Transport for London
London Underground

## Category 1 Standard

# S1093 PMVT Lifts (including managed evacuation lifts)

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**MAYOR OF LONDON**

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# 1 Purpose

1.1 The purpose of this Standard is to define the requirements for all PMVT lifts in LU stations within operational areas.

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| **Note:** | Section 3 of this Standard is structured to align with BS EN 81-1 to assist reading and understanding. |

# 2 Scope

2.1 This Standard applies to lifts that are used as a Primary Means of Vertical Transportation in a LU station. They shall be referred to as PMVT lifts.

2.2 Lifts that are used as a Secondary Means of Transportation in a LU station shall be referred to as SMVT lifts. SMVT lifts are not covered by this Standard: refer to LU standard 1-095.

2.3 This standard applies to the design, manufacture, installation, commissioning and safe use of all PMVT lifts. This includes managed evacuation lifts and the modernisation of existing PMVT lift installations.

2.4 This Standard does not apply to inclined lifts or vertical lifting platforms.

2.5 This Standard does not apply to the stages of design, manufacture, installation, commissioning and safe use of PMVT lifts in non-operational areas.

# 3 Requirements

## 3.1 Performance, safety and conditions

### 3.1.1 General

3.1.1.1 Hydraulic and scissor type lifts shall not be used.

3.1.1.2 Suppliers shall ensure that the total system requirements of this Standard are met.

3.1.1.3 The lift shall comply with this standard in addition to the provisions of BS EN 81, BS EN 81-28, BS EN 81-58 or equivalent standard, BS EN 81-70, BS EN 81-71 category 1, BS EN 81-73, EN 81-80 (where relevant) and the Lifts Regulations; all as detailed in this Standard. Where any conflicts arise, compliance with this standard shall take precedence, except where a breach of law would arise.

3.1.1.4 The lift shall also comply with Railway Safety Principles and Guidance Parts 1 and 2 (sections A and B), the Building Regulations Approved Documents ‘B’ and ‘M’. Where any conflicts arise between the Railway Safety Principles and Guidance, the Building Regulations and this standard, compliance with this standard shall take precedence, except where a breach of law would arise.

3.1.1.5 The spatial layouts of the lifts within LU stations shall be in compliance with LU Station Planning Category 1 standard 1-371.

3.1.1.6 PMVT lifts shall have a capacity of 50 persons (typical LU installations). The physical restraints of the existing LU environment could preclude such installations and where this occurs the Supplier shall demonstrate where such installations are impractical, however in these cases the minimum capacity of the lift shall be no less than 27 persons.

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| **Note:** | The standard euro-person has a mass of 75kgs. |



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3.1.1.7 The lift shall have as high a rated speed as is possible whilst remaining compliant with Annex K of EN 81-1 and to Table 5 of BS 5655-6.

3.1.1.8 The control system shall operate the lift at rated speed ±2%.

3.1.1.9 Where the supplier uses Finite Element Analyses, they shall follow the procedure detailed in Attachment 1.

3.1.1.10 The lift shall be rated to operate continuous cycles between landings, including opening and closing of the doors, for a minimum of 20 hours per day, 365 days per year. The loading shall be assumed as constantly varying between an empty lift car and 80% of rated load.

3.1.1.11 The lift shall have a declared design life.

3.1.1.12 A Whole Life Design Cost Plan shall be provided for each new installation or modernisation covering a minimum period of 60 years. This plan shall incorporate the data and component lives as determined through all testing.

3.1.1.13 The design life of the following key components shall be calculated and declared as a minimum: control system, drive machine, safety gear, lift door equipment including car door operator, lift car and landing door equipment and suspension ropes. Any additional components of which the design life would be critical to the operation of the lift shall also be calculated and declared to LU.

3.1.1.14 With each new installation or modernisation a whole life robust and demonstrable Reliability, Availability, Maintainability and Safety (RAMS) Plan shall be provided.

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| **Note:** | A typical RAMS template can be supplied on request for guidance. |

3.1.1.15 There shall be no potential for single point failures to cause injury.

3.1.1.16 All essential supplies listed in clause 3.13.1.13 shall not be susceptible to common modes of failure.

3.1.1.17 The lifts shall be installed in pairs as a minimum to allow for transfer between lift cars.

3.1.1.18 The lift could be required to be designated as a managed evacuation lift as defined in a site specific basis specification.

3.1.1.19 The use of the lift for managed evacuation purposes shall be considered during any refurbishment works.

3.1.1.20 Lifts used for managed evacuation shall be designed in accordance with BS 9999 and site specific requirements.

3.1.1.21 The lift shall be able to convey PRM's and comply with the requirements of the Department of Transport document 'Inclusive Mobility', BS 8300 and BS EN 81-70.

3.1.1.22 The stopping accuracy of the car at landing levels shall be ±5mm.

3.1.1.23 References to British Standards shall be taken to include the words 'or equivalent DIN, AFNOR or other national Standards', subject to the agreement of LU.

### 3.1.2 Performance

3.1.2.1 The lift shall have a declared minimum number of journey cycles between any component or system failure.

3.1.2.2 Materials used in the manufacture of the lift shall comply with LU standard 1-085.



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3.1.2.3 The measurement of lift ride quality shall conform to BS ISO 18738-1 and the following:

3.1.2.4 The maximum level of vibration in the lift car during a journey shall not exceed 40 milli-g in all three axes defined as vertically in the direction of travel, between guides and back to front. The acceleration values are as measured in the frequency bandwidth of 0 to 10 Hertz.

3.1.2.5 The noise level emanating from each drive machine shall not be greater than 73 dB(A) measured at a 1.0 m range from the generating source.

3.1.2.6 Noise levels in the car and on the landings shall not exceed 65dBA measured 1 metre up from the floor level from a central position in the lift car and 1 metre from the landing doors during normal operation.

### 3.1.3 Welding

3.1.3.1 All welding shall be undertaken in accordance with BS EN 287-1, BS EN 287-6, BS EN ISO 9690-2, BS EN ISO 15607, BS EN 15609-1, BS EN ISO 15610, BS EN ISO 15611, BS EN ISO 15612, BS EN ISO 15613, BS EN ISO 15614-1 and BS EN ISO 15614-2 by a coded welder appropriately qualified for, and tested against, the welding activity being undertaken.

3.1.3.2 For the first lift of a type, and any variant thereafter, the Supplier shall prepare a schedule of all welds and welding procedures incorporated within the lift for the approval of LU. The schedule shall at least include the location and type of each weld, the proposed method of inspection and whether this is factory or site executed.

3.1.3.3 The Supplier shall ensure that the structural assessment of the welds shall be according to BS 7608 for steel and BS 8118 for aluminium. Where these codes are not applicable, the Supplier shall nominate an alternative, to be agreed with LU, prior to commencement of the analysis.

### 3.1.4 Safety

3.1.4.1 The lift shall meet the safety requirements of the SAFed Guidelines on the Supplementary Tests of In-Service Lifts 2006, BS 7255 and BS EN 13015.

3.1.4.2 The lift shall undergo an examination, in accordance with Attachment 4, once every six months.

### 3.1.5 Conditions

3.1.5.1 The lift shall operate in the environment encountered on the LU network. Relevant data regarding the conditions to be expected on specific installations will be supplied in the site specific documentation.

## 3.2 Documentation

### 3.2.1 General

3.2.1.1 All supporting documentation shall be in English and any translation shall be by an accredited translator.

## 3.3 Station system interfaces

### 3.3.1 Lift car

3.3.1.1 CCTV coverage of the lift car interior shall be provided in accordance with LU standard 1-140.



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3.3.1.2 Either a volt-free contact or an industry standard data port and protocol shall be made available for the CCTV interface. The functionality of this is as described by clause 3.13.5.5.

3.3.1.3 An emergency communication system shall be provided in accordance with clause 3.14.9.1.

### 3.3.2 Lift well

3.3.2.1 A leaky feeder or radio antenna shall be installed within the lift well to allow station staff to remain in radio contact at all times. This shall be considered part of the lift system.

### 3.3.3 Lift machine room

3.3.3.1 An incoming earthing conductor shall be provided with the incoming mains electrical supply.

3.3.3.2 An earth bar shall be provided within the machine room and shall be connected to the incoming earth supply using a removable link for testing purposes.

3.3.3.3 A secondary main 400V AC supply via a changeover switching unit shall be provided for managed evacuation lifts only as required by site specific requirements.

3.3.3.4 In event of the main power supply failing, the essential supply distribution board shall automatically be switched to an auxiliary sustained power supply.

3.3.3.5 A volt free pair of wires shall be made available for the interface with the fire and smoke detection system. On activation or the identification of two positive fire alarms the fire detection system shall send a signal to the lift controller. The lift shall then return to the designated landing, allow passengers to exit and shut down with doors open until the fire detection monitor is reset.

## 3.4 Primary systems interface

### 3.4.1 Civils

3.4.1.1 Lift structures shall comply with LU standards 1-150 and 1-153.

3.4.1.2 Tolerances for the construction of lift structures shall allow for the more rigorous tolerance demands required for lift installations in BS ISO 4190-1.

### 3.4.2 Station operations

3.4.2.1 LU staff shall be competent to put the lift in and out of service, and to release passengers from a failed lift as required.

## 3.5 Lift well

### 3.5.1 Emergency doors

3.5.1.1 Emergency access landings shall be fitted on single lift wells, where required, to ensure that travel between lift landings is never greater than 11m.

a) The emergency door shall be a minimum of 1,800mm high by 900mm wide.

b) The emergency door shall be mechanically locked and electrically interlocked. The electrical interlock shall be connected into the landing door lock safety line.

c) If a castell key is used to open the emergency door it shall be the same key that is used to isolate the main circuit breaker for that lift.



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### 3.5.2 Lift structural elements

3.5.2.1 Design and Assessment of the lift support structural elements shall comply with Attachment 2.

3.5.2.2 Glass shall not be used in the structural build of lift wells or lift cars.

### 3.5.3 Protection of the well

3.5.3.1 A smoke detector shall be installed at the head of the lift well. Where multiple lifts are sited in the same well space the number of smoke detectors required shall be determined on a site specific basis.

3.5.3.2 Full height lift well division screens shall be installed when two or more lifts operate in the same lift well.

### 3.5.4 Exclusive use of the lift well

3.5.4.1 Lift machinery spaces shall only be used for accommodating the equipment or services necessary for the operation or maintenance of the lift.

### 3.5.5 Lighting of the well

3.5.5.1 Lift well lighting shall be provided to give a minimum of 100 lux throughout the lift well with all landing doors closed.

3.5.5.2 The lighting shall be supplied via two runs of lift well lighting extended to include the pit, each of which shall be wired from an independent supply and provide fifty percent of the overall lighting. One of these must be the emergency back up supply.

3.5.5.3 Lift well lighting shall be controlled by switches at the machine room, on access to the lift pit or lowest landing and the uppermost landing.

3.5.5.4 Lighting shall be provided beneath the lift car controlled by a switch on the car top.

### 3.5.6 Lift pit

3.5.6.1 Dependant on the existing infrastructure, where the pit exceeds 2.5 metres in depth, access into the lift pit shall be via a lift pit access door.

3.5.6.2 Lift pit access doors shall be mechanically locked and electrically interlocked. The electrical interlock shall be connected into the landing door lock safety line.

3.5.6.3 Where the pit access door is in a public area the pit access door lock shall be of a type to be agreed with LU.

3.5.6.4 Designs for pit floors above voids must give due consideration to buffer characteristics and account for true maximum deceleration levels.

## 3.6 Machine and pulley rooms

### 3.6.1 General provisions

3.6.1.1 Design and Assessment of the supporting structural elements of the lift machine and associate machine room and pulley room equipment shall comply with Attachment 2.

### 3.6.2 Machine room conditions

3.6.2.1 The machine room shall have the correct cooling and heating to maintain the ambient working temperatures between +5 degrees to +25 degrees Celsius.



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### 3.6.3 Construction and equipment of machine and pulley rooms

3.6.3.1 Lighting levels in these areas shall be a minimum of 200 lux at floor level.

3.6.3.2 Lighting at control panels shall be designed to eliminate shadowing.

3.6.3.3 The lighting of the machine rooms shall prevent the stroboscopic effect of moving machinery such that maintenance staff shall recognize the true linear and rotational movement of components.

## 3.7 Landing doors

### 3.7.1 General provisions

3.7.1.1 At each level served, landings shall be provided on both the entrance side and exit side of the lift, to allow for through car operation and optimal passenger flow rate. The lift control system shall provide for the reversal of passenger flow through the lift car in any sequence of door opening and closing.

3.7.1.2 Landing doors shall be fitted with vision panels made from toughened and laminated glass, in accordance with 3.7.1.3 of this standard. The vision panels shall be sized and positioned such that they afford equal functionality to both wheelchair users and ambulant persons.

3.7.1.3 The glass used for vision panels shall have the appropriate compliance mark clearly visible and include:

a) the glass suppliers name and trademark;

b) type of glass confirming it is laminated and toughened;

c) the thickness of the glass and laminated layer.

3.7.1.4 The vision panels shall have minimum dimensions of 300mm wide and 600mm high and shall be positioned such that they afford equal utility to both wheelchair users and ambulant persons and shall be in alignment with the lift car door vision panels.

3.7.1.5 Subject to site specific conditions landing doors and the adjacent architrave panelling shall have a minimum fire rating of one hour and shall be tested in compliance with BS EN 81-58.

3.7.1.6 Landing door leading edges shall be profiled to form a male to female overlap in the closed position.

3.7.1.7 Landing entrance finishes shall meet the contrast requirements as described in BS 8300 Annex B clause B1.

3.7.1.8 The landing doors shall comply with BS EN 81-1 clause 7.2.3.6 b) or c) with respect to the measures to prevent the dragging of children's hands.

### 3.7.2 Strength of doors and their frames

3.7.2.1 Landing and car doors shall have efficient longitudinal, transverse and torsional rigidity to be capable of withstanding and operating under an air pressure differential of 500 Pa across the doors due to wind pressure, whilst maintaining maximum allowable running clearances.

3.7.2.2 Lift landing door assemblies, together with their frames and fixings, shall comply with the Category 1 requirements stipulated in BS EN 81-71 clause 5.3.1.2. b)



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**3.7.3 Height and width of entrances**

3.7.3.1 Car and landing entrances shall be no less than 2100mm in height.

3.7.3.2 The car and landing doors shall be centre opening and be designed to give a minimum clear entrance width of 1400mm.

**3.7.4 Sills, guides and door suspension**

3.7.4.1 Door sills shall incorporate self clean dust slots.

3.7.4.2 The car and door sills shall be able to support a 1000 kg load, applied at two points via a trolley with wheels 300mm apart, without any permanent deformation.

3.7.4.3 A secondary means of preventing the landing door panels disengaging from the door sill groove shall be provided to guard against failure of landing door guide shoes.

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| **Note:** | Compliance to clause 3.7.4.3 can be achieved by employing the use of a full width plate to which the door guide shoes are attached. |

3.7.4.4 A minimum of two door sill cleaning tools for use by LU station staff shall be provided with each lift, the design shall be agreed with LU.

3.7.5 **Protection in relation to door operation**

3.7.5.1 Each landing door set shall be fitted with an electrical interlock.

3.7.5.2 Each landing door set shall be fitted with intrinsically fail-safe mechanical locks.

3.7.5.3 Any failure of the interconnection between landing door panels shall not permit a lift to move with any door panel in an open position.

3.7.5.4 Each landing door set shall be positively driven in both directions by the car door operator.

3.7.5.5 Door operating mechanisms and locks shall not be casually accessible when the lift doors are open.

## 3.8 Car and counterweight

**3.8.1 Lift car and sling**

3.8.1.1 Design and Assessment of the structural elements of the lift car sling, its connections and car enclosure shall comply with Attachment 2.

3.8.1.2 The lift car shall be designed to be vandal resistant and comply with BS EN 81-71 in respect of Category 1 compliance.

3.8.1.3 The interior of the lift car shall be designed in accordance with BS EN 81-70 including the disability categories given in Annex B Table B1.

3.8.1.4 Lift floors and skirting shall be formed as a continuous surface to be impervious and inert to liquids (including urine and cleaning fluids).

3.8.1.5 The slip resistance on the lift car floor shall achieve a mean Slip Resistance Value (SRV) of 36 when tested wet and dry, against the HSE 'Slip Assessment Tool' as described in BS 7976-1.

**3.8.2 Car entrance**

3.8.2.1 Lift cars shall be designed to cater for through traffic.



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### 3.8.3 Car doors

3.8.3.1 Car doors shall be fitted with vision panels made from toughened and laminated glass in accordance with clause 3.7.1.3 of this standard.

3.8.3.2 The vision panels shall have minimum dimensions of 300mm wide and 600mm high and shall be positioned such that they afford equal utility to both wheelchair users and ambulant persons and shall be in alignment with the landing door vision panels.

3.8.3.3 The car doors shall comply with BS EN 81-1 clause 8.6.7.5. b) or c) with respect to the measures to prevent the dragging of children's hands.

3.8.3.4 Each car door set shall be fitted with electrical interlocks.

3.8.3.5 Each car door shall be fitted with intrinsically fail safe mechanical locks. It shall be permissible to lock only the fast speed door panel, provided that any failure of the door opening mechanism shall not permit any of the slow speed door panels to open independently.

3.8.3.6 Car and landing doors shall be top hung.

3.8.3.7 Car doors shall also comply with clause 3.7.2 of this standard.

### 3.8.4 Protection during operation of doors

3.8.4.1 Each set of car doors shall be provided with a means of detecting any obstruction in the door openings to prevent the door closing onto any such obstruction.

| | |
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| **Note:** | The system shall prevent the possibility of trapping child harnesses and dog leads. |

3.8.4.2 Door nudging shall be provided to cater for the prolonged presence of an obstruction; the maintainer shall have the facility to enable or disable this feature.

3.8.4.3 Advance door opening is precluded by this Standard.

### 3.8.5 Emergency transfer doors

3.8.5.1 An emergency transfer door system and security key switch shall be supplied for the transfer of passengers to an adjacent lift.

3.8.5.2 The emergency transfer door key switch shall be situated within a control system panel that is accessible from outside the lift well and shall be connected into the control safety line to ensure that the failed lift is electrically isolated when the key is removed. A unique key shall operate the transfer door locks of the adjacent lift (i.e. the lift that is to be used as the rescue lift).

3.8.5.3 The horizontal distance between the lift cars shall not exceed 0.75 m. However in installations where the existing infrastructure prevents compliance, then the lift car design shall be such that the distance is as small as reasonably practicable to prevent passenger discomfort and ensure safe passage between cars.

3.8.5.4 A passenger transfer bridge and ladder shall be provided for use when transferring passengers between the cars. Each transfer bridge shall have a mass no greater not weigh more than 25 kgs and be able to support a point loading of 100kgs on an area of 250mm by 250mm without permanent deformation.

3.8.5.5 The transfer door shall be protected by a two piece positive break type electrical interlock switch, to prove door closure. It shall be locked by two mechanical locks, which shall be electrically interlocked into the safety circuit, to ensure positive proof of the mechanical locking of the transfer door.



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3.8.5.6 The transfer door shall be provided with a vision panel with minimum dimensions of 100mm width by 150mm length.

3.8.5.7 A semi-automatic system shall be provided to enable to the rescue car to align with the failed car within a tolerance of +/- 200mm.

3.8.5.8 In new or refurbished installations, where there are three or more lift cars side by side, any lift cars that are flanked by more than one lift shall have transfer doors on either both sides of the lift car.

**3.8.6 Car roof**

3.8.6.1 An emergency trap door shall be provided in the lift car roof.

3.8.6.2 A working platform shall be provided that is supported independently of the lift car roof and covers the whole lift car roof area. The working platform shall be designed such that it shall support the weight of four people (300kgs) without permanent deformation in all areas of the working platform, including access hatches.

**3.8.7 Equipment on top of the car**

3.8.7.1 A car top control panel shall be positioned for ease of operation from a safe and easily accessible position on the lift car roof.

3.8.7.2 The car top control panel shall comply with the layout as defined by Figure C.2 of BS 7255.

3.8.7.3 The power socket shall provide 110V AC (centre tapped) and shall be easily accessible from a lift landing entrance.

3.8.7.4 An 110V AC (centre tapped) car top light shall be provided and controlled from a switch on the car top control panel.

**3.8.8 Ventilation**

3.8.8.1 Lift cars shall be naturally ventilated.

3.8.8.2 Forced (exhaust) ventilation fans shall be provided to be capable of delivering forty air changes an hour in order to remove the build up of stale air during lift failure.

3.8.8.3 Redundancy shall be provided by fitting a minimum of two fans, each of which shall be capable of delivering forty air changes per hour.

3.8.8.4 The ventilation system shall be provided with an alternative power supply consistent with the requirements of the managed evacuation strategy.

3.8.9 **Lighting**

3.8.9.1 Average horizontal luminance in the lift car at floor level shall be 150 lux with a uniformity of 0.7.

3.8.9.2 Glare shall be controlled so that any reflections created by the lighting do not impair the view in any CCTV equipment.

3.8.9.3 Two lift car lighting circuits shall be supplied directly from separate supplies, not via the automatic changeover switch.

3.8.9.4 The emergency car lighting shall be a minimum of 100 lux when measured at floor level at the centre of the car and on the car operation panels.



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3.8.9.5 The emergency car lighting shall be provided with an alternative power supply consistent with the requirements of the managed evacuation strategy. An indication shall signify the light fitting that is fed from the alternative power supply.

**3.8.10 Counterweight**

3.8.10.1 The design and assessment of the lift counterweight structural elements and connections shall comply with Attachment 2.

## 3.9 Suspension, compensation, and protection against overspeed, unintended car movement and upward overspeed of the lift car

**3.9.1 Suspension ropes**

3.9.1.1 There shall be a minimum of eight suspension ropes.

3.9.1.2 Where suspension rope weight compensation is required, ropes shall be used.

**3.9.2 Safety gear**

3.9.2.1 The safety gear, overspeed governor and car and counterweight buffers shall be designed as an integrated system.

3.9.2.2 The car safety gear and counterweight safety gear (where fitted) shall be of the progressive type.

3.9.2.3 Instantaneous safety gears are precluded from use on any lift car or counterweight.

3.9.2.4 The design and assessment of safety gears shall comply with Attachment 2.

3.9.2.5 A counterweight safety gear shall be fitted only when required to satisfy the requirements of BS EN 81-1.

**3.9.3 Overspeed governor**

3.9.3.1 An overspeed governor shall operate one safety gear device only. There may be more than one safety gear device and therefore more than one overspeed governor within the lift system as a whole.

3.9.3.2 The overspeed governor shall continuously monitor the car speed.

**3.9.4 Protection against upward overspeed of the lift car**

3.9.4.1 A BS EN 81-1 compliant device shall be fitted to protect against upward overspeed of the lift car.

**3.9.5 Protection against unintended movement of the lift car**

3.9.5.1 Provision shall be made to protect against any unintended movement of the lift car, in both up and down directions, under all load conditions, when the lift car is stationary at a landing.

3.9.5.2 The unintended movement device chosen shall enable once the lift car becomes stationary at any landing - this shall occur prior to the un-locking of the car and landing doors. The device shall remain enabled until the lift is ready to move under normal operating conditions. The device shall not be disabled until both the car and landing doors are mechanically locked and electrically interlocked.

3.9.5.3 Pneumatically operated devices are precluded from use.

3.9.5.4 The device selected shall be fail-safe in operation and self-monitoring and shall be type approved.



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3.9.5.5 The device used for self-monitoring shall prevent the next start if a defect is detected.

3.9.5.6 The maximum allowable unintended movement of the lift car until the device is activated shall be 50mm.

3.9.5.7 The maximum overall unintended movement distance travelled by the lift car from the respective landing shall not exceed 300mm.

3.9.5.8 The device shall operate when the speed reaches 50% of nominal speed during hand-winding (where fitted) and power-winding.

3.9.5.9 The unintended movement device shall be fed from the essential supplies and shall not deploy as a direct result of power failure during the normal operation of the lift.

3.9.5.10 In the event of failure of the normal power supply the device shall remain operable and continue to provide protection against unintended movement of the lift car.

3.9.5.11 The device shall be fail safe in operation under power failure conditions and shall be able to be reset following the return of the power supply.

3.9.5.12 Manual resetting of the device after an unintended movement event shall be restricted to competent persons: however, it shall be possible for a single competent person to effect manual resetting.

3.9.5.13 Resetting of the device shall not require the removal or dismantling of the device or its protective covers, nor shall it affect the calibration of the device in anyway whatsoever.

3.9.5.14 All events of device operation shall be logged, complete with a time and date stamp, by the control system processor.

3.9.5.15 The device shall not be affected by normal test, power wind and hand winding operations (when fitted).

## 3.10 Guide rails, buffers and final limit switches

### 3.10.1 General provisions concerning guide rails

3.10.1.1 The design and assessment of the lift guide rails structural elements shall comply with Attachment 2.

3.10.1.2 Car and counterweight guides shall be fixed to a sole plate arrangement attached to the pit floor. The sole plate shall be designed such that a section of guide can be easily removed if required.

### 3.10.2 Guiding of the car and the counterweight

3.10.2.1 The lift car and counterweight shall be guided by spring loaded guide rollers to maximise ride comfort and to eliminate the need to lubricate guide rails.

### 3.10.3 Car and counterweight buffers

3.10.3.1 The car and counterweight buffers shall be hydraulic and of energy dissipation design.

3.10.3.2 The car buffers shall be capable of bringing the lift car plus 110% of contract load to a gradual and positive stop in the down direction at the maximum impact speed possible, as defined by the tripping speed of lift car overspeed governor, without exceeding a deceleration of 1g.



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3.10.3.3 The counterweight buffers shall be capable of bringing the counterweight and an empty lift car to a gradual and positive stop at the maximum impact speed possible, as defined by the tripping speed of counterweight overspeed governor, without exceeding a deceleration of 1g. Where counterweight safety gear is not fitted then the counterweight buffers shall be selected subject to the maximum impact speed that can be attained by the counterweight.

## 3.11 Clearances between the lift car and lift well walls facing the lift car entrance, and between lift car and counterweight

3.11.1 Full height, smooth and imperforate lift well fascia panels shall be provided to reduce the distance between the well fascia panels and the lift car sill to a maximum of 50mm.

3.11.2 The width of the fascias shall overlap the landing door clear entrance by 100mm on both sides.

3.11.3 The clearance between the full height car and landing door finger guards shall not exceed the running clearance between car and landing door sills by more than 5mm.

3.11.4 The finger guards shall extend a minimum of 100mm back from the door leading edge and ramp back to the body of the door.

3.11.5 The distance between the lift car sill and the landing sill shall be a maximum of 30mm.

## 3.12 Drive machine

### 3.12.1 General provision

3.12.1.1 To maximise efficiency and reliability the drive machine shall be of permanent magnet gearless design.

3.12.1.1 Duty ratings shall comply with BS EN 81 with some exceptions specific to the LU environment as follows:

a) Power transmission and braking elements shall be designed with a factor of safety on Ultimate Tensile Strength of not less than 8 for wrought and 10 for cast components.

b) The above criteria are not enough to ensure system and individual component integrity. Integrity analyses shall give due regard to:

i) Properties of materials.

ii) Stress concentrations arising from geometrical features and welding.

iii) Stresses and combinations of stresses arising from all reasonably foreseeable conceivable static, dynamic and cyclic loading conditions.

iv) The system and its constituent components shall not fail under any conceivable, including faulted, loading conditions.

v) The system and its constituent components shall have a nominally infinite fatigue life.

### 3.12.2 Drive of the car and the counterweight

3.12.2.1 The drive machine shall have the capacity to meet all maximum out of balance, duty and test requirements of the lift.



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| Loading Requirement | Percentage of passenger load |
|---|---|
| a) Normal Duty Load | 100 percent |
| b) Balanced Load | 40 percent |
| c) Maximum Test Load | 110 percent |
| d) Maximum out of Balance | 70 percent |

### 3.12.3 Drive machine vibration and isolation

3.12.3.1 Attention shall be paid to the vibration severity of the drive machine with respect to the effect on reliability, safety and human perception, refer also to clause 3.1.2. LU shall be advised, at time of tender, of the maximum effective value of the vibratory velocity and the frequency commensurate with the design standard.

3.12.3.2 The drive machine motor shall conform to quality Grade B (Special) for vibration, as defined in BS EN 60034-14.

3.12.3.3 The drive motor rotor shall conform to the limits defined in BS ISO 1940-1 for balancing quality.

3.12.3.4 The vibration severity for the drive machine motor shall be to Table A.2 of BS 7854-3 and ISO 8579-2 for the gearbox (if fitted).

3.12.3.5 The drive machine assembly shall be mounted such as to ensure that vibrations are not transmitted into the surrounding structure.

### 3.12.4 Braking system

3.12.4.1 The braking system shall be fail safe and self-adjusting.

3.12.4.2 The manual brake release shall be fitted with a mechanical interlock that is freed using a unique key electrically interlocked into the lift safety circuit to prevent unauthorised use.

3.12.4.3 The control system shall not permit uncontrolled runaway during electrical releasing of the braking system.

### 3.12.5 Auxiliary power winding

3.12.5.1 An electrical auxiliary drive system shall be provided. This shall allow the lift to be driven up or down via a set of constant pressure push buttons.

3.12.5.2 Auxiliary power winding of the drive machine shall be via a dedicated and independent electrical power supply that is capable of providing a minimum of two complete cycles of the lift.

3.12.5.3 If a battery backup system is chosen as the means of providing the electrical power supply to the auxiliary power winding system it shall be fully monitored with its functional condition displayed.

3.12.5.4 In the event of a complete auxiliary power winding system failure, a battery backup system, independent of that (if used) in 3.12.5.3, shall enable the braking system to be energised to allow the lift car to move in a direction, subject to the weight differential between the lift car and counterweight.

3.12.5.5 The auxiliary power winding system (see Figure 1 for a typical layout of a machine room located ‘auxiliary power winding control panel’ on an existing geared drive machine and Figure 7 for a typical upper landing located ‘auxiliary power wind control panel’ arrangement) shall be designed to provide the following user interfaces:



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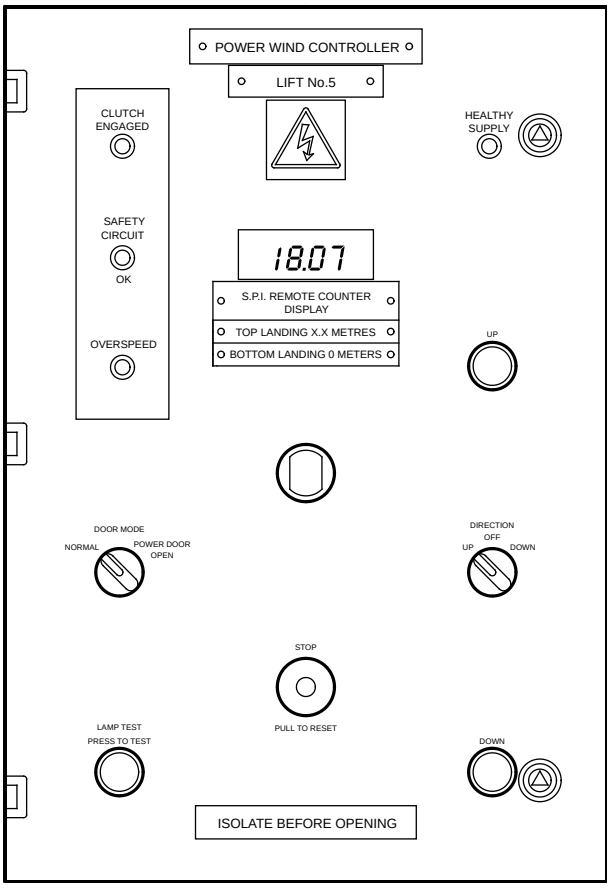


**Figure 1 – Typical layout of auxiliary power wind control panel – geared drive machines.**

3.12.5.6 To power wind the lift the following actions shall be taken;

a) The main circuit breaker shall be switched off, and the Castell key removed. The auxiliary power winding control panel shall have a matching Castell socket, into which the key shall be inserted and rotated to activate it;

b) The mode for power winding up or down shall be selected from the power winding control unit, as up or down. Then the up pushbutton or down pushbutton shall be pressed continuously;

c) The brake(s) shall be lifted automatically by the power winding control system;

d) The lift shall stop if the up or down pushbutton is released;

e) A digital indicator shall display the position of the lift in the lift well;

f) The lift shall stop automatically when the lift car is level at the landing;



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g) When the lift is stationary at landing level the doors shall be able to be powered open by the following procedure:

h) set the mode of the 'normal or powered door opening' switch to 'powered door opening' from the power winding control unit;

i) operate the entrance doors control from the landing control panel to open the entrance doors. The doors shall open and remain fully open until the 'normal or door powered opening' switch is reset to 'normal' and the entrance doors control is returned to its original state.

3.12.6 **Manual hand wind (Optional)**

3.12.6.1 The fitting of a manual hand wind system will be dependant on the drive machine selected. If fitted the hand winding procedure shall be as follows:

a) Isolate the power supply by removal of the Castell key;

b) The hand winding indicator on the controller shall be activated by operating the hand winding key switch, this mutes the alarm and activates the proximity devices at floor level;

c) Engage the hand wind clutch and remove the unique key;

d) Free the brake release lever using the unique key and engage the brake release lever;

e) First person releases the brake, while the second person hand winds the car;

f) On reaching floor level the hand wind alarm shall sound and the first person shall re-engage the brake;

g) The car and landing doors can then be opened.

| | |
|---|---|
| **Note:** | The clutch shall not be disengaged unless the brake release lever has been returned to its storage position and locked. |

3.12.7 **Protection of machinery**

3.12.7.1 All rotating components shall be guarded in accordance with The Supply of Machinery (Safety Amendment) Regulations, the EC Machinery Directive and BS EN ISO 13857:2008.

3.12.7.2 All guarding shall be constructed such that all rotating parts are visible, do not hinder examination and maintenance operations and are only removable by the use of a tool.

## 3.13 Electrical installations and appliances

### 3.13.1 General provisions

3.13.1.1 The lift shall be fed from either the LU and/or DNO supply.

3.13.1.2 LU supplies are nominally 400Vac 3phase and neutral 50Hz and the Supplier shall ascertain the actual nature of the supply characteristics.

3.13.1.3 Where a new power supply or altered load is required LU standard 1-100 shall be applied.



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3.13.1.4 When utilising regenerating drives appropriate co-ordination shall take place between the drive supplier and the LU power supply designer to ensure power quality is not adversely affected.

3.13.1.5 The Supplier shall comply with the requirements regarding Electromagnetic Compatibility (EMC) and harmonics as specified in clause 3.13.8.

3.13.1.6 The electrical supply to the lift shall be interlocked by the use of a unique coded LU Castell key isolation system which shall be separate from the lift control and located at an agreed position. The convention, based on equipment owned by the respective LU line as per Table 1, shall be used:

| LU Lines | Key Convention |
|---|---|
| Bakerloo, Central and Victoria lines | Alpha-Alpha-Numeric |
| Jubilee, Northern and Piccadilly lines | Alpha-Numeric-Alpha |
| SSL lines | Numeric-Alpha-Alpha |

**Table 1: Castell key convention**

3.13.1.7 A supply healthy indicator, as per 3.13.6.5 - 'Main Supply Healthy' indicator, shall be provided for the electrical supply.

3.13.1.8 Examination, testing and certification of the electrical system shall include:

a) Measurement of the earth loop impedance value and fault current levels;

b) Visual and physical checking of the integrity of the earthing and bonding connection and wiring.

c) Measurement of the earth continuity of the whole installation. This shall include checking of the earthing and bonding of controller metallic handles and controller enclosures and all metalwork associated with the lift;

d) Testing of the operation of RCD devices.

3.13.1.9 The lift electrical installation shall be tested and certificated in accordance with BS 7671.

3.13.1.10 Borrowed neutrals shall not be used.

3.13.1.11 Dedicated neutral connections shall be made to every device and circuit, except when they are protected by the same circuit breaker.

3.13.1.12 The control system and essential functions shall be fed from both the LU and DNO supplies via an automatic changeover switch.

3.13.1.13 The essential supplies shall be monitored and shall include, but not be limited to, the following functions:

a) Lift alarms;

b) Lift car ventilation fan(s).

c) Communication system, including autodial unit.

d) Upward overspeed device.

e) Unintended movement device.



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f) Temperature monitoring of the LMR;

g) Back-up batteries for operation during power failure;

h) 50% of lift car lighting;

i) DMI's;

j) Voice synthesisers;

k) CCTV;

l) AFILS;

m) Position and sequence indicators.

3.13.1.14 With reference to items from a) to g) in clause 3.13.1.13 - the failure of any of these facilities shall remove the lift from service and park the lift car with the doors remaining open at the next scheduled stop.

3.13.1.15 The lighting for the lift machine rooms, the lift car top and the lift car shall be supplied separately via two runs of lighting, each of which shall be wired from an independent supply and provide fifty percent of the overall lighting. One of these must be the emergency back up supply.

3.13.1.16 Local isolation for the main incoming lift supply shall be provided in the machine room. This shall allow for the safe working on the control system without reliance on isolation by a third party.

3.13.1.17 Where the main circuit breaker is remote from the machine room entrance(s) a safe means of isolation shall be provided.

3.13.1.18 Where the logic controller interfaces with the safety line via a safety relay or safety relays then these shall be proprietary type units conforming to BS EN 60204.

3.13.1.19 Safety devices that utilise PESSRAL shall be declared at the time of tender and shall be accompanied by type examination certification; their use is subject to LU approval.

3.13.1.20 Terminals that remain live after the main circuit breaker has been tripped shall be suitably shrouded and warning labels attached irrespective of the voltage present. Instructions shall be clearly visible as to how to isolate these supplies.

3.13.1.21 All electrical enclosures shall be designed to be electrically safe even if access doors/panels are opened without prior isolation of the electrical supply.

3.13.1.22 Electrical separation from earth shall be provided in the front of all controllers and switchboards.

### 3.13.2 Electrical wiring

3.13.2.1 Wiring for lift communications, control and power shall be segregated from each other.

3.13.2.2 Lighting, ventilation and communications cabling shall be incorporated into the main travelling cables. These vital supplies shall ensure continued operation even after failure of one cable.

3.13.2.3 The travelling cables shall comply with BS EN 50214 and Engineering standard 1-085.



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3.13.2.4 All cables shall be continuous, without joints and shall be terminated with solderless crimped connectors.

**3.13.3 Lighting and socket outlets**

3.13.3.1 110Vac (centre tapped) electrical sockets shall be provided in the lift machine room, lift diverter room (where applicable), lift pit, lift well mid point and at the top of the lift shaft. The socket outlets shall be rated to allow the use of power operated hand-tools individually rated up to 3kw.

**3.13.4 Car controls**

3.13.4.1 A "Press to Operate Lift" push button shall be provided for passenger operation that is operable in semi automatic mode.

3.13.4.2 This button shall activate the buzzer indicating that the lift is required during manual operation (car or landing control) or shall initiate the semi automatic sequence when that mode of control has been selected.

3.13.4.3 The push button shall have a permanent low intensity red LED illumination at all times and on acceptance of a call the illumination shall increase to full intensity until the call has been answered.

**3.13.5 Emergency alarm push button**

3.13.5.1 An emergency alarm push button, recessed into the faceplate into which it is mounted, shall be provided in the lift car for passenger operation. The push button shall operate the alarm bells when it is pressed but shall require constant pressure for three seconds to initiate latching of the alarm bell circuitry to alleviate accidental operation.

3.13.5.2 When the lift car emergency alarm push button is operated it shall activate the alarm bells, or sounders, that are audible at all landings, and in the lift car, the lift machine room and the station operations room.

3.13.5.3 The emergency alarm push button shall have permanent low intensity yellow LED illumination at all times. Whilst pressed the illumination shall increase to full intensity which shall be maintained whilst the push button remains pressed.

3.13.5.4 The emergency alarm bells, or sounders, shall be muted on voice communication being established between the lift car and the permanently staffed position.

3.13.5.5 Activation of the emergency alarm shall cause the lift control system to signal the station CCTV system either via volt-free contact or an industry standard data port and protocol provided under clause 3.3.1.2. This shall cause the lift car CCTV camera image to be automatically displayed on the designated SOR monitor and instigate real time recording.

3.13.5.6 It shall be possible to silence the emergency alarm at either the upper or lower landing, via an emergency alarm reset pushbutton in the respective landing control panels.

| | |
|---|---|
| **Note:** | After an emergency alarm operation the respective lift shall not be placed back into passenger service until the lift car has been visually checked to ensure that it is safe to do so. |

3.13.5.7 The emergency alarm, when activated due to a non lift failure incident, shall cause the lift to park at the nearest landing in the same direction of travel, and park with the doors open until the emergency alarm is reset.



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3.13.5.8 The lift emergency alarm shall activate if the lift fails in the lift well, or at a landing, during automatic or semi-automatic mode. In this case the emergency alarm can be muted by switching the lift to 'manual' mode in the upper landing control panel. If at any point safe movement of the lift is re-established during the emergency alarm phase then the lift shall travel in the direction of travel set at time of failure and park with the doors open at the next landing.

**3.13.6 Operation panels**

3.13.6.1 Symbols used on control panel layouts are as follows:

○ = LED

● = Push Button

= Key Switch

= Selector Switch

3.13.6.2 The controller shall incorporate a device accurately representing the position of the lift car within the lift well and a machine room control panel.

3.13.6.3 The machine room attendant control panel on a lift undergoing refurbishment, which retains a geared drive machine, shall include the following push buttons, key and selector switches (typical layout as Figure 2):

a) Transfer Door(s) (key switch(es);

b) Hand winding – 'Press To Test' (push button);

c) Hand winding – 'Turn Key To Activate' (key switch);

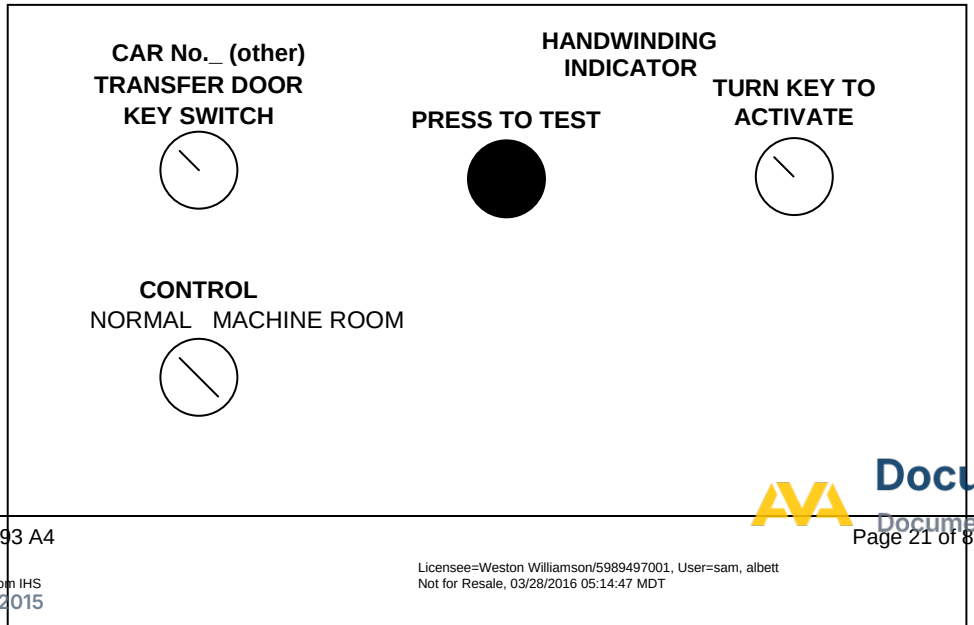
d) Control – 'Normal/Machine Room' (switch);

e) Emergency Stop (captive push button);

f) 'Run Up' (push button);

g) 'Run Down' (push button);

h) 'Fast – Slow' (switch).



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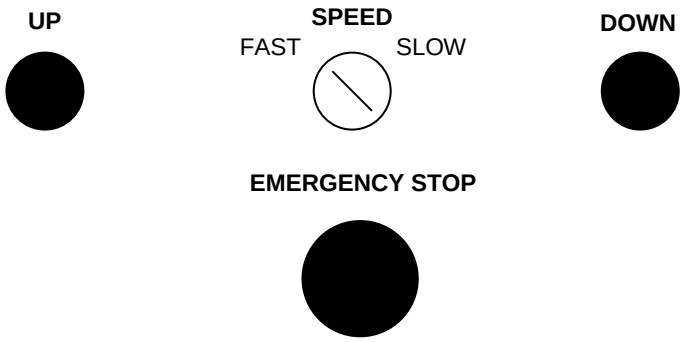


**Figure 2 - Typical machine room attendant control panel layout (Geared Drive Machine)**

3.13.6.4 The machine room attendant control panel on a new installation, or a refurbishment which incorporates a gearless drive machine, shall include the following push buttons and selector switches (typical layout as Figure 3):

a) Control - Normal/Machine Room (switch);

b) Fast - Slow (switch);

c) Run Up (push button);

d) Run Down (push button);

e) Emergency Stop (captive push button).

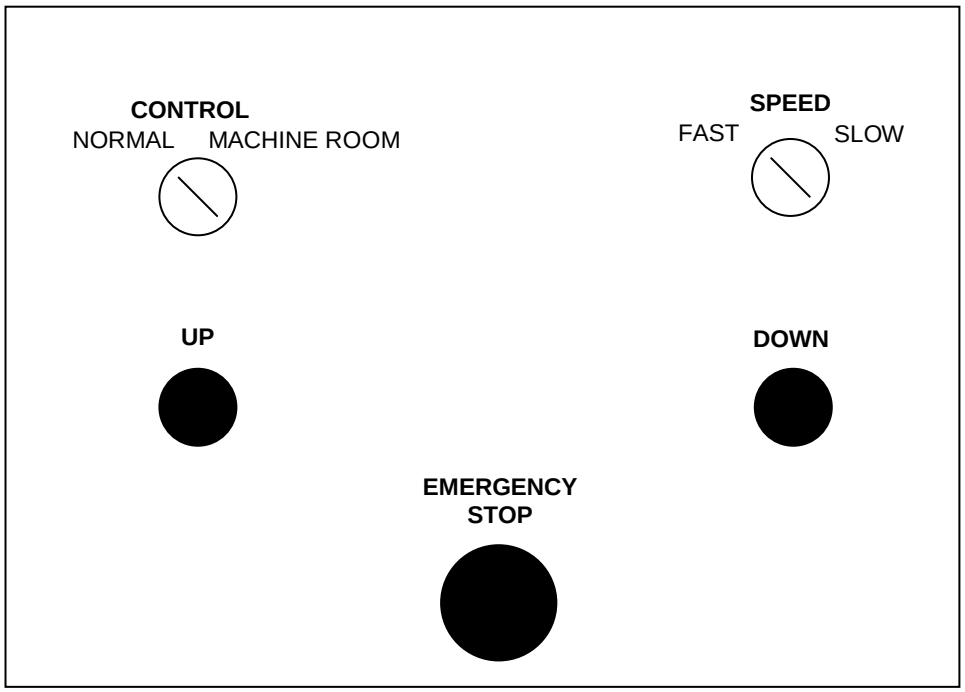


**Figure 3 - Typical machine room attendant control panel layout (Gearless drive machine).**

3.13.6.5 The following status information shall be provided on the machine room attendant control panel as a minimum:



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Amber = 'Sequence Indicator'

Red = 'Failure Indicator'

Green = 'Supply Indicator'

| Indication | Colour |
|---|---|
| Exit doors closed (Upper landing) | Amber |
| Exit doors closed (Lower landing) | Amber |
| Exit doors closed (Car) | Amber |
| Entrance doors closed (Upper landing) | Amber |
| Entrance doors closed (Lower landing) | Amber |
| Entrance doors closed (Car) | Amber |
| Call registered (Upper landing) | Amber |
| Call registered (Lower landing) | Amber |
| Automatic Control Mode | Amber |
| Semi/Automatic Control Mode | Amber |
| SCADA/SMS Control Mode | Amber |
| Manual Mode | Amber |
| Door obstructed | Amber |
| Door safe edge cut/out | Amber |
| Car Fan On | Amber |
| Maintenance | Amber |
| Slow speed | Amber |
| Lift Car Overloaded | Amber |
| Brake failed to lift | Red |
| Transfer door open | Red |
| Failed in well | Red |
| Passenger alarm | Red |
| Governor jaws operated | Red |
| Communications system failure | Red |
| Main supply healthy | Green |
| Auxiliary supply healthy | Green |
| Essential supply healthy | Green |
| Spare x 2 | Amber |
| Spare x 2 | Red |
| Spare x 2 | Green |
| Numerical lift position (dot matrix) | Red (7 segment/dot matrix) |
| Position Indicators x 6 | Amber |

3.13.6.6 The lift car attendant controls shall be housed behind a hinged and locked panel.

3.13.6.7 The lift car attendant panel shall incorporate the following indicators, selector switches and push buttons (typical layout as Figure 4):

a) 'Car' control (switch) - to be set to off when the panel is closed;

b) 'Fast - Slow' speed (switch);

c) Entrance doors - 'Open - Close' (switch);



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d) Exit doors - 'Open - Close' (switch);

e) Safety edge reset (push button) - following the designated number of failures of the door closing sequence the lift shall shut down until the fault has been rectified and door safety edge is reset;

f) Emergency Stop (captive push button);

g) Run Up (push button);

h) Run Down (push button);

i) Car fan - 'On - Off' (switch);

j) Display indicating lift car position in lift well (*optional – refer to site specific information);

k) 'Lift Car Aligned' indicator providing a visual indication when lift car is in alignment with adjacent lift car during cross transfer operations (*optional – refer to site specific information);

l) 'Lift Car Aligned' buzzer providing an audible alert when lift car is in alignment with adjacent lift car during cross transfer operations (*optional– refer to site specific information).

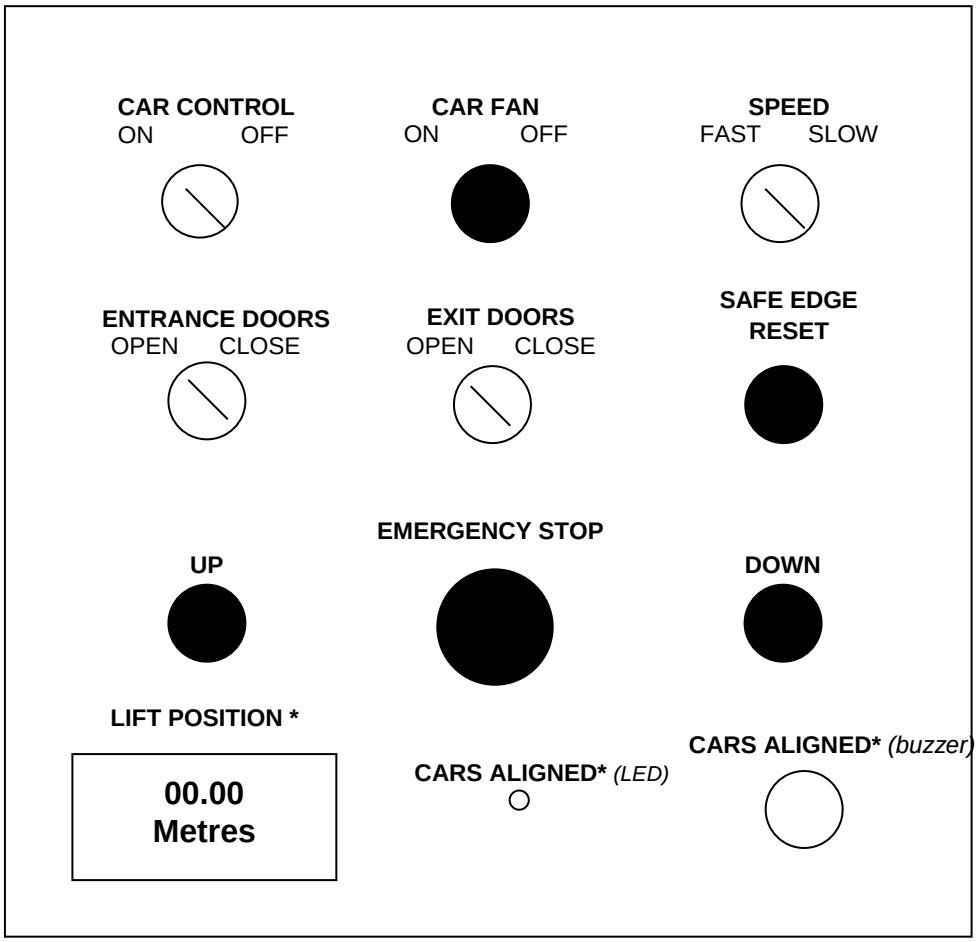


**Figure 4 – Typical Lift Car Attendant Panel**

3.13.6.8 A maintenance communication system shall be fitted. A typical layout, showing a two car communication panel arrangement, is shown in Figure 5. Where there are



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more than two lift cars the panel arrangement shall be covered by a site specific specification. The following indicators, selector switches, push buttons and indicators shall be fitted:

a) 'Talk Override' (push button);

b) 'Cancel' communication (push button);

c) 'Power' available indicator (Green);

d) 'In Use' indicator (Red):

Separate push buttons/keypads/handsets shall be fitted in the following locations to enable communication between these locations:

a) Motor room;

b) Upper landing;

c) Lower landing;

d) Top of car;

e) Top of car of adjacent lift(s);

f) Lift car of adjacent lift(s);

g) SOR;

h) Lift pit;

i) Lift pit of adjacent lift(s);

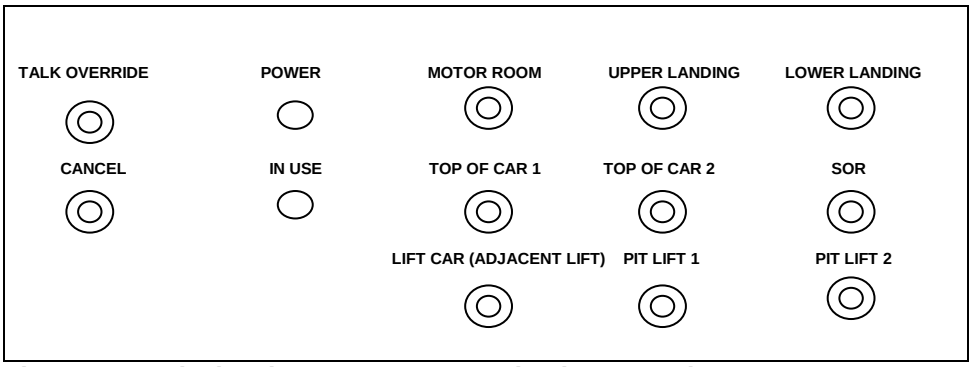


**Figure 5 - Typical Maintenance Communications Panel**.

3.13.6.9 The landing attendant controls shall be housed behind a hinged and locked panel door.

3.13.6.10 The upper landing control attendant panel shall provide the following indicators, selector switches and push buttons (typical layout as Figure 6);

a) 'Automatic control mode' (indicator);

b) 'Semi-automatic' control mode (indicator);

c) 'Manual' control mode (indicator);

d) 'Car fan' operational (indicator);

e) 'Lift stopped in lift well' (indicator);



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f) 'Passenger alarm operated' (indicator);

g) Lift doors obstructed (indicator);

h) Lift exit doors cut out (indicator);

i) Lift operational mode control - Automatic; semi automatic; manual (switch);

j) Emergency alarm reset (captive push button);

k) Entrance doors - 'Open - Close' (switch);

l) Entrance doors - 'Door Hold' (switch);

m) Exit doors - 'Open - Close' (switch);

n) Exit doors - 'Cut out - Normal' (switch);

o) Lamp test (push button);

p) Safety edge reset (push button) - following the designated number of failures of the door closing sequence the lift shall shut down until the fault has been rectified and door safety edge is reset;

q) Car fan - 'On - Off' (switch);

r) Emergency Stop (captive push button);

s) 'Run Up' (push button);

t) 'Run Down' (push button);

u) 'Fast - Slow' (switch).



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