Design Guidance
For
Vertical Transport Services
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# Design Guidance for Vertical Transportation Services

**Revision 3**

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D.1 PASSENGER/GOODS LIFTS

D.1.1 General

This design brief covers the requirements for any new lift installation installed at University College London. This will include the supply, delivery, erection, fitting, testing and commissioning and consultants witness testing of all equipment and associated materials and plant.

The aim of this design brief is to ensure that all equipment is generic in design and is not special to any lift contractor. It should be ensured that all spares will be supplied by an independent third party supply chain.

Passenger lifts should be designed and installed to be readily maintainable by competent independent lift engineering companies.

Motor drive systems should be variable frequency. Above 0.6m/s they should have closed loop feedback.

Control systems should be fully collective. In some cases such as residences this will need to be reviewed and will be dependent on the building design.

Car entrance and landing doors should be two panels centre parting.

Minimum lift size should be 1100 wide, 1400 deep, and 2200 high. Car should have two recessed luminaries with emergency light converter. Car finishes should be robust and suitable for the environment the lift has been installed into.

The minimum entrance size should be 900 wide and 2000 high. The entrance size may increase dependant on the lift use requirements.

A Fire Alarm recall facility is required. When activated the lift should return to the designated floor, where it will allow passengers out and then the lift will shut down. The car door open button and main floor landing call button should remain operative.

Once the lift installation has been fully completed and prior to handover to UCL the lift installer should carry out emergency release training to UCL staff. A certificate should be issued to each individual person confirming training has been completed satisfactorily.

During planning of the lift facility for a building a traffic analysis and disabled access assessment should be carried to establish the number of lifts required together with the performance requirements of the lift. This will establish the lift speed and size and duty requirements.

The following list of components and suppliers gives the preferred specialists to meet the requirement to be readily maintainable by, and for spares to be readily available to, competent independent lift engineering companies.

Hoisting Machines
Sassi.
Ziehl-Abegg
Loher
Motors
Loher
Sassi
Ziehl-Abegg

Pulleys & Divertors (Cast Iron Only)
Hollister Whitney
Sassi
Monitari

Door Operators and Door Operating Equipment
GAL MOVF
Selcom VF *(Light Duty Installations)*
Sematic *(Light Duty Installations)*

Control Systems
Liftstore
International Lift Equipment (MRL’s only)

Shaft Detection Systems
Tape Head same manufacture as controller.
Liftstore

Limit Switches
Kronemberge FES.

Push Buttons
Liftstore

Indicators
Red Dotmatrix 50mm Character on the Car and 30mm on the landing.
Lift Store
Stentorgate

Communication Equipment
Windcrest

Door Detectors
Memco

Pump Units For Hydraulic Lifts
Bucher with LRV electronic valve.

Rams for Hydraulic Lifts
Bucher

Emergency Communication Systems for evacuation lifts and fire fighting lifts
Windcrest
**D.1.2 Drive Unit**

**Variable Frequency Motor**
The motor should be induction AC type incorporating forced ventilation.

The control of the motor should be achieved, through power transistors, by finite adjustment to the frequency and voltage of an AC power supply through a Pulse Width Modulator incorporating four-quadrant regeneration.

The inverter drive should meet the harmonic limits laid down in the current Electricity Council Recommendation and must fulfil all radio interference requirements.

The motor and its control should be compatible to the power supply to the machine room and is to incorporate a sound filter to dampen the Pulse Width Modulator enabling the Lift to run at all loads/speed without appreciable noise or hum.

The motor control should be by means of either an Open loop up to a contract speed of 0.63 m/s or a Closed Loop System incorporating a speed regulator that must be fully adjustable to give optimum performance throughout the intended travel of the Lift.

The regulator will respond to feedback signals derived from the motor speed, motor voltage, distance to travel and load within the Lift car.

The system is to have an accurately controlled method of controlling rate of change in acceleration. The acceleration should initially be set at 0.8 m/s² and it should be adjustable between 0.8 m/s² and 1.2 m/s².

The motor control should incorporate direct floor approach and stopping, with the machine brake being applied only after the car is stationary.

The system should maintain its speed between -2% and +2% of its designed operating speed.

Protection to the motor windings should be in the form of thermistors with additional protection provided by the inverter should any of the following occur:

1. Over-current in the drive circuit
2. Over-voltage of the intermediate circuit
3. Under-voltage of the intermediate circuit
4. Network voltage asymmetry not correct
5. Temperature rise of the semi-conductor cooling plates
6. Regulator electronic voltages incorrect
7. Operation of the electronic braking network incorrect
8. The speed of regulator becomes saturated

The motor should bear the actual manufacturers name and data plate. All motor terminals should be readily accessible and of screw fixed or bolted design located within a terminal box.

Lifting eyes are to be provided to the motor casing.

The motor should be rated for a Lift duty of 180 starts per hour.

Motor bearings should be of the roller type.
In the event the driving machine requires site assembly it must be carried out by the manufacturer or approved agent.

The levelling accuracy should have a tolerance of +/- 3mm.

The tacho-generator or other means of speed reference should be so sited that easy access is provided and the items are not subject to accidental damage.

In the event of loss of tacho-generator feedback under normal conditions and on car top control the Lift will immediately shut down and the brake will be applied. The Lift will no longer attempt to respond to calls until tacho-feedback has been reinstated.

Where the handwinding wheel is separate from the driving machine, tacho-generators or other feedback encoders should not be mounted at the motor end of the high-speed shaft necessitating their removal for handwinding purposes.

Brake
A brake switch should be installed to the brake. This switch should prove that the brake has lifted prior to the main drive unit motor being energised. If the brake does not lift the main drive unit motor should not move the lift.

D.1.3 Control System General Requirements

Control Cabinet
The control panel should be of the steel enclosed cabinet type with louvred ventilation, internally and externally finished in powder coating or plastic skin plate. The identity of all the contactors, relays, solenoids, and other equipment in the controller should be clearly indicated by means of permanent, heat resistant non-fade, plastic labels. Dymo or similar will not be acceptable. A key to abbreviations and symbols used will be affixed to the inside of the controller or controller door.

Access should be from the front only unless complexity of equipment necessitates rear entry also. The doors should be full height and width of the panel and should be of double hinged mechanically latched type.

The enclosure should provide protection to IP23 Standard.

Two external lifting eyes are to be fitted to the top of the controller cabinet to allow lifting without distortion.

All resistors are to be mounted externally to the main control equipment in a housing mounted to suit the site conditions with suitable ventilation.

Doors should not be of the lift-off type and should be separately earthed.

A notice should be permanently affixed to the controller door detailing the final torque settings entered on to the main drive inverter.

Where location dictates, control panel(s) should be sound isolated.
Control Components

The system should be microprocessor controlled.

The microprocessor section of the control panel should be separately mounted, such that the inadvertent connections of high voltages or physical damage from falling objects are prevented.

All input/output lines must be capable of withstanding short circuits and the application of 500v for short duration i.e. megger tests, without permanent damage.

An electronic, non-resettable, permanently displayed digital trip counter should be provided to record the number of journeys for the lift.

Each control panel is to be provided with a visual display showing the operating status of the Lift and incorporating LED indicators which show each of the following sequences:

- Power on
- Power to each processor board
- Lift in service
- Lift direction
- Calls registered for car and landing
- Door open/door close
- Safety edge operation
- Lift overload
- Lift on car preference
- Lift on door hold

The control cabinet should be provided with an external changeover switch to convert from NORMAL to INSPECTION operation, together with UP and DOWN buttons, and an OVER-RIDE button.

When switched to INSPECTION all safety circuits will be in use. On operating the continual pressure OVER-RIDE button, the safety gear switch on the car, buffer switches, over travel limits, governor switch and governor tension weight switch will be over-ridden. This OVER-RIDE button is to assist in the release of the safety gear or to move the Lift from the overtravel limits.

This INSPECTION/NORMAL switch will NOT OVER-RIDE the mechanics control station or any other part of the safety circuit.

For each individual Lift a MAINTENANCE/NORMAL SERVICE switch is to be provided on the control panel which will prevent the Lift answering its landing calls.

A door isolation switch will be provided which will prevent operation of the car doors.

A key operated switch should be provided to operate the overspeed governor (remote overspeed governor).

Where the preferred method for interrogating the lift control system when fault finding or altering the lift operating parameters is by the use of a portable or hand held device, then any such device should be permanently located within the controller cabinet and should become the employers property. It should be site specific and any unique identification number should be recorded on the device.
Special cooling and/or filtration equipment is to be incorporated to reduce the spread of dust through the controller and to maintain satisfactory ambient temperatures and prevent local hot-spots.

The following items are required:

- Phase failure/phase reversal protection
- Double journey timers
- Automatic homing [switched]
- Door nudging with audible signal
- All control equipment to be protected by miniature circuit breakers not fuses
- Door open/door close timers fully adjustable for dwell and operating speeds
- Anti-interference features for all car controls
- Earth terminals and full earth bonding
- Supplies to printed circuit boards should be protected by miniature circuit breakers
- Microprocessor based car position reference system
- Thermal overloads for main motor protection or alternatively protection within the controller software
- Car and landing door lock short-circuit protection

A device should be fitted that determines the lift machine and machine room temperature.

An over temperature will cause the lift to shut down at the next floor in a controlled manner.

Suitable outputs should be provided to provide speech generation. The processor should provide advanced signals to highlight such items as “Doors Closing” etc.

In the event of loss of tacho-generator feedback under normal conditions and on inspection control the Lift will immediately shut down and the brake will be applied. The Lift will no longer attempt to respond to calls until tacho-feedback has been reinstated.

*The door open button within the lift car should illuminate during the door closing cycle.*

**Equipment Reliability**

The control circuit where fed from an alternating current source should be greater than 100V and not greater than 240V.

On relay components the "VOLTAGE RELIABILITY" should be at least 80%, ie the control circuits must operate at 25% below design voltage.

The "COMPONENT RELIABILITY" should not be less than three million, ie the expected number of operations between two failures.

All timers should be of solid state design.

All car and landing control indicators will illuminate until their call is answered by the lift.

The lift should not interfere with the reception of radio and television programmes or the supply of computer-related equipment. The lift equipment should be fitted with the necessary interference suppression and filtration components during manufacture.

Car position reference systems should be actuated by one of the following:
Shaft encoders
Transducers

Any other proposed system should be with the approval of UCL.

**Car Preference**

Car preference operation will be provided. With the key in the ON position the Lift will be removed from NORMAL operation and will respond only to car calls and will ignore all other automatic operations. The key will be captivated when in the "ON" position.

When under car preference the Lift will park with both car and landing doors open.

The Lift will respond to continuous pressure on the selected car floor push only and only the first call will be answered. For any subsequent call it will be necessary to press the car button to achieve further door closing.

**Wiring Diagrams**

Contract specific plastic encapsulated wiring diagrams are to be provided within the machine room in addition to those provide within the O & M Manuals.

**D.1.4 Fully Collective Control**

Following registration of a landing call, the Lift will respond to that call only when it is travelling in the direction of the call.

It will store this call in memory if travelling in the opposite direction and answer it sequentially when travelling in the direction of the call.

If the Lift responds to a floor where both UP and DOWN calls are registered it will respond only to the call in the direction in which it is committed to travel.

If no car call is then placed and there are no further hall calls in that committed direction, the doors will re-open and its committed direction will reverse and it will respond to the other call.

Car calls will be answered sequentially as their destinations are reached irrespective of the order in which they were registered. As each car call is answered it will be cancelled.

Each controller is to incorporate automatic logging which will have an indicator display board to show a record of events covering the following Lift functions:

- Primary safety circuit failure
- Primary loop failure
- Car door switch fault
- Landing door lock fault
- Failure of doors to open
- Lift overloaded condition
- Landing and car calls cancelled
- Shutdown due to successive failed attempts to start
- Limited force door closing having been operated
- Memory failure
- Programme error
- Stuck landing/car call button
- Service to engineers visit
- Two spare signal/record facilities
**D.1.5 Handwinding System**

An electronic handwinding system should be provided which should incorporate both audible and LED illumination. The equipment should be wall-mounted adjacent to its corresponding hoisting machine and should be easily viewed from the normal handwinding position.

A control switch mounted on the handwinding unit should initiate the operation of the handwinding system. When switched "ON" and under handwinding operation, it will indicate both visually and audibly as the Lift becomes level with a landing floor level. The unit should display the position of the lift car relative to the nearest landing.

Supply to the handwinding system should be from an independent low-voltage source incorporating an emergency supply which automatically becomes available in the event of mains power failure.

Irrespective of the position of the mains supply switch, the operation of the switch on the handwinding buzzer system should render all other controller components inoperative and an illuminating indicator should be sited adjacent to the handwinding switch to notify that the buzzer system is switched on.

**D.1.6 Mechanics Control Station**

The car top control station panel should be mounted vertically within 1000mm of the landing entrance and easily assessable from the landing. (In the through car condition it should be assessable from the side with the majority of landing entrances)

The mechanics control station on the car top should contain maintenance and testing switches, direction push buttons, a 13amp switch socket outlet with RCD protection, and a proprietary brand of 16 watt twin fluorescent bulkhead light fitting with polycarbonate or similar shatter resistant diffuser.

The light fitting should also be provided with an emergency power source from an independent supply of 3 hours duration. This unit should be sited on the car top.

It is permissible to feed the emergency car lighting from this source provided that a 3-hour duration is maintained in each case.

All car top lighting and power points should come from a common source but should be individually fused.

All switches and push buttons should be clearly marked with their functions.

Operation of these switches and push buttons should be as follows:

**Roof Light Switch**
Control of Roof Light

**Shaft Light Switch**
In addition to the shaft lighting switch circuits in the motor room and lift shaft, an intermediate switch should be incorporated in the mechanics control faceplate, which will provide the shaft lighting system with a third point of operation.
**Emergency Stop/Run Switch**
The emergency stop switch should be a push/pull type (push to stop pull to run). The button should be at least 50mm in diameter and coloured red. The stop button should be proud of its shroud only in the “run” position.
The button should show visual indication of both operational positions and incorporate the word STOP placed on or near it.
The button should be position at the extreme top right position on the car top control panel.

**Inspection/Normal Operation Switch**
NORMAL - Normal operation
INSPECTION - Car and landing push buttons isolated: push buttons on mechanics control panel become operative, and the Inspection/Normal Operation switch becomes illuminated.
This words NORMAL and INSPECTION should be marked on or near the switch.
The switch is to be protected against involuntary operation and a bi-stable design. The switch should be shrouded.
The switch should be positioned in the extreme top left on the car top control panel.

**Door Control Switch**
The words DOOR OPEN AND CLOSED placed on or near the switch and should be position to the extreme bottom left on the car top control panel.

**Up, Run and Down direction buttons**
The up direction button, the run button and the down direction button should be arranged centrally and vertically in line with the up direction button positioned at the top of the car top control panel.

These should operate car in the UP or DOWN direction (only while the respective direction button and the intermediate run button are depressed). These should operate under constant pressure.

**Engineers Alarm Button**
An enshrouded continuously illuminated alarm push in yellow and engraved alarm over a red back ground and located below the stop button.

A mechanically operated UP inspection limit is to be incorporated in the control circuit so that when the INSPECTION switch is in the INSPECTION position and the UP button is depressed, the car should stop at the top of the lift shaft low enough to ensure that a 2 metre tall person standing on the top of the car should be in no danger of coming into accidental contact with any overhead equipment or structure. Immediately after the UP test limit has been set and checked for final position the limit supporting arm, in addition to the conventional clip fixings, is to be twice pinned through the guide flange. In addition, a notice is to be fitted with the wording WARNING - DO NOT MOVE UP INSPECTION SAFETY LIMIT.

All controls should be fully shrouded and sensibly positioned, accessible and no further than 1 metre from the entrance.

**D.1.7 Defects Liability Maintenance**
Routine maintenance for each of twelve calendar months from the Main Contract Practical Completion date, i.e. during the Defects Liability period, should be included in the project.

This should include the cleaning, oiling, greasing and adjustment of all parts of the lift system, to maintain as far as possible the accuracy of the operation as stated in this specification.
The lift machine room floor, walls, pit and well should be kept free of oil, grease and rubbish and should be left in a tidy manner after maintenance.

The Contractor should renew all lamps in pushes and indicators that are found defective at the time of the maintenance visit.

Throughout the initial twelve-month maintenance period the Lift Sub-Contractor should allow for providing suitably qualified personnel to answer any breakdown calls at no additional charge.

The maintenance should include for callouts 24 Hours a day, 365 days per year Monday to Sunday, including Bank Holidays. Response time from receipt of advice of a breakdown to arrival on site to be two hours or less.

A log card should be provided by the Lift Sub-Contractor to record maintenance visits, inspections, breakdowns, repairs, etc. This log card should normally remain in the lift machine room and should be the property of UCL

**Maintenance and Guarantee Schedule**
Within a week of completion of the lift system, the Lift Contractor should prepare a simple schedule, defining the guarantee and maintenance arrangements for the initial twelve-month maintenance period, suitable for presentation to the building tenant.

**D.1.8 Machine Room Less Lifts**

In addition to the aforementioned requirements the following specification for machine-room-less lifts should be provided. Generic lift equipment from the approved suppliers list should be used.

**Guides**
Guides should be positioned in a conventional layout with one guide each side of the lift car and separate counterweight guides. All guide fixings should be independent of each other.

**Type of Roping**
The preferred roping layout for the lift should be 2:1.

**Drive Unit**
The drive unit should be a gearless unit.

The drive unit should be mounted within the lift well suitably mounted so that it can be easily maintained. If mounted within the lift pit the drive unit should be mounted at least one metre above the pit floor.

Where Fire Fighting lifts are specified the drive unit should be positioned at the top of the lift shaft.

**Controller**
The controller should be as detailed in D.1.1. It should be capable of being positioned anywhere within 5 metres of the lift well. The controllers should be positioned within a suitably sized secure room where the equipment can be worked on safely. There should be at least 1 metre x 1 metre of free working space in front of the controller.

Lift electrical services and the lift mains supply should be provided in the controller room.
A 200mm square straight duct should be provided from the controller room to the lift well. A draw wire should be left in the duct if it is over 1 metre long.

**Handwinding**
An electronic handwinding system should be provided which should incorporate both audible and L.E.D visual indication of when the lift is at floor level.

A control switch mounted on the control cabinet should initiate the operation of the handwinding system. When switched "ON" and under handwinding operation, it will indicate both visually and audibly as the Lift becomes level with a landing floor level.

Supply to the handwinding system should be from an independent low-voltage source incorporating an emergency supply which automatically becomes available in the event of mains power failure.

Irrespective of the position of the mains supply switch, the operation of the switch on the handwinding buzzer system should render all other controller components inoperative and an illuminating indicator should be sited adjacent to the handwinding switch to notify that the buzzer system is switched on.

The lift should be driven to floor via buttons in the controller cabinet. The system should work for at least two independent floor travels in the event of power failure.

**Counterweight Frame**
A conventional counterweight frame must be employed on the lift. The counterweight should weigh a value equal to the lift car weight + 50% of the contract load.

**D.1.9 Hydraulic Lifts**
In addition to the aforementioned requirements the following specification for hydraulic lifts should be provided.

**Guides**
Guides should be positioned in a cantilevered arrangement up to a Lift Contract Load of 8 Persons 630 Kg. Above this contract load the car guide rails should be positioned either side of the Lift Car.

**Ram/Cylinder**
Up to a Lift Contract Load of 8 persons 630 Kg a single ram may be employed. Above this contract load at least two rams should be employed.

**Type of Roping or Chain Layout**
The roping/chain layout for the lift should be 2:1 rope/chain suspended.

**Drive Unit**
The drive unit should consist of a steel fabricated tank with rubber isolation between its feet and the floor. The unit should incorporate a submerged motor and screw pump. The control valve should be mounted to the top of the tank and should incorporate closed loop feed back technology. The drive unit should incorporate as a minimum a hand pump, a pressure gauge, a manual lowering facility and high and low pressure switches. A low pressure protection facility will prevent the lift being manually lowered if the working pressure to the ram is reduced to below the minimum allowable working pressure. It should be designed as a minimum to be able to cope with 60 motor starts per hour.
Machine Room

A machine room should be provided. It should incorporate the drive unit, controller, and Lift Electrical services. The machine room should be suitably heated and ventilated to dissipate the heat generated by the lift equipment.

Lift Speed

Hydraulic lifts should not exceed a contract speed of 0.6 m/s.

D.1.10 Evacuation Lifts

Where evacuation lifts are installed the following is required as a minimum.

Controller

The controller should comply fully with the requirements to function as an “Evacuation Lift” and as detailed within BS9999.

In the event of power failure the control system should “remember” what floor the lift is on.

Communication

A communication system should be installed between the machine room, the lift car and each landing. The master communication panel should be installed at the main fire access level and it should be possible from this floor to contact and speak to any other communication panel.

All other communication panels should be able to contact and speak to the master pane.

The communication panel should incorporate a “euro” type key switch, which when activated will instate the communication system and switch on the evacuation control mode of the lift.


A secondary back up power supply for the lift in accordance with BS9999 should be provided.

WHEN INSTALLING AN EVACUATION LIFT IT SHOULD BE TRACTION DRIVEN.

D.1.11 Fire Fighting Lifts

Fire fighting Lifts should be designed in accordance with current standards and Regulations.

All the requirements covered within this design brief should be met apart from the following differences:

When installing Machine Room- Less Lifts, the drive unit should be positioned at the top of the lift shaft and the roping arrangement can be 1:1 if required.

Position Indicators should be of UK third party supply suitable for the temperature range needed to comply with this standard.
**D.1.12 Platform Lifts**

Platform lifts should comply with BS6440.

The maximum vertical travel should be 4 metres.

The minimum size of the platform should be 1100mm wide x 1400mm deep for vertical platform lifts and 900mm x 1200mm for stair platform lifts.

The platform must be directly driven through a mains supply and must not rely on batteries that are charged when the platform is not in use.

Platform Lifts should only be installed where it is not practical to install a conventional passenger lift.

**D.1.13 Stair lifts**

Stair lifts should comply with BS5776.

The Stair Lift must be directly driven through a mains supply and must not rely on batteries that are charged when the platform is not in use.

A stair lift must only be installed as a last resort.

**D.1.14 Energy saving features**

Every lift installed should incorporate the following features to reduce power consumption when the lift has been idle for a pre-determined time:

**Car lighting**

If the lift car remains idle for more than 15 minutes the car lighting should automatically switch off. The lighting should switch back on if any car or landing call is entered or a fire alarm recall signal is received by the controller. If the alarm button is pressed then the car lighting should remain on.

Car lighting should be of low energy light fitting such as L.E.D Down lighters, fluorescent down lighters or fluorescent tubes.

**Inverter Sleep Mode [Variable frequency drive lifts only]**

If the car remains idle for more than 15 minutes the drive system inverter should shut down and go into sleep mode. If a car or landing call is entered or a fire alarm recall signal is received by the controller the inverter should be reinstated to full functional order.

**Regeneration System**

If required and detailed within a particular project all lifts should incorporate a regenerative system on the lift drive that enables unused energy to be returned to the mains supply.

[CLAUSE D.1.14 IS NOT APPLICABLE TO PLATFORM LIFTS OR STAIR LIFTS.]
D.2 STANDARDS & REGULATIONS FOR LIFTS

The installation should as a minimum conform with the following where applicable together with any current amendments or updates:

1) British Standard Specifications series 5655 that are still current.
2) BS EN81 1 & 2 1998 Safety Rules for the construction and installation of lifts.
3) BS EN81-3 2001 Safety Rules for the construction and installation of electric and hydraulic service lifts. (When service lifts are fitted)
5) BS 7671 - IET Wiring Regulations current edition.
6) Low voltage electrical equipment (Safety) Regulations 1989.
7) PM26 Safety at Lift Landings.
14) BS EN81-70: 2003 - Safety Rules for the construction and installation of lifts – Particular applications for passenger and goods passenger – Accessibility to lifts for persons including persons with disability. (To be complied with in full unless Dimensions do not permit)
16) BS EN294: 1992 Incorporating Amendment 1- Safety of Machinery – Safety distances to prevent dander zones being reached by the upper limbs.
17) BS 8300: 2001 - Design of buildings and their approaches to meet the needs of Disabled people – Code of practice.
20) BS7255:2001 – Safe Working on lifts. (All new passenger and goods/passenger lifts should comply)
21) BSEN81-72: 2003 – Safety Rules for the construction and installation of lifts – Particular applications for passenger and goods passenger lifts – Part 72 Fire Fighter Lifts. (Where Fire Fighting Lifts are required)
22) BS588: Part 8: 1999 – Fire precautions in the design, construction and use of buildings – Code of practice for means of escape for disabled people. (Where evacuation lifts are required)
23) BS5776: 1996 – Specification for Stair Lifts