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## 20 ELEVATORS/ESCALATORS

### 20.1 GENERAL

#### 20.1.1 Scope

1 This Part specifies the general requirements for elevators and escalators used only for passengers

2 Related Parts and Sections are as follows:

This Section

Part 1 ..... General Provisions for Electrical Installations

Part 4 ..... Motor Starters

Part 6 ..... Cables and Small wiring

Part 7 ..... Conduits and Conduit Boxes

Part 8 ..... Trunking

Part 9 ..... Cable Trays

Part 10 ..... Wiring Accessories and General Power

Part 11 ..... Light fittings

Part 15 ..... Electric Motors

Part 22 ..... Earthing and Bonding

Part 23 ..... Testing

Section 5 Concrete

Section 16 Structural metal work

Section 17 Metal work

#### 20.1.2 References

1 The following standards and documents of other organisations are referred to in this Part, and shall be complied with:

BS 476 ..... Fire tests on building materials and structures

BS 476-8 ..... Fire Tests on Building Materials and Structures Part 8: Test Methods and Criteria for the Fire Resistance of Elements of Building Construction; (BS 476-20 Fire tests on building materials and structures - Method for determination of the fire resistance of elements of construction (general principles))

BS 5655 (EN 81) ..... Lifts and service lifts

BS 5656 (EN 115) ..... Safety rules for the construction and installation of escalators and moving walks - Examination and test of new moving walks before putting into service. Specification for means of determining compliance with EN 115-1

BS 6977 ..... Insulated flexible cables for lifts and for other flexible connections (EN 50214 : Flat polyvinyl chloride sheathed flexible cables)

BS 7255 ..... Code of practice for safe working in lifts

EN 81 ..... Safety rules for the construction and installation of lifts

EN 115 ..... Safety of escalators and moving walks

ISO 9000 ..... Quality management and assurance standards

Qatar General Electricity & Water Corporation (KAHRAMAA) Regulations for passenger and goods lifts.

### 20.1.3 Submittals

- 1 Manufacturer's product data and samples.
  - (a) submit three 75 x 300 or 300 mm length samples of each required finish, excluding those intended for painting after installation, for the Engineer's approval
  - (b) catalogues shall be provided of signal equipment units to show push buttons, lights, graphics and mounting provisions.
- 2 Shop Drawings:
  - (a) drawings for all main components including the pit, hoistway, and the machine room general arrangements, foundations and installations, sectional elevations of the hoistway, car and entrance details, and signal details
  - (b) component specifications and preventative maintenance charts
  - (c) electrical schematics and one copy of the approved master electric schematic and approved lubrication chart shall be framed with a clear plastic cover and mounted on the machine room wall.
- 3 Motor data including:
  - (a) manufacturer
  - (b) minimum guaranteed efficiency
  - (c) power factor under all load conditions
  - (d) locked rotor current
  - (e) motor speed
  - (f) mounting details
- 4 Certificates of Compliance.
- 5 Certified Test Reports.
- 6 Operation and Maintenance Manuals.
- 7 Training Programme.

### 20.1.4 Quality Assurance

- 1 Products shall be from an experienced manufacturer who can demonstrate equal or larger capacity installations using similar equipment, installed and successfully operating for at least 5 years, with names and phone numbers of contacts at installations to verify performance. The manufacturer shall comply with ISO 9000 or equivalent.

### 20.1.5 Warranty

- 1 All components shall be free of defects in materials or workmanship.

- 2 The Contractor shall remain responsible for routine maintenance for 400 days from the date of acceptance of the installation by the Engineer. During this period the Contractor shall promptly replace and/or repair any fault with supply of all spare parts without any cost to the Client.
- 3 Motors shall have 5 year warranties.
- 4 Individual warranties by component manufacturers in lieu of single source responsibility by the elevator manufacturer shall not be acceptable.
- 5 Items which fail during the warranty period, excluding expendable items, shall be replaced without cost to the Employer.
- 6 Manufacturer's guarantee and warranty certificates shall be provided prior to equipment start-up.

## 20.2 PRODUCTS

### 20.2.1 Description

- 1 Equipment shall be provided by a single manufacturer who shall design, fabricate, and test all components of the elevators as well as supervise, install and commission the units.
- 2 Elevators shall be complete in all respects and shall include but not necessarily be limited to the following components:
  - (a) machine room equipment
  - (b) hoistway equipment
  - (c) elevator entrance ways
  - (d) door opening and closing devices
  - (e) elevator cars
  - (f) car control stations
  - (g) landing control stations
  - (h) appurtenances
- 3 The Contractor shall make all modifications, adjustment, and improvements to the elevator system necessary to meet the performance requirements specified. The elevator shall provide safe, smooth operation, complying with all building and elevator codes required by the authorities.

### 20.2.2 Electric Traction Passenger Lifts

- 1 Machine Room Equipment
  - (a) general: shall be provided with manufacturer's standard pre-engineered elevator system in accordance with the specification. Manufacturer's may provide custom-manufactured elevator systems that meet specified requirements. Where components are not specified, components shall be provided as for manufacturer's standard pre-engineered elevator systems, or as necessary to produce a safe and fully operational elevator system

- (b) motor control: solid-state power converter/inverter with line filters or chokes to prevent peaks or spikes from feeding back into building power systems
- (c) hoisting machine: variable voltage variable frequency (VVVF) thyristor, traction-type, geared hoisting machine with squirrel cage motors designed specifically for elevators. Unless specified otherwise, variable voltage variable frequency AC drives shall be used. Refer to part 5 of this section for general specification
- (d) selector: microprocessor solid-state, integrated controller with durable cabinet, lockable doors and adequate ventilation to dissipate heat, wired to identified terminal block studs, with identifying symbols or letters identical to those on wiring diagrams, permanently marked adjacent to each component on the controller
- (e) The microprocessor based controller shall include the facility to interface with Remote Elevator Monitoring (REM) and Elevator Management Service (EMS) as a part of Building Management System through the data network system.

## 2 Hoistway Equipment

- (a) guide rails and brackets: T-section cold drawn (not fabricated) guide rails and brackets suitable for travel, car weight and support locations at structural floors, with backing as EN 81
- (b) buffers: energy dissipation type with blocking and supports
- (c) normal terminal stopping devices: in accordance with EN 81
- (d) electricity wiring: copper conductors with 600 volt insulation throughout with individual wires coded, with 10 % spare capacity. All connections shall be identified on studs or terminal blocks, rated 75 °C minimum. Splices or similar connections in wiring are not permitted except at terminal blocks, control cabinets or junction boxes. Flexible heavy-duty service cord to BS 6977 may be used between fixed car wiring and car door switches
- (e) conduit and duct shall be PVC jacketed or galvanised steel 20 mm minimum diameter. Flexible conduit shall not exceed 450 mm in length and shall be as in Part 7
- (f) entrance equipment:
  - (i) door hangers: shall use two-point suspension with upthrust rollers
  - (ii) door tracks: replaceable bar or formed cold drawn steel with smooth hanger contact surface
  - (iii) interlocks: operable without retiring cam, with interlocks that are visible and conspicuous when doors are open, painted matt black
  - (iv) closures: spring or aspirator type
  - (v) pit stop switches to EN 81

## 3 Hoistway entrances shall be fire rated in accordance with BS 476 Part 8, with frames as follows:

- (a) floor entrances, jambs and heads shall be fabricated steel with a 304 stainless steel cladding
- (b) frames shall be hollow metal, bolted to form a one-piece unit

- (c) jamb and head depth and profiles shall be as indicated on the Project Drawings, fabricated from mild steel not less than 1.2 mm thick, steel pan construction, with side-opening doors, rubber bumpers to cushion closing impact, and finished faces as specified. Each door panel shall include gibs. The trailing door gib shall be in the sill groove throughout the length of travel
- (d) sills: extruded hard aluminium
- (e) fascia toe guards, dust and fascia width hanger covers: 1.5 mm galvanised steel with door open bumpers on entrances equipped with vertical struts.

#### 4 Door Opening and Control Devices

- (a) safety edge devices shall be full height, infra red, non contact, door edge safety devices to detect obstruction in the doorway and reverse
- (b) nudging action : in the event that the safety edge is operated for a pre-determined time interval (15-20 seconds) after automatic door closing has been initiated, a buzzer shall sound, and the doors shall close with a maximum of 0.35 Kg-meters kinetic energy
- (c) Microprocessor based Variable Voltage Variable Frequency (VVVF) drive operational control shall be extended for door control as integral with the car movement.

#### 5 Car Equipment

- (a) car frames: welded or bolted steel channel construction
- (b) platforms: isolated type, steel, construction fire proofed on the underside
- (c) guide shoes: nylon sliding type
- (d) car sills: hard aluminium type sill
- (e) toe guards: in accordance with EN 81
- (f) car door hangers and tracks: as specifications on hoistway entrance hangers and tracks
- (g) headers: minimum 1.2 mm thick steel shaped to provide stiffening flanges
- (h) car door electrical contacts shall operate in conjunction with the car doors so that elevators cannot operate unless doors are closed, or within tolerances allowed by EN 81
- (i) door operators : shall be microprocessor based a.c./d.c. capable of opening doors at no less than 60 m/min and accomplishing reversal in no more than 65 mm of door movement
- (j) car finishes front return, side & rear wall, door, handrail, floor, ceiling panels, and light fixtures shall be finished as detailed in the Specifications
- (k) removable panels shall be provided as specified for side and rear wall panels at elevators with facings glued to plywood, full-height between top of base and ceiling of car. Panel joints shall be flush with panel surfaces in accordance with manufacturer's standard layouts. Elevator car suspended ceiling panels shall have suitable strong backing in the ceiling frame to prevent sagging, without exposed screws or bolts.

6 Car Control Stations

- (a) car control stations shall have durable vandal resistant face plates and micro-Touch Buttons  
located no higher than 1620 mm above the car floor (875 mm for alarm buttons)  
floor buttons, alarm buttons, door open buttons shall be identified by engraved or painted letters or symbols in accordance with EN 81
- (b) car floor buttons shall have 16 mm numbers on the face of buttons corresponding to the floors served for registration of the car stops. Call registration lights, located within or behind the buttons, shall illuminate the floor number corresponding to the call registered
- (c) alarm buttons at the bottom of stations shall be provided to ring bells located on the car doors. Open and close buttons shall be provided to stop motion of doors and cause them to return automatically to their fully open or closed position respectively. Buttons shall be effective while cars are at landings and until cars start into motion, regardless of any special operational features
- (d) car top control stations shall be in accordance with EN 81, mounted on car tops, accessible from landings
- (e) work lights and plug receptacles shall be provided top of elevator car with on-off switches and bulb guards
- (f) car position indicators shall be provided in elevator car operating panels with digital indicators representing floors served and direction of car travel
  - (i) when cars leave or pass a floor, the numeral representing the floor shall be displayed, thereby indicating the position of the car in the hoistway at all times
  - (ii) proper direction arrows shall be continuously illuminated to indicate the direction of travel

7 Landing Control Stations

- (a) micro-touch buttons stations shall be provided adjacent to door jambs of each entrance with the following features:
  - (i) flush-mounted vandal resistant durable faceplates and buttons for each direction of travel, illuminated to indicate call registration
  - (ii) A fire recall station shall be provided at the main access level in addition to the call button
- (b) signal fixtures shall be provided at each entrance to indicate the intended direction of travel of the elevator to waiting passengers, with the following features:
  - (i) display numerals for car level, arrow and a gong mounted in the box fastened in the wall. Up or down arrows shall be illuminated and a gong sounded (once for up direction travel and twice for down direction travel) prior to the car's arrival at the floor. The light shall remain illuminated until shortly before the elevator doors start to close
  - (ii) hall lanterns shall be provided, of impact resistant plastic lenses and with satin stainless steel finish.

8 Performance. The elevator shall:

- (a) speed to within plus or minus 10 % of the specified speed under any loading condition

- (b) safely lower, stop, and hold up to 125 % of the rated load
  - (c) stop the elevator within plus or minus 10 mm of the design landing elevation under any loading condition.
- 9 Unless otherwise specified in the Project Documentation, operation shall be "Selective Down Collective Automatic Operation" as defined in EN 81. Doors shall open automatically when a car arrives at the main floor to permit egress of passengers, whether or not the main floor call has been registered in the car. When the car has arrived at the landing it shall have its doors open until the car is dispatched, or on expiration of a timed loading interval with no demand.
- 10 Emergency Features shall comply with EN 81 for Emergency Firemen's Service, and the following:
- (a) emergency operation: the elevator shall be equipped with a control system to operate
  - (b) and recall the car in fire or other emergency condition.
  - (c) terminals shall be provided on the controller for connection of signals from the sensors. Operation shall be similar on all elevators and visual/audible signals shall operate until return is complete or automatic operation restored
  - (d) standby lighting and alarm: during power failure, car lighting and car alarm shall be supplied with standby power via a car-mounted battery unit, including solid state charger, with testing means, installed in common metal container. Batteries shall be rechargeable with 10 year minimum life expectancy. Car mounted units shall operate alarm bell and light only
  - (e) emergency landing device: in the event of normal power failure, an emergency evacuation power supply shall drive the lift to a nearby floor. This controller shall be operated by sealed batteries which will be kept automatically charged for use by the unit:
    - (i) standby power shall be provided by 24/12 V battery units mounted in the machine room, including solid-state chargers with testing means installed in common metal containers
    - (ii) upon arrival at floor landings, elevator doors shall open automatically and remain open until the regular door time has expired. Elevators shall then become inactivated
    - (iii) upon restoration of normal power supply to the building, elevators shall automatically resume normal operation.
- 11 Protection of electrical work: boxes and enclosures shall be provided with gasket covers. Doors and motors shall be totally enclosed.

### 20.2.3 Electro-Hydraulic Passenger Lift

- 1 General: materials and equipment associated with electro-hydraulic passenger lifts shall comply generally with the requirements stipulated for electric traction lifts above, with specific requirements stipulated below.
- 2 Lift Machines
- (a) hydraulic pumps shall of the high efficiency type of either vane or screw type design. Means shall be provided where pumps may be coupled to the driving motors without the effect of eccentric loading on the pump bearings



- (b) if pumps/motors of monoblock construction are offered, access shall be provided for inspection/replacement of coupling systems, thrust bearings, etc.
  - (c) pump/motor assemblies shall be mounted on rigid mild steel bedplates and suitably insulated, to absorb vibration of pump/motor assemblies
  - (d) direction of rotation of pumps shall be clearly indicated on pumps where they can be readily seen
  - (e) pumps shall be clearly marked to indicate inlets and outlets, related to a specified direction of rotation if external to power systems. Inlet sides to pumps shall be fitted with renewable fine mesh filters
  - (f) data plates with manufacturer's name, part model and serial number shall be permanently displayed on or adjacent to pump/motor assemblies.
- 3 Drive Motor. Motors shall be suitable for operation for 415 V 50 Hz 3 Phase
- (a) motor drive: solid-state power converter/inverter with line filters or chokes to prevent peaks or spikes from feeding back into building power systems
  - (b) pump drive: variable voltage variable frequency (VVVF) thyristor controlled, geared machine with squirrel cage motors designed specifically for elevators. Unless specified otherwise, variable voltage variable frequency a.c. drives shall be used. Refer to part 5 of this section for general specification
  - (c) control: microprocessor solid-state, integrated controller with durable cabinet, lockable doors and adequate ventilation to dissipate heat, wired to identified terminal block studs, with identifying symbols or letters identical to those on wiring diagrams, permanently marked adjacent to each component on the controller
  - (d) The microprocessor based controller shall include the facility to interface with Remote Elevator Monitoring (REM) and Elevator Management Service (EMS) as a part of Building Management System through the data network system
  - (e) shall run with the minimum of noise and vibration, capable of a continuous duty cycle of at least 60 motor starts per hour. Contractors shall submit full test certificates in triplicate for all tests. Refer to part 5 of this section for motor starter general specification and part 15 for electric motor general specification.
- 4 Anti-creep devices shall be provided which shall automatically limit the car movement within 75 mm of the landing, from any point within the interlock zone, irrespective of handling doors. Devices shall only operate in landing level interlocked zones, and shall operate cars in the 'UP' direction only. Operation may depend on the availability of the electrical power supply provided that:
- (a) main switches are kept in closed positions at all times except during maintenance, repairs and inspections
  - (b) electrical protective devices shall not cause electrical power to be removed from the anti-creep mechanism, except when such a device operates in consequence of motor failure.
- 5 Mufflers: High pressure systems shall be suitably muffled. Flexible pipes shall be included to prevent the hydraulic pulse attenuation from being transmitted to cars.

6 Cylinders and rams

- (a) Cars shall be directly supported by one side-acting steel ram turned true parallel, fine polished, and of sufficient diameter and strength to raise the Contract load at Contract speed
- (b) ram attachments to car platforms shall be of sufficient strength to support ram weight with a safety factor of 4
- (c) rams shall not be subjected to bending stresses or eccentric loading. Eccentric loading shall be taken by car frames and guide shoes
- (d) Rams shall be provided with solid metal stops at limits of stroke, or other means to prevent rams travelling beyond limits of cylinders
- (e) multi stage rams, shall only be used if approved by the Engineer
- (f) cylinder interconnections shall incorporate flow restriction valves to limit ram descent speed, should supply pressure lines fracture
- (g) suitable trays shall be fitted to ram heads to collect leakage from ram seals.

7 Pipes and Pipe Supports

- (a) all necessary pipework and supports shall be provided between cylinder and valve block assemblies. Pipes shall be supported such that undue stresses are eliminated at all joints, bends and fittings, particularly at sections of systems subject to vibration
- (b) cross-sectional areas of pipework shall be sufficient to prevent cavitation and starvation and not to induce turbulence or rise in temperature of oil.

8 Oil Storage Tank

- (a) oil storage tanks shall be constructed of heavy gauge sheet steel provided with tight fitting covers, oil level gauges and protective vents. Suction inlets shall be provided with filters to prevent ingress of foreign matter to systems. Means of completely draining oil storage tanks shall be provided.

9 Valves

- (a) check valves shall be provided and shall be installed so that they hold the lift car with the Contract load at any point in the lift well, when the pump stops, or the pressure drops below the minimum operating pressure
- (b) check, relief and other auxiliary valves shall withstand a static pressure equal to twice the normal operative pressure without damage
- (c) valve gear/blocks shall be fitted with gradual restriction/release of hydraulic fluid to provide smooth acceleration and slowing of cars
- (d) main pressure supply restrictions shall be diverted back to oil reservoirs and not to pump outlets
- (e) relief valves shall be located between pumps and check valves and shall be of such types and so installed in by-pass connections that valves shall pass oil directly to tanks and not to pump suction sides
- (f) main controlling valves shall be constructed such that they will remain closed to supply when pressure is shut off

- (g) electrically controlled valves shall remain safe in the event of power supply failure.

#### 20.2.4 Escalators

##### 1 Escalator Trusses

- (a) escalator trusses shall be of welded construction, fabricated from warm rolled standard ST 52 steel profiles. Sides of trusses shall be of frame work design
- (b) truss design shall ensure that the maximum deflection is less than  $D/880$  of the distance between end supports with a calculated passenger load of  $500 \text{ N/m}^2$ .
- (c) oil tight welded 5 mm sheet steel bottom plate shall be welded over the full length and width of the bottom of the trusses
- (d) prior to welding, profiles shall be sand blasted, and after welding shall be protected against corrosion by minimum  $40 \mu\text{m}$  thick primer coat
- (e) a maintenance room shall be provided at the end of the lower landing to EN 115
- (f) truss support angles welded to the truss at the ends of both landings shall be capable of carrying the weight of the escalator and the load transmitted by the passengers ( $5000 \text{ N/m}^2$ )
- (g) teflon sliding supports shall be used at the lower landing and if an expansion joint of the building is located between upper and lower landings
- (h) anti vibration rubber pads shall be provided to ensure that escalator support angles are isolated from building structures. Pads shall be used at both landings.

##### 2 Track System

- (a) closed track systems shall be provided to guide and support step chains and steps as they cycle around trusses
- (b) track holders shall be welded to the framework of the trusses in order to fasten the individual tracks

##### 3 Main Drive

- (a) main drives shall be located in upper landings and shall consist of a rigid solid shaft to eliminate tension with self-aligning spherical roller bearings
- (b) main drive shaft bearings shall be replaceable without dismantling balustrades
- (c) main drives shall provide smooth operation and power transfer from drives to moving steps.

##### 4 Tension carriage

- (a) tension carriages shall be located at lower landings of escalators for tensioning step chains
- (b) step chains shall be guided laterally by sliding block guides and constantly tensioned by two compression springs
- (c) reversal tracks shall be fabricated from 3.5 mm sheet steel
- (d) special openings shall be provided to remove steps for maintenance or replacement

- (e) correct chain tension shall be monitored by safety switches at each side of the tension carriages.
- 5 Step Chain
- (a) step chains shall be made of flat steel links, provided with wheels and interconnected by pins made of hardened ground steel
- (b) the breaking strength per stand shall be 150 kn. The safety factor shall be 5 for the maximum rise. Step chain pins shall allow a maximum pin pressure of 32.3 N/mm<sup>2</sup> at maximum rise
- (c) both sides of step chains shall be linked by solid axles to optimise performance
- (d) step chain wheels shall be provided at both ends of step axles between step chain links and shall have sealed bearings and oil resistant rubber tyres.
- 6 Steps
- (a) steps shall be one piece die-cast aluminium design with cleated treads and rises, ensuring maximum safety as each step meshes with the adjacent step
- (b) step rollers shall have polyurethane tyres
- (c) step tread pitches shall be 8.47 mm. Riser pitches shall be 16.94 mm
- (d) steps shall be fastened to step chain by means of spring loaded pins providing a positive fixing to the axle, allowing the steps to be easily removed for maintenance
- (e) step systems shall be designed such that step removal does not require dismantling of skirting or balustrade parts
- (f) steps with yellow demonstration lines or yellow plastic inserts may be required, as specified.
- 7 Handrail drive system
- (a) handrail drive systems shall be driven directly from step chains via drive sprockets and reinforced toothed belts
- (b) handrail drive units shall be located on both sides of the escalator in the incline section close to upper landings
- (c) synchronicity between steps and handrails shall be assured to within EN115 recommendations
- (d) design and positioning of drive systems shall be such that components can be inspected without need for step removal
- (e) handrails shall be provided as endless vulcanised loops. Handrails shall have endless inner steel cord members to make handrails free of elongation, eliminating the need for frequent retensioning
- (f) handrail guides shall be made from extruded aluminium profiles, having special polymer covers throughout the length to reduce friction between guides and handrails to a minimum
- (g) passenger lines shall have tensioned spring clamps located between aluminium profiles and glass panels
- (h) return lines shall have aluminium profiles fastened to trusses using screws.

8 Balustrades, decking and skirting

- (a) balustrade heights above finished floors shall be 1000 mm or 930 mm in upper and lower landing areas
- (b) inclined sections heights shall be 842 mm at right angles to step nose lines
- (c) material and finishes for balustrades, decking and skirting profiles shall be as specified

9 Combs, Comb Plates and Floor Plates

- (a) combs, comb plates and floor plates shall be designed for maximum passenger loads in accordance with EN 115
- (b) combs shall be made of die cast aluminium, screwed to comb plates for ease of replacement if necessary. Comb teeth shall have intentional rupture points, allowing them to break easily in the event of objects getting trapped between steps and combs, thereby preventing serious damage.
- (c) comb plates shall be made from extruded aluminium profiles with laterally extending grooves preventing passengers from slipping. Grooves shall be powder coated black and the surfaces finished as stated in the particular specification
- (d) fixed floor plates shall be made from extruded aluminium profiles with laterally extending grooves to match the comb plate. The grooves shall be powder coated black and surface finished as specified
- (e) removable floor plates shall be provided, allowing access to both machine rooms and maintenance rooms. Removable floor plates shall be constructed from low weight extruded aluminium profile sections allowing ease of the removal by one service mechanic. Standard removable floor plates shall be recessed by 7 mm, allowing for infill materials as specified.

10 Drive Machinery and Brakes

- (a) drives, motors and gearboxes shall be designed to ensure quiet and smooth operation of the escalator
- (b) star delta starting shall be provided for motors > 5 kW
- (c) motor insulation Class F, protection class IP 55
- (d) operational brakes located between motor and gear boxes shall have an AC commercial magnets and shall use asbestos free brake linings. Double acting shoe brakes shall be fail safe and shall operate automatically via springs in the event of power failure or on safety switches tripping
- (e) a hand winding devices shall be provided with machines in order to move step bands by hand

11 Electronic Controllers

- (a) protection class controller cabinet shall be IP 54
- (b) control voltages shall be < 50 V

- (c) cabinets shall have an industrial enamel triple corrosion resistant coating with the following layers:
  - (i) phosphate layer
  - (ii) primer coating, minimum 25 µm layer thickness
  - (iii) final coating, colour RAL 5019 (blue), minimum 35 µm layer thickness, or as otherwise specified
- (d) controllers shall be equipped with modular electronic boards. Mother boards shall cover all basic functions
- (e) interface capabilities shall be provided for remote monitoring by volt free contacts
- (f) controllers shall include the following functions:
  - (i) directional settings
  - (ii) supervision of power supply voltage
  - (iii) full motor protection against overheating
  - (iv) fault indicator by means of display
  - (v) control of safety contacts
  - (vi) asymmetric relays

12 Operation Panels

- (a) operation panels shall be installed at upper landings and at lower landings
- (b) panels shall be located in steel panels next to handrail entry guards
- (c) operational panels at the lower landings shall be equipped with key switches and stop buttons only
- (d) operation panels at upper landings shall be equipped with key switches, key boards, displays and stop buttons
- (e) displays shall have 8 digits, using 5 x 7 dot matrix for alpha numeric indicators with text shown in plain language
- (f) after setting of passwords via the key board, displays shall show maintenance and fault finding information, including but not limited to:
  - (i) memory of faults (50 messages deep) e.g. amount of faults within a definite period of time
  - (ii) operating hour counter (total and per week)
  - (iii) start counter (total and per week)
  - (iv) stopping distance and deceleration indicator

13 Electrical Safety Devices

- (a) the escalator shall be equipped with all safety devices required by EN 115 including, but not limited to:
  - (i) emergency stop buttons and key switches at landings
  - (ii) handrail entry devices

- (iii) broken step chain devices
- (iv) comb plate safety devices
- (v) broken step and chain wheel control contacts
- (vi) step chain roller monitoring switches
- (vii) non reversal devices (electronic device, located in the controller)
- (viii) operational brakes
- (ix) motor thermal devices
- (x) sockets for manual inspection
- (xi) main and secondary circuit breakers
- (xii) earthing contacts
- (xiii) asymmetric relays (inside controllers)
- (xiv) hand lamps

## 20.3 INSTALLATION

### 20.3.1 Site Condition Inspection

- 1 Before the commencement of installation of equipment the hoistway and machine room areas shall be examined to verify that no irregularities exist that would effect the execution of the work, particularly:
  - (a) the hoistway size, plumpness and wellway lengths
  - (b) the support areas for bracket and beams etc.
- 2 Installation shall not commence until previous work conforms to Project requirements.

### 20.3.2 Preparatory Work

- 1 Legal Hoistways and Pit Enclosures. The following shall be provided:
  - (a) clear plumb hoistway with variations not exceeding 25 mm at any point
  - (b) bevel cants (15 degrees from vertical) over any rear or side wall ledges or beams that project 50 mm or more into the hoistway
  - (c) provisions for guide rail bracket supports in concrete in place as required, with necessary supports provided by elevator installer as indicated on shop drawings walls and floors cut and patch as necessary
  - (d) blockouts or cutouts for push button stations, hall lanterns and position indicators
  - (e) front hoistway wall, erected after entrances have been installed
  - (f) pit ladders, cars and counterweight buffers, and rail load supports
  - (g) waterproof pits and 600 x 600 x 600 mm deep sump pit
  - (h) barriers at open hoistways and entrances during construction
  - (i) cars, entrances, and special metal finishes protected from damage after installation
  - (j) hoistways vented to outside air.



- 2 Machine Rooms. The following shall be provided:
- (a) facilities conforming to EN 81 and requirements of authorities having jurisdiction
  - (b) concrete on metal deck machine room floors
  - (c) fire-rated, self-closing, and lockable machine room access doors installed
  - (d) machine room ventilation
  - (e) machine room floor slab, smoke venting grates, dampers, and ducts installed.
  - (f) machine room walls, ceiling and floor painted and monocoat beam fireproofing sealed to prevent flaking.
- 3 Electrical Services. The following shall be provided:
- (a) pit and machine room lighting and convenience outlets in accordance with EN 81
  - (b) conduits run from elevator hoistways to ground level control consoles. Sizes and locations as indicated on elevator installation drawings
  - (c) 415 V, 3-phase, 50 Hz main power feeders to terminals of each elevator controller unit, including protected lockable "OFF" disconnect switch (copper conductors to terminals)
  - (d) 240 V a.c., single-phase, 50 Hz, power feeders to each car controller available for lighting and exhaust blowers, including individual 20-amp circuit breakers at locations shown on elevator shop drawings
  - (e) suitable power feeders and branch wiring circuits as required to elevator control panels in machine rooms as designated by elevator installer.

### 20.3.3 Installation

- 1 The elevator installer shall supervise and co-ordinate the preparation of all shop drawings, the selection and furnishing of all materials included in the specifications, and the installer shall also install the cars. Installation work shall be to BS 7255. The elevator installer shall also be responsible for the supply and installation of the following:
- (a) electrical controls and signal fixtures and wires complete
  - (b) conduit and wiring to lighting and ventilating fixtures, with temporary power and lighting as required
  - (c) headers, tracks and thresholds
  - (d) hangers and gibs on car doors and hang doors
  - (e) communications system as specified
  - (f) basic car construction of 1.2 mm steel, with vent slots in accordance with EN 81, and wall panels as specified
  - (g) exhaust blowers, isolated from steel canopies on rubber grommets.
- 2 Each equipment item shall be installed in accordance with accepted manufacturer's directions, referenced codes and specifications, with clearances complying with the same.
- 3 Items shall be installed so that they may be removed by portable hoists or other means for maintenance and/or repair, and so that access for maintenance is safe and readily available, in accordance with BS 7255.



#### 20.3.4 Field Quality Control

- 1 Inspection
  - (a) work at job sites will be checked during the course of installations. Full co-operation with inspections is mandatory
  - (b) corrective work required shall be accomplished prior to performing further installations dependent upon, or related to, required corrections.
- 2 Acceptance. The Engineer's and Employer's acceptance inspections shall be performed, before acceptance of the works. Verification will be required that tests have been completed, corrective work accomplished and installation approved for issuance of a permit to operate.

#### 20.3.5 Field Adjustments

- 1 Guide rails shall be aligned vertically within a tolerance of 1.5 mm in 30 m. Joints shall be secure without gaps and irregularities filed to a smooth surface.
- 2 Cars shall be balanced to equalise pressure of roller guide shoes on rails
- 3 Equipment shall be lubricated in accordance with manufacturer's instructions.
- 4 Motors, controller, levelling switches, stopping switches, door operators, interlocking, and safety devices shall be adjusted to achieve required performance levels.

#### 20.3.6 Acceptance Inspection and Tests

- 1 Acceptance of installations shall be made only after all field quality control and tests are complete, all submittals and certificates have been received, and the Engineer is satisfied that the following have been satisfactorily completed. The Contractor shall supply, labour, materials and equipment necessary for tests:
  - (a) workmanship and equipment comply with specifications
  - (b) speed, capacity, and floor-to-floor performance comply with specifications
  - (c) performance of the following are satisfactory:
    - (i) starting, accelerating, running
    - (ii) decelerating, stopping accuracy, stopping
    - (iii) door operation and closing pressure
    - (iv) equipment noise levels.
  - (d) in all test conditions, speed and performance times specified shall be met, stopping accuracy shall be maintained without re-levelling, and general ride quality shall be acceptable to the Engineer.

Temperature tests may also be required, at the Engineer's discretion.

- 2 Should tests detect any defects or poor workmanship, or non-compliance with or variance from the specification requirements, the following work and/or repairs shall be completed at no expense to the Employer:
  - (a) replace all equipment that does not meet specification requirements

- (b) perform all work and supply all labour, materials, and equipment necessary to complete specified operation and/ or performance
- (c) perform all retesting required by the authorities and the Engineer to verify specified operation and/ or performance.

#### 20.3.7 Clean Up

- 1 Areas shall be kept orderly and free from debris during Project progress.
- 2 Loose materials and filings resulting from work on hoistway surfaces and truss interiors shall be removed.
- 3 The machine room equipment and floor shall be cleared of dirt, oil and grease.
- 4 Hoistways, cars, car enclosures, entrances, operating and signal fixtures, handrails, and trim shall be cleaned of dirt, grease, and finger marks.

#### 20.3.8 Manufacturer's Services

- 1 The manufacturer's representative shall inspect the final installation and supervise initial operation. Manufacturer's certificates shall be provided prior to field testing equipment.
- 2 The manufacturer's representative shall instruct and train plant personnel for at least one 8 hour day on proper operation and maintenance procedures.

#### 20.3.9 Maintenance and Guarantees

- 1 The Contractor shall be responsible for the system maintenance and repair of any fault for a period of 400 days starting from the provisional handing over. During this period the Contractor shall replace and/or repair any fault with all spare parts without any cost to the Client.
- 2 The Contractor shall guarantee the system for a period of 400 days. During this period the Contractor shall clear any failure due to design problems or poor installation and workmanship.

END OF PART