS 04951.1 for further details on weather protection for passengers.
- Lift controller cabinets shall be installed on the lift shaft wall as far from water sources as possible and to incorporate IP65 rated protection.
- All landings shall have a slope away from the lift to ensure water does not enter the lift. The gradient shall be determined by a civil engineer.
- All landings shall be designed to ensure wind-driven rain does not blow into the lift shaft and does not contact the controller, call buttons, doors and landing.
- All lift louvres shall be storm and vermin proof to prevent water ingress from rain and wind-driven rain into the lift shaft. Where practical, louvres shall be installed away from prevailing storm directions typical for the site location. Detailing on corners of louvres shall also prevent water ingress through the use of back flashing when required.

- Glazing of the lift shaft shall be waterproof to prevent water ingress and to allow positive air flow when the lift shaft fan is operating.
- Paths and platforms shall slope away from lift entries. Where a path or platform slope towards the lift cannot be avoided, stainless steel grate drainage with mechanical fixings shall also be designed and installed before lift commissioning so that the risk of water entering the lift is mitigated in so far as is practicable.

5.5 Heavy goods, heavy equipment and mobile plant loading

Interchanges and buildings that have a large and busy retail component may require goods lifts or a goods capable passenger lift to accommodate frequent deliveries. Passenger and goods lifts should be separated. Where it is impracticable, the dual-purpose lift shall be constructed and registered as a goods lift in accordance with AS 1735.1.1 and AS 1735.1.2.

If the lift is specified to transport goods, then the lifts shall be designed for transportation of heavy goods, heavy equipment and mobile plant such as EWP and scissor lifts to the maximum rated load on the load notice.

Where the door placement is not centred or in cases where equipment is placed in an unfavourable position, such as further from the guide rails, then the total gross weight of the equipment shall be less than 75% of the maximum rated load of the lift.

Car frames, car platforms (floors) and all door sills shall be reinforced to allow such additional loading and point loads.

5.6 Vandal and misuse resistance

The lifts in transport facilities are heavily exposed to vandalism and misuse that can lead to high maintenance costs and breakdown rates, and cause inconvenience to passengers. All elements of the lifts shall be designed to improve resistance against vandalism and misuse, particularly impact and etching damage, and ensure maintainability at an acceptable level of reliability and aesthetic condition. Surfaces and finishes shall facilitate rapid repair of vandalism and removal of graffiti and increase the effort required for vandalism to occur. All fixtures accessible to public shall comply with category 2 installations in EN 81-71.

Anti-graffiti films or other appropriately tested anti-graffiti methodologies shall be applied to glazing for vandal-proof front of house finishes. The use of glazing panels below handrail level should be avoided within the lift car and lift shafts at landing levels. Glazing panels shall be installed only where sightlines are required to facilitate passive surveillance in accordance with TS 04992.

Stainless steel of at least 304 grade as a minimum shall be installed for graffiti and scratch prevention. Higher levels of stainless steel (316 grade) shall be taken into account based on site location, for example, within close proximity to marine environments.

5.7 Energy consumption

The lifts shall provide passenger service while incurring minimal environmental impact.

Lift cars and lift shafts shall be designed to minimise solar gain in both the lift shaft and the lift car. During periods of low usage, the lift cars shall park at a non-exposed level to minimise solar gain. Refer to NCC for energy consumption and efficiency measures.

6 Performance requirements

6.1 Standby battery system

The lift battery shall be capable of initiating the lowering or raising of the lift car to the next floor in the event of a mains power failure. The lift shall shut down until normal mains power resumes after reaching the next floor and opening the doors.

Standby batteries shall be provided for the alarm sounders, lift shaft lighting, lift car lighting, remote monitoring system, communication devices, car voice annunciation and powered ventilation equipment. Standby times shall be allowed, as shown in Table 2, in the event of power failure.

Table 2 – Standby times

Equipment	Standby time
Emergency lighting (car and lift shaft)	Two hours continuous illumination. Additionally for lifts installed in metro environment, four hours continuous illumination.
Communication devices	Two hours continuous use
Car ventilation and air-conditioning and fan equipment	Two hours continuous use
Alarm sounders	Two hours continuous operation of all sounders

The emergency lighting shall have a dedicated standby battery, independent of any other battery-backed systems. The standby battery shall support the emergency lighting operating continuously for the specified duration.

Other battery-backed units that share a common battery shall be capable of operating for the specified periods, assuming concurrent operation of all supported equipment.

For lifts installed within the metro environment, CCTV cameras shall be battery backed for at least four hours in line with emergency lighting.

6.2 Ride comfort, noise and vibration

6.2.1 General

All passenger lifts shall achieve the levels of noise and vibration specified in Section 6.2.4.

Lifts shall meet the performance criteria detailed in Table 3.

Table 3 – Lift performance criteria

Property	Requirement
Maximum door opening time	Fully adjustable initially set to two seconds
Maximum door closing time	Fully adjustable initially set to three seconds
Door dwell times	Four seconds in response to landing call or combined car and landing call. Two seconds in response to car call. One second after re-establishment of a passenger by door scanning device or pushing of a door close button
Floor levelling accuracy	±5 mm under varying load conditions. For lifts installed in metro environment ±3 mm under varying load conditions.

6.2.2 Noise levels on lift lobbies

Lift noise, when measured at 1.5 m from the floor and 1 m from the door face with the doors closed, shall not exceed 50 dB(A) at any time during the lift cycle to ensure adequate customer comfort.

6.2.3 Lift vibration

6.2.3.1 General

Vibration measurements shall be taken at the centre of the car, on the floor, in three mutually perpendicular axes corresponding to vertical vibration and lateral quaking. Measurements shall include vibration levels in each direction over the following cycles:

- one full cycle from the bottom landing to the top landing
- one full cycle from the top landing to the bottom landing.

Journeys shall be measured to identify that the correct speed profiles are being achieved.

A cycle is defined as the period from when the doors start to close at one level, to when the doors have fully opened at the final level.

The vibration levels shall not exceed the values indicated in Table 4.

6.2.3.2 Noise levels in lift cars

Noise levels in the lift car under acceleration, deceleration and at maximum car velocity in the cycle shall not exceed the values indicated in Table 4 when measured with any mechanical ventilation devices switched 'OFF'. Readings shall also be checked with these devices switched 'ON'.

6.2.4 Noise and vibration performance table

Table 4 identifies the maximum allowable car noise and vibration performance for differing car speeds.

Table 4 – Maximum allowable car noise and vibration performance

Lift speed (m/s)	Maximum acceleration (m/s ²)	Maximum jerk (m/s ³)	Maximum noise in car dB(A)
1.0 to 4.0	0.8	1.4	55

Horizontal vibration in the frequency range of 1 Hz to 80 Hz (inclusive) shall not exceed a maximum acceleration level of 0.8 m/s². This limit applies to any time during a complete cycle, in any one-third octave band in the frequency range specified.

Vertical vibration in the frequency range of 1 Hz to 80 Hz (inclusive) shall not exceed a maximum acceleration level of 0.8 m/s². This limit applies to any time during a complete cycle, in any one-third octave band in the frequency range specified.

Vertical vibration during acceleration, deceleration, and stop and start periods in the frequency range of 1 Hz to 80 Hz (inclusive) shall not exceed a maximum acceleration level (in any one-third octave band) of 0.1 m/s².

These maximum vibration levels apply to lift car speeds of up to 4 m/s.

Maximum in-car noise levels should be measured with the lift car air conditioning and ventilation in operation while the car remains at a fixed location.

7 Technical requirements

7.1 Electrical installations

7.1.1 General

The design of electrical installation shall comply with AS/NZS 3000 and AS/NZS 3008.1.1. All cables other than travelling cables shall be in accordance with AS 1735.1.2 and AS/NZS 3000. The installation of conduit shall be in accordance with AS 1735.1.2 and AS/NZS 3000.

Lifts installed in buildings, interchanges, stations and the like near 1500 V dc track shall be installed in accordance with TS 03954 for LV requirements, and TS 03677 and TS 03743 for earthing and bonding requirements.

Note: Locations that constitute near 1500 V dc track are specified in TS 03954.

Lifts installed in outdoor areas, for example overline bridges, pedestrian bridges and the like, shall require lightning protection assessments in accordance with TS 03677 and AS 1768.

7.1.2 Trailing cables

Trailing cables shall be flexible multi-core type specifically designed for lift operation with conductor sizes adequate for the electric current to be applied inclusive of air-conditioning systems where required in accordance with Sections 7.1.6 and 7.3.

Woven wire-mesh screens shall be installed between the trailing cables and shaft walls. All cables shall be terminated so that a short circuit between any two cores does not cause a lift to move away from a landing when the lift doors are open.

Screened, communication grade, trailing cables with IP rating 65 in accordance with AS 60529 that are suitable for use with any of the microphone, telephones, intercom, lift indicators and CCTV equipment shall be used.

Where the camera cables are located underground or subject to immersion, cables with IP rating 68 in accordance with AS 60529 shall be provided.

Communication grade trailing cables shall conform to AS/NZS 3008.1.1 for lift installations.

Trailing cables shall contain 20% spare conductors at the completion of the initial installation.

7.1.3 Lift shaft lighting

Lighting shall be positioned at the top of the lift shaft, the bottom of the lift shaft, in the controller box (landing) and in the maintenance box.

A clearly labelled switch for operating the lift shaft lighting shall be provided in an easily accessible location adjacent to any lift pit access ladders.

Luminaires shall be positioned in accordance with AS 1735.1.2. In the lift shaft, the top and bottom luminaire and every alternate luminaire in the lift shaft shall have a self-contained emergency battery pack.

7.1.4 Lift car lighting

7.1.4.1 General

The design of lift car lighting shall be robust to suit a public transit environment and reduce the risk of damage through vandalism or tampering.

7.1.4.2 Lift car interiors

Lift car interiors shall be provided with sufficient lighting lux levels for intended use, purpose, safe access and security.

Interior illumination in lift cars shall be in accordance with AS 1428.1 and AS 1428.2. All lux levels shall be measured at a height of 1.5 m above the floor level.

From a security perspective, lighting requirements shall comply with TS 04992.

The design of light fittings shall include vandal resistant fittings and tamper-proof screws.

7.1.4.3 Lift car top lighting

A low energy light fitting incorporating a non-maintained emergency light shall be provided on top of the lift car. The fitting shall be powered by a standby battery supply.

7.1.5 Emergency lighting

In addition to mains operated lighting, an emergency system shall be installed and energised automatically to the normal lift car and lift shaft lighting following the failure of the mains supply. The emergency system shall provide a minimum constant illumination of 50 lux in accordance with the duration nominated in Table 2. The emergency lighting shall be combined within the luminaires used for the main lighting. Separate emergency lighting luminaires shall not be accepted.

The luminaires for the emergency lighting shall be located and rated such that they provide sufficient illumination to distinguish the lift car threshold and all communication and control features within the lift car. This is in addition to general illumination of the lift car and lift shaft.

Power for all emergency lights shall be supplied by more than one power supply and configured such that not all lights connect to any one supply. Each supply shall be on separate circuits to ensure redundancy and that failure of any one supply does not result in total failure of all the lights in the lift car. This is to enable testing of emergency lights in accordance with AS/NZS 2293.1, AS/NZS 2293.2 and TS 04936.

7.1.6 Interference

The arrangement of the electrical equipment in lifts shall not interfere with the correct operation of radio, television receivers or other electronic apparatus in the buildings in the locality, caused by the normal working of the lifts.

All lift equipment shall be provided within the limitations for electromagnetic emissions and immunity provided in AS/NZS 61000.6.8. Suppression components shall not be used in any part of the circuit where a failure of the suppression components can cause an unsafe condition.

7.2 Lift car ventilation and air conditioning

Refer to NCC for requirements on lift installations and HVAC requirements for lift cars.

Lift cars shall also include air conditioning to maintain comfortable conditions for the occupants. The mechanical ventilation and air conditioning shall operate when the temperature inside the lift car exceeds 21°C. The mechanical ventilation and air conditioning shall be of sufficient capacity so that the maximum temperature in the lift car interior does not exceed 25°C when the temperature in the lift shaft is 45°C.

7.3 Lift shaft ventilation and air conditioning

7.3.1 Operation

Refer to NCC for requirements on lift installations and HVAC requirements for lift shafts.

The lift shaft fan or fans shall be positioned at the bottom of the lift shaft and be capable of positively pressurising the shaft to avoid the ingress of dust, water and so on. The fan shall be connected to the remote monitoring system.

Where air conditioning is required in accordance with the NCC, it shall be designed and installed to not permit condensation build-up within the shaft.

7.3.2 Fan

Ventilation fan or fans shall be provided with thermostat and thermal overload protection. The lift shaft ventilation thermostat shall be positioned at the top of lift shaft where the lift electrical equipment is located and a sufficient distance away from any control system extraction fan output. The lift shaft fan penetration shall be internally protected with a mesh screen to prevent entry into the lift shaft in case of maintenance or removal of the lift shaft fan. Fan calculations and selections shall be provided to demonstrate that the lift shaft is positively pressurised.

The lift shaft ventilation intake shall be filtered and weatherproof. Access for maintenance should be achievable without entering the danger zone. The fan filter shall be fitted with an industry standard gauge, such as a Magnehelic gauge or equivalent, for the specific type of fan and connected to an alarm through the remote monitoring system. This gauge shall be visible from inside the lift shaft and contained within the ventilation void. Fan filters shall be reusable to enable cleaning and reinstallation.

7.3.3 Louvres

All lift shaft ventilation louvres shall be vermin proof and storm proof. The louvres shall be hinged and lockable. Access for maintenance should be achievable without entering the danger zone. Where louvres are installed in positions accessible to the public, vandal-proof welded mesh screens shall be installed. The mesh screens shall not impede the louvre door opening

mechanism. The installed location of louvres shall take into account the ease of access for maintenance. For example, louvres should not be installed in locations which require rail possessions or traffic management plans.

7.4 Guides rails and brackets

7.4.1 General

The lift car and counterweight guides shall be jointed and fixed to their brackets so that they do not deflect by more than 5 mm under normal operating conditions. The lift car frame and counterweight assembly of each lift shall be equipped with roller guides that operate quietly and smoothly through the travel of the lift car and counterweight.

7.4.2 Fixings

For lift shafts that are not steel framed, mechanical anchor fixing methods shall not be used for any structural connections or lift guide brackets that connect the lift rails or structure to the lift shaft. Only chemical anchor fixings shall be used due to the dynamic loading produced by the lift.

7.4.3 Guide rail construction

All lift car and counterweight guides shall be machined, undercut tee section, with tongue and groove plated joints. All lift car and counterweight shall be provided with steel bases.

A clear space at the top of all guide rails shall be provided so that they are not subject to any vertical force from the lift shaft roof slab or surrounding structure.

7.4.4 Guide fixing pitches

The fixing pitch between guide brackets shall be arranged to restrict the designed deflection below the permissible maximum when calculated in accordance with AS 1735.1.2 and AS 1735.1.3. If the maximum deflection cannot be achieved due to limitations on the guide fixing pitches caused by construction or structural constraints, suitable guide rail backing shall be provided to achieve the deflection criteria accordingly. Guide rail brackets shall be hot-dip galvanized.

7.5 Buffers

Car and counterweight buffers shall be provided in accordance with AS 1735.1.2. Buffer stands and supporting pit steels shall be hot-dip galvanized.

Hydraulic buffers shall be fitted with electrical proving switches that maintain full buffer extension.

7.6 Guarding and screening

7.6.1 Lift shaft screening construction

Unless specified or otherwise approved, lifts located in common shafts shall have shaft screening manufactured from 10 SWG x 25 mm steel weld mesh securely welded within a rigid angle frame.

Screens shall not be used to support trunking, conduits or any ancillary lift equipment in the lift shaft.

7.6.2 Counterweight screens

Counterweight guarding shall be provided in accordance with AS 1735.1.2.

Where the screen conceals buffers with serviceable parts (oil buffers or buffers with switches or other like items) such parts shall be easily visible and accessible either through a removable panel or around the screen.

7.6.3 Lift shaft flushing

Stainless steel, framed panels of minimum 1.2 mm thickness shall be provided. A ramped apron shall be provided below the lowest track or sill.

All fixings shall be countersunk with no projection into the running clearance between the lift car and landing sills.

7.7 Lift pits

7.7.1 Emergency stopping devices

Emergency stopping devices shall be of a mushroom head design. Toggle or rocker type switches shall not be accepted.

All emergency stopping devices shall be clearly and permanently labelled 'Emergency Stop' with a permanently fixed label.

A minimum of two emergency stopping devices shall be installed, one at a convenient and accessible location near the bottom of the lift pit ladder, and the other at a convenient and accessible location next to the top of the lift pit ladder.

7.7.2 Socket outlets

A socket outlet controlled by a local or integral residual current device shall be provided in each lift pit above any possible flood water level.

7.7.3 Lift pit access ladders

A lift pit ladder shall be provided to allow for safe and easy access to each lift pit with handrails extending to a minimum of 1100 mm above the lift pit access level.

All ladders shall be permanently fixed within the lift shaft in a position that is easily visible and accessible from the lift pit access level. Ladders shall be hot-dip galvanized.

7.7.4 Lift pit sump

A dry sump of at least 300 mm x 300 mm x 300 mm with stainless steel perforated cover shall be provided to dewater the pit using a portable submersible pump.

7.8 Lift drives

7.8.1 General

The lift drive control system shall provide fully closed loop feedback for speed control by way of an encoder device mounted directly on the high-speed shaft of the drive motor or similar agreed method.

7.8.2 Lift motors

An emergency stopping device shall be provided and fixed adjacent to the lift machine. Local power supplies conditions shall be taken into account. Where necessary, localised power conditioners, such as UPS, shall be provided to mitigate the problem of high incoming voltages and harmonics.

7.9 Machines

7.9.1 General requirements

All components comprising the lift machine and associated supports, together with any diverting pulleys, shall be located in the lift shaft and supported on vibration insulators. The machine drive system shall include all suppression equipment and filters, transformers, capacitors, line inductors, reactors and any other components necessary. This is required to eliminate distortion and avoid interference with the mains distributing system, and any sensitive electrical and electronic equipment in the lift shaft.

Vibration isolating pads shall be installed between the machine base plate and support beams or between the machine support beams and the shaft.

7.9.2 Gearless machine room less machines

Only VVVF asynchronous squirrel cage type or VVVF permanent magnet synchronous machines shall be used in gearless MRL machines. Gearless machines shall be capable of achieving floor levelling accuracy as specified in Table 3 under varying load conditions.

7.10 Suspension and compensation ropes or belts (or both)

All ropes or belts (or both) shall be delivered to site together and be properly coiled or reeled to protect them from being damaged while being transported.

The suspension anchorage devices shall permit and indicate equalisation of tension in each rope or belt (or both).

A data plate shall be attached to the lift car crosshead providing details of the suspension rope or belt (or both), its construction, date of installation, lift 'contract speed', rated car load mass of empty car, and rope or belt length.

7.11 Car slings

The lift car shall be carried in a steel sling securely fixed together and substantially reinforced and braced. This is to relieve the lift car enclosure of all strain and to withstand the operation of the safety gear under full-load conditions without any permanent deformation.

7.12 Guide shoes

7.12.1 General

All lifts shall utilise roller guides to the car and counterweight.

All guide rollers shall be selected to achieve the noise and vibration limits as detailed in Section 6.2.

7.12.2 Roller guides

Roller guides shall comply with the following requirements:

- roller guides shall be mounted such that they provide continuous contact of all wheels with the corresponding rail surfaces under all conditions of loading and operation
- roller guides shall run on dry guide rails
- guards shall be provided to protect the wheels on top of the lift car and counterweight.

The lift car and counterweights shall be statically balanced following fitting of all equipment and finishes prior to final fixing and setting of the roller guides.

7.13 Overspeed governors and safety gears

Safety gear and overspeed governors shall be provided and installed in accordance with AS 1735.1.2.

The governor tension weight assembly mounted in the lift pit shall incorporate:

- a pulley guard to prevent the ingress of objects and
- electrical switch to identify governor rope stretch or failure.

7.14 Counterweights

A billet filled counterweight shall be provided as required to optimise power consumption and to provide traction in accordance with AS 1735.1.2.

Counterweights and billets shall be painted yellow.

Billets shall be restrained from movement within the counterweight frame.

7.15 Lift car walls, floors and ceilings

All lift car walls below handrail level shall be of textured stainless steel panels. Stainless steel shall be of grade 304 minimum, with higher grades to be taken into account depending on site location and conditions. Handrails shall be installed to the height level nominated in AS 1735.12. Handrails shall meet all loading requirements as nominated in AS 1735.12. Handrail fixings shall be vandal resistant. Glazing shall only be used for the area below the handrails where sightlines are required to facilitate passive surveillance as determined by risk assessments undertaken in accordance with TS 04992. Metro lift cars shall be constructed as far as is reasonably practicable with glazed vision panels and be accompanied by a risk assessment in accordance with TS 04992.

All lift car walls above handrail level shall be of textured stainless steel panels with glazing panel cut-outs. Glazing panels shall be fully framed. Glazing panels shall not extend to the edges of any wall face. Glazing panels shall not be used for any structural purpose. For replacement lifts, glazing panels shall be provided in lift cars to line up with existing window structures within the lift shaft.

The installed locations of glazing shall take access requirements into account to avoid rail possessions, traffic management plans and the like for maintenance.

The lift car floor coverings shall be of stainless steel checker plate material.

7.16 Lift car roof equipment

7.16.1 Maintenance control unit

A maintenance control unit shall be provided on the top of the lift car. The maintenance control unit shall be mounted such that the risk of accidental operation of any controls is eliminated. In addition to housing an emergency stopping device and door operating controls, a common run button shall be provided. The common run button, in conjunction with the operation of the directional pushes for up and down, shall provide movement of the car under maintenance control.

All controls on the maintenance control unit shall be clearly labelled.

7.16.2 Roof safety hooks

The lift car roof shall be fitted with at least two safety hooks, each clearly marked with its safe working load, for the attachment of safety harnesses. Additional hooks shall be provided to ensure that a hook is located within 1500 mm of any normally accessible point on the lift car roof.

7.16.3 Guardrail on lift car top

Guardrails shall be provided on the top of car in accordance with AS 1735.1.2.

7.17 Automatic horizontal sliding doors

7.17.1 Door operators

The electric door operators (VVVF or dc PWM) shall be of high speed, heavy-duty construction and suitable for intensive traffic duty.

The opening and closing speed of the door operator shall be easily adjusted to suit operating conditions.

The interval of time of doors in fully open position shall be easily adjustable, to a maximum period of 30 seconds depending on site-specific needs.

7.17.2 Passenger protection system

A passenger protection device or devices shall cause the doors to reopen when an obstruction enters the detection zone and before contact is made with any such obstruction.

The passenger protection device or devices shall be effective from 25 mm (or less) above the sill up to a height of 1.8 m (or more) above the sill. The passenger protective device or devices shall not project beyond the leading edge of the door panel or panels.

The passenger protection device or devices shall be mounted on the edge of the doors for ease of access and cleaning.

Each passenger protection device should incorporate red and green indicator lights to provide higher levels of safety to the passengers.

7.17.3 Lift door sills, guides and suspension

Each lift door shall be provided complete with a top track, running sill and supporting frame with the mechanical strength required for loading and operation in accordance with AS 1735.1.2 and AS 1735.1.3. Door guide blocks shall be easily renewable from the lift shaft side of the door panel without the door having to be lifted or removed. Sills shall be installed flush with the landing floor finishes.

Goods lift landings and car door sills shall be appropriately designed and installed to cater for the intended point loads of the specific lift.

7.17.4 Mechanical car door locking

A lift car door shall not be able to open, except during the pre-opening condition and when the car is within a designated unlocking zone in accordance with AS 1735.1.2.

All lift car doors shall be provided with a mechanical car door lock, matched to the door drive and electrical locking equipment.

7.17.5 Landing door and door frames

Landing doors shall be of glass and framed with embossed stainless steel. Where a location is deemed to be a higher risk of damage to full height glass doors, a risk assessment shall be undertaken to determine the whole-of-life applicability to installing doors with stainless steel lower portions. The surrounding landing structure, including the landing entrance frame trim, shall be finished stainless steel. For metro, brushed stainless steel visible to public shall be of multi-directional brushed stainless steel with anti-fingerprint coating.

The landing door mechanisms shall be of commercial heavy-duty material. The landing door mechanisms shall provide a smooth operation of the lift door sets without causing snatch or bounce of the landing or car doors.

As a minimum, the non-glass landing doors, frames and associated items shall pass a one-hour standard fire test in accordance with relevant Australian standards. Where there are specific fire resistance ratings for the building or structure where the lift is being installed, all landing doors, frames and associated items such as sills, tracks and locking devices shall comply with the requirements of relevant authorities, such as FRNSW, and building owner.

Landing door sills shall be adequately supported to withstand mobile plant, such as EWP, up to the maximum load on the load notice in the lift car.

Each landing level shall contain a braille plate detailing the level in a tactile symbol and braille equivalent. The plate shall be located on the landing entrance trim.

The landing doors shall also be capable of providing continuous uninterrupted door operation during varying conditions of air flow depending on the site location, for example with a pedestrian bridge, the flow from landing to shaft or from shaft to landing.

Raised tactile and braille signs identifying both the lift car and landing level shall be provided on both sides of the lift landing door frame.

7.17.6 Lift car door

Lift car doors containing glass shall be framed in embossed stainless steel. Lift car door and landing glazing shall be mounted such that it can be easily removed and replaced without having to replace the entire door.

Lift car door sills shall be adequately supported to withstand mobile plant, such as EWP, up to 50% of the maximum load on the load notice in the lift car.

The car door drive operator shall be microprocessor-controlled, VVVF that is capable of driving the car and landing doors quietly and smoothly in both directions of movement. The connecting means between the lift car door and landing door shall operate without snatch or bounce of the car and landing door panels.

The driving mechanism shall be of commercial heavy-duty design. The design and physical arrangement of driving mechanisms shall enable the doors to be held open against their driving action without damaging the door driving mechanism. The closing movement of the doors can also be reversed, if necessary, without undue effort.

The lift car door shall be fitted with sound isolation to prevent the transfer of vibration or noise to the car superstructure.

7.17.7 Protection of door entrance

7.17.7.1 Scanning device

A scanning device shall be installed that provides full protection of the door entrance to suit the type of doors used as follows:

- Solid car door and solid landing doors – 3D infrared non-touch door scanning units.

The 3D door sensors shall be designed to be able to be switched to 2D mode if required.

The door sensors when operating in 3D mode shall be capable of sensing an object 300 mm out from the door entrance.

- Glass car doors or glass landing doors – 2D infrared non-touch door scanning units.

The door scanning device shall be:

- of a type that uses an infrared light source
- capable of reversing the doors where an intrusion is sensed at any point between 50 mm and 1600 mm above the car sill
- incorporate red and green indicator lights to provide higher levels of safety to the passengers
- rigidly constructed and mounted in an approved manner for stability of aim and focus, and to minimise the effects of vibration, bumps and sun light interference on the device operation
- designed to prevent the ingress of dust.

7.17.7.2 Delayed door closure (door nudging)

An alternative means to continue the safe operation of the lift shall be provided in one or both of the following situations:

- when closing of the doors is delayed due to door scanning device being deliberately operated for an extended period of time
- the scanning device is inoperative for some reason.

Where the delay results from operation of the door scanning device, the doors shall be rendered ineffective after an adjustable time of 15 to 50 seconds. The doors shall close fully at a substantially reduced speed and pressure while a warning buzzer sounds. The 'Door Open' button shall remain effective during this cycle of operation.

Force-limiting sensors shall reopen the doors if a permanent obstruction is present.

The timing device shall be automatically reset to provide normal operation as soon as the door has closed and the lift car has commenced to move away from the floor, following a door closure.

7.18 Controllers

The components and cabinets shall be designed and mounted in a manner that facilitates inspection, maintenance, adjustment and replacement of any serviceable parts and in accordance with AS 1735.1.2 and AS/NZS 3000.

8 Operational and control requirements

8.1 Lift car operation

8.1.1 Lift car arrival gongs

An adjustable electronic chime shall be provided at each floor to give an audible indication when the lift car arrives at the landing in response to a hall call.

The electronic chime shall operate once for the up direction and twice for the down direction.

The electronic chime shall incorporate an adjustable setting to enable operation between two and five seconds before the lift arrives at a floor.

8.1.2 Lift car arrival indicator

Arrival indicators shall be provided at each landing. Arrival indicators shall illuminate for an adjustable period between two and five seconds before arrival.

8.1.3 Lift car operating panels

Table 5 shows the minimum requirements for the car operating panels.

Table 5 – Lift car operating panel schedule

Feature	Details
Faceplate material	2.5 mm stainless steel
Edges	Square and deburred
Finish	Linish No. 4
Fixings	Tamper-proof 'torx' countersunk screws or equivalent screws
Load notice	As appropriate
Buttons	US91compact round metal having tactile, with black pressed face and white/green illumination and vandal proof. All external call buttons shall be rated to minimum IP65.
Alarm or phone button	Shall be illuminating
Surface engraving and braille (main and auxiliary operating panels)	In addition to braille requirements in Appendix ZZ of AS 1735.12:2020, surface engravings shall be as follows: <ul style="list-style-type: none"> • lift number – 13 mm high and 1 mm thick Gill Sans in black with a luminance factor not less than 0.3 in contrast to the background • emergency telephone instructions – 10 mm high and 1 mm thick Gill Sans filled black • floor engraving – 10 mm high and 1 mm thick Gill Sans filled black • braille signage to be located adjacent to destination buttons.

Feature	Details
Emergency telephone	Hands free emergency call in car main operating panel only
Auxiliary car operating panel	Panel shall include the following: <ul style="list-style-type: none"> • the lift identification number • the destination buttons and destination description initial (for example P, C) in raised tactile • an emergency phone button.
Car button location	The location of buttons shall be between 1050 mm and 1200 mm from floor level.

Site locations may determine variations in expected passengers, customers and users that may influence the selection of appropriate lift design solutions, particularly buttons. Where it is determined that extra-large (or ‘Jumbo’) buttons would be beneficial, extra-large buttons shall be installed in accordance with Annex B of AS 1735.12:2020.

8.1.4 Lift car door open button

A door open push button shall be provided to remain effective when the lift is standing within a door zone. The doors shall reopen by pushing the button if they are closing or closed and remain open for a pre-set period.

Control or security features shall not be arranged to override the operation of the door open button to ensure passengers are not trapped within the lift car.

8.1.5 Lift car indicator plate

A dot matrix or LCD indicator plate shall be provided to each lift car displaying floor or level designation and direction of travel arrows.

8.1.6 Voice announcement in lift car

The lifts shall be provided with automatic audible information in the lift cars.

The volume of the announcement shall be in accordance with AS 1735.12. A voice announcement in English shall be activated each time the lift stops in response to a car or landing call. A chime shall also ring when the lift arrives at a floor. The announcements shall correspond with the destination descriptions on the lift car operating panels.

8.2 Landing operating panels

Table 6 shows the minimum requirements for lift landing operating panels.

Table 6 – Lift landing operating panel schedule

Feature	Details
Faceplate material	2.5 mm stainless steel
Edges	Square and deburred
Finish	Linish No. 4
Fixings	Tamper-proof 'Torx' countersunk screws or equivalent
Buttons	US91 compact round metal having tactile, with black pressed face and white/green illumination and vandal proof. All external call buttons shall be rated to minimum IP65.
Landing button location	The location of buttons shall be between 1050 mm and 1200 mm from floor level.
Landing button plate	Braille signage shall be located adjacent to landing buttons. Braille provision shall be in accordance with the requirements in Appendix ZZ of AS 1735.12:2020.

Site locations may determine variations in expected passengers, customers and users that may influence the selection of appropriate solutions, particularly buttons. Where it is determined extra-large (or 'Jumbo') buttons would be beneficial, extra-large buttons complying with AS 1735.12:2020 Annex B shall be installed.

8.3 Push buttons

8.3.1 Dual push button illumination

All buttons shall be provided with double illumination enabling a white illumination in a non-activated state and enabling a green illumination in the activated state.

8.3.2 Call registered indicator

Each push button shall incorporate an illuminating indication when it has been operated. This shall be cancelled when the function has been completed (for example, door open illuminates until the doors are fully open, a car or landing call button illuminates until the call is answered).

8.4 Independent service control

Each lift shall be provided with an independent service control with a control key switch located in the operating panel of the lift car. The independent service switch shall be capable of performing the following:

- remove the lift from the normal control system so that it responds to and cancels car calls only
- park the car with doors open
- allow car button registration to be made in the normal manner and with respect to further travel of the lift, shall set the direction of travel
- the key switch for the independent service shall be limited access type.

8.5 Automatic re-levelling

The lift car shall be designed to allow for automatic, accurate re-levelling. This is required as the car can move out of level by ± 5 mm (for metro ± 3 mm) with the doors open or closed due to stopping at a floor, loading, unloading or sinkage.

8.6 Out of service functions

8.6.1 Out of service key switch

Out of service key switches shall be provided at the designated location or locations in the lift car and at designated landing or landings. When the switch is activated, all landing calls shall be cancelled. The out of service indicator shall illuminate on each landing. All existing car calls shall be answered. New calls shall not be accepted.

The lift shall return to the designated floor and park with the doors closed after all existing car calls have been answered.

8.6.2 Out of service indicator

An indicator shall be provided at all floors indicating that the lift is out of service. Any control feature that prevents normal use of the lift to passengers shall automatically activate this indicator.

The indicator shall be connected to a battery backed emergency power supply to enable indication even in the event of mains power failure or disconnection.

The out of service indicator shall be displayed as an illuminated graphic with the 'OUT OF SERVICE' sign, fitted within the landing call plate.

8.7 Fire service operation

An additional key switch shall be provided at the main terminal floor for fire service operation. Refer to NCC for requirements on lift installations.

Fire service operation shall be operable only with the use of a key that is removable in either the 'OFF' or the 'ON' position.

On switching the fire service key to the 'ON' position:

1. a continuous audible signal in the lift car shall be activated
2. a visual signal indicating 'FIRE SERVICE IN OPERATION' shall be displayed in the lift car
3. all lift car calls shall then be cancelled
4. the lift car(s) shall return to the designated main terminal floor
5. the lift car(s) doors shall open and
6. the lift car(s) shall park.

Landing calls shall not be accepted during fire service operation.

If the lift is in flight when the fire service operation is activated, it shall continue to the next available floor level, without opening the doors then immediately return to the main terminal floor.

In the event of the fire detector in the lift shaft being activated, the lift car shall complete its current operation and then not respond to further car calls.

Note: In response to the fire detection event, the next lift operation will be 'fire service operation' under the authority of the FRNSW.

This lift operation may be superseded by the site-specific asset fire life safety strategy. As part of the design development, the asset fire life safety strategy should be consulted prior to confirming lift operations.

8.8 Electronic passenger detector

8.8.1 General

An electronic passenger detector shall be provided. The electronic passenger detector shall be effective when the lift is standing at a floor level with the doors open or closing.

Passenger movement within the detection zones shall initiate an adjustable delay in the remaining door open time if the door is open, (initially set to two seconds). The door shall reopen a closing door.

8.8.2 Overload control

Lift cars shall be provided with a car weighing device. If the lift car load exceeds the rated lift capacity by more than 10% (or a minimum of 75 kg):

- the car shall be prevented from starting
- an overload buzzer shall sound, and
- an overload message shall be displayed on the car indicator screen.

The doors shall remain open until the excess load has been removed from the lift car.

8.9 Emergency battery drive (uninterrupted power supply, automatic rescue drive)

In the event of a power failure when a lift is in flight, the lift shall stop mid shaft. The UPS or ARD shall provide temporary power to the lift to facilitate release of passengers to the nearest floor above its stopped position.

The emergency operation shall be performed at low speed. All safety functions shall remain operational to prevent an unsafe condition occurring. When the car has arrived at the nearest upper floor, the doors shall open. The lift shall be removed from service until power is restored.

The lift shall return to normal service automatically following re-instatement of the power supply.

The emergency battery drive unit shall be designed such that it is protected from damage resulting from harmonics and poor quality permanent electrical supply power. Typically, poor quality power is a characteristic of the rail environment, for example.

8.10 Emergency manual operation

When the lift is being raised manually an audible and visual signal shall be activated when the lift passes through the unlocking zone. The indicator shall be easily seen and heard by personnel carrying out such emergency procedures.

This indicator shall be powered by a battery backed power supply to allow for correct operation in the event of a power failure.

The manual raising procedures shall be clearly described on a non-fade notice, mounted permanently in a prominent position in the machinery space.

The marking of suspension ropes or belts (or both) shall not be accepted for identifying the location of the lift car at a floor level.

8.11 False car call cancel

Provision shall be made to detect the presence of, and cancel, false car calls. This shall be achieved by carrying out one or more of the following:

- comparison of the number of calls to the load being carried
- by the non-operation of an infrared detection device following a predetermined number of car stops
- a combination of both.

8.12 Motor start counter

A motor start counter shall be provided in the control panel. The counter shall provide data on the number of starts per hour, number of door operations, and run-time of the lift. The counter shall continue to collect data and record information throughout the life of the lift, from the time of commissioning.

8.13 Water sensor in lift pit

A sensor shall be provided in the lift pit to detect the presence of water.

When the sensor is activated, a signal shall be provided through voltage free contacts that enables operation of an alarm. When the sensor is activated, the lift shall proceed to the top floor, evacuate any passengers and remain at that level with the door closed. The lift shall remain unavailable for passenger use until the lift pit sensor no longer detects water.

8.14 Lift shaft fan sensors

8.14.1 Fan filter blocked sensor

An industry standard gauge is to be fitted to the lift shaft fan, as specified in Section 7.3.2, to detect the state of the lift shaft fan filter. The lift shaft fan controller shall indicate a blocked fan filter through this sensor to the lift controller and the remote monitoring system through a relay inside the lift controller.

8.14.2 Fan motor thermal overload sensor

A sensor shall be provided to detect thermal overloading due to excessive current draw in the lift shaft fan motor. The lift shaft fan controller shall indicate a motor thermal overload through this sensor to the lift controller and the remote monitoring system through a relay inside the lift controller.

9 Interfacing system requirements

9.1 CCTV camera in the lift car

CCTV cameras shall be installed in the lift car in accordance with TS 04989 and TS 00050. CCTV cabling between the power or control panels and the lift car shall be provided. Cabling shall be provided to the lift control box and installed in accordance with manufacturer specifications.

CCTV cameras shall be positioned within each lift car to allow for full coverage of the entire floor space including each corner, the doors and the lift control panel.

9.2 Alarms and communication systems

9.2.1 Emergency alarm devices

An emergency signal shall be provided in the lift car. The emergency signal shall be powered by a standby battery not used for any other purpose.

When the alarm button is pressed, the button shall illuminate. A reassurance sounder fitted on the lift car shall be clearly audible within the lift car, to indicate that the emergency signal is functioning.

The alarm system shall be capable of being extended to a central alarm panel. A voltage-free contact with suitable terminals shall be provided for this purpose in the machinery space.

9.2.2 Handset free emergency phone systems

An emergency hands-free phone system shall be installed in the lift car.

The handset free emergency communication system shall be automatically activated following manual push button activation of the emergency alarm.

Continuous actuation of the emergency alarm button for a period of greater than three seconds shall initiate a capability to connect to two remote locations.

Telephone buttons, speakers and microphones, shall be located in the car-operating panel. A suitably descriptive notice shall be engraved in the lift car, with instructions for passengers to operate the hands-free phone system.

The emergency phone system shall disconnect after a period of three minutes.

9.3 Remote alarm and monitoring system

The remote alarm and monitoring system shall include a termination in the controller for an interface to asset operations systems through either or both of the following:

- a dedicated I/O board
- a dedicated communication port or connection, indicatively RS 232, RS 485 or RS 422.

Agreed lift controller data and signals shall be allowed to communicate to the asset operations systems for operational monitoring, data logging and providing remote alarms and alerts.

9.4 Communication junction box

The communication junction box shall be provided in stainless steel adjacent to the lift controller to house interface connections between the lift and external services including, but not limited to, the following:

- CCTV interface connections
- remote alarm interface connection
- emergency phone interface connection
- remote monitoring interface connection
- smoke detector interface connection
- lift shaft vent fan fault interface connection
- any other external interface connections.

9.5 Materials

9.5.1 General

All materials shall comply with relevant Australian standards. Material manufacturers and suppliers shall certify that the materials to be used conform to such standards.

The materials and finishes used in the lifts and lift shaft installations shall be selected for site-specific conditions and fit for purpose.

Material data sheets shall be provided on request.

9.5.2 Castings, extrusions or profiles

All castings, extrusions or profiles shall be of adequate thickness and strength to meet the specified design life, structural and durability requirements and eliminate any risk of distortion in

the finished surfaces. The thickness of such elements shall be sufficient to ensure their complete rigidity in the lengths required in the final installation.

9.5.3 Stainless steel

Stainless steel shall be grade 304 minimum, with higher grades to be taken into account depending on site location and conditions. For metro, minimum grade 316 steel shall be used.

The stainless steel shall be free from visible signs of pitting corrosion and fabricated in a workshop free of carbon steel grinding or cutting.

Stainless steel used for faceplates shall have a minimum thickness of 2.5 mm. All panels shall be flat and smooth. Where welded, the panels shall show no evidence of weld or heat marks.

9.5.4 Sealant

Any form of sealant shall be compatible with the adjacent elements of construction in each location. All excess sealants shall be properly cleaned from exposed surfaces.

Installed sealant shall provide a smooth continuous surface to the full width of the joint. The sealant shall be tooled flat.

Sealant installation shall be in accordance with the sealant manufacturer's instructions.

9.5.5 Painting

With the exception of self-finished surfaces, hot-dipped galvanized and elements otherwise specified, the whole of the equipment shall be painted one coat in the factory after full and proper surface preparation, including priming.

All steelwork shall be de-rusted, treated with rust inhibitor or galvanized, primed and painted. All steelwork in the lift car, shaft and landing shall undergo protective treatment to protect against the effects of corrosion. All lift materials that are not made of stainless steel shall be protected by applying a paint coating of durable surface tolerant epoxy with a minimum dry film thickness of 100 microns.

9.5.6 Glass

All glass shall be of sufficient thickness and annealed laminated safety glass of 11.7 mm minimum thickness, two layers bonded with a minimum 1.52 mm PVB interlayer.

All glass shall provide undistorted vision and reflection through clear sections and be free from roller wave.

All surfaces shall be thoroughly cleaned before glazing to ensure that frames and glass are free from dust, moisture, frost, oil, grease or other foreign substances.

All glass panels shall be fully framed on all sides with stainless steel strips. Setting blocks, corner blocks and spacers shall be used to install the glass. All necessary protective measures shall be taken to prevent mechanical damage of glass, any damaging splashes or weld spatter and so on.

All glass shall be fitted with vandal proof fixings.

All glass shall be easily accessible for cleaning and allow for replacement of glass during regular day-to-day operations without extensive disruption to passengers.

9.6 Maintenance

All lift services, systems and equipment maintenance and upgrades shall comply with TS 04955.1. Maintenance regimes shall also be developed in consultation and in accordance with supplier input to achieve the RAM targets detailed in Section 5.3.

10 Testing and commissioning

10.1 General

All testing and commissioning shall be carried out by suitably qualified testing personnel, experienced in such work and using suitable instruments. Records shall be kept of all required testing tasks and outcomes and submitted within the operations and maintenance manuals.

10.2 Dynamic tests on electric traction lifts

Notwithstanding the requirements of AS 1735.1.3, the tests shall include the following dynamic tests:

- motor current readings shall be taken and recorded in the up and down direction with empty car, balanced load and full load in the car
- downward operating safety gears shall be tested under 100% load with the safety gear operated either by over speed or through a test groove provided on the governor; this is to verify the correct operation of the safety gear and overspeed assemblies
- manual activation of the governor
- upward overspeed control equipment shall be tested with an empty lift car travelling upward in an overspeed condition or through a test groove on an overspeed governor if provided
- car buffers shall be tested by running the lift car carrying 100% rated load onto the buffers
- counterweight buffers shall be tested by driving the empty car upward so that the counterweight strikes the buffers.

10.3 Functional tests

The operational functions of all lifts shall be tested, including but not limited to, the following:

- all push buttons, indicators and sounders, gongs and other like items
- all key switches and functions controlled thereby
- special control features such as fire alarm recall, emergency recall switches, out of service switches and other such features
- where two or more lifts operate under a group control arrangement, this shall be tested, together with any other special traffic handling features
- smoke parking of the lift in the event of a smoke alarm
- emergency evacuation function in the event of mains electrical power loss
- lift shaft mechanical ventilation.

10.4 Putting into service

The lifts shall be successfully commissioned. Any defects identified during commissioning shall be rectified prior to handover.

The machinery spaces, lift shaft and cars shall be cleaned of all debris. The entire installation shall be cleaned prior to handover for general use.

11 Assurance

All lift services, systems and equipment shall be assured in accordance with TS 04955.1.