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Title:

Specification for Heavy Duty Metro Escalators

PART 2: MECHANICAL COMPONENTS

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PART 2 – MECHANICAL COMPONENTS

1. Scope

1.1. Part 2 defines the requirements for escalator mechanical components, over and above the general requirements stated in Part 1.

2. Truss

2.1. Truss framework

2.1.1. Refer to annexe.

2.1.2. The site-specific documentation for a particular contract may impose additional constraints on the allowable truss dimensions, particularly where delivery routes are restricted.

2.1.3. The *Contractor* shall submit a CDS showing details for the proposed trusses and support systems, including civil engineering requirements for all escalators. Appendix 2.1 provides a sample template for information. The trusses shall be grouped according to height rise. The maximum variation between any escalator height in any group shall be no more than 15% of the maximum height rise within that group. The number and positions of supports in each group is to be similar, supports are to be located to suit site conditions. The variation between similar spans in each group is to be no more than 15% of the largest span. The truss depths, member sizes and geometry are to be similar in each group.

2.1.4. The *Contractor* shall be responsible for the design, manufacture, and installation of the truss.

2.1.5. The truss shall comply with BS EN 1990, BS EN 1991 and BS EN 1993.

2.1.6. The truss shall not rely on the surrounding concourse floor or adjacent escalators for any lateral support. The truss shall not provide any support to the station infrastructure, except for small areas of floor plates immediately adjacent to the escalator, in the upper and lower landing areas, to be agreed with the *Employer*.

2.1.7. For each height rise group, a three-dimensional framework model of the truss shall be prepared using a suitable software programme. The model shall facilitate the evaluation, by the *Contractor*, of all truss stresses acting on joints/elements and support reaction forces. The *Contractor* shall demonstrate that the member forces do not exceed those permitted by BS EN 1993, to verify the overall integrity of the structure.

2.1.8. The maximum deflection of the truss shall not exceed either 3mm or 1/1500th of the span (whichever is the lesser) between adjacent supports, under full passenger loading.

2.1.9. Access routes may require the truss to be broken down into sections to negotiate these routes. Such sections shall be provided with precision bolted joints and all separate truss components shall be clearly marked before leaving the factory to ensure the correct sequence of assembly on site.

2.1.10. The truss shall be designed for ease of manual cleaning, both internally and externally. Wherever possible, angle and channel members shall be orientated to prevent the build-up of detritus.

2.1.11. The underside of the escalator shall not have a soffit or panelling, to ensure that access to the area beneath the escalator is unhindered for cleaning purposes.

2.2. Truss supports

2.2.1. Truss supports may comprise either concrete plinths or steel structures, or a combination of both. Steel supports and fixings shall be provided and installed by the *Contractor*. Any builder's work to be carried out by others shall be clearly indicated on drawings by the *Contractor*.

2.2.2. The truss supports shall incorporate a facility for accurately aligning the escalator truss during installation and also for the correction of alignment following any subsequent ground settlement which may take place. The minimum range for adjustment shall be ±25mm.

2.2.3. All loading reactions during starting, running, stopping and abnormal fault conditions (i.e. sudden arrest of the step band), shall be taken by the truss supports.

3. Tracks

3.1. Tracks shall be constructed of steel or (where appropriate) cast iron, and shall be designed for ease of renewal. Running track wearing surfaces on the passenger side, including the upthrust tracks in the lower curve area shall be of a minimum 5mm thickness. Running track wearing surfaces on the return side shall be of a minimum 3mm thickness throughout, where load relieving ramps are provided. Where load relieving ramps are not provided, the running track wearing surfaces shall be a minimum 5mm of thickness in the regions of the curves, including the upthrust tracks in the lower curve area. Other track surfaces shall be nominally 3mm thickness. The maximum allowable wheel loadings are defined in clause 5.2 below.

3.2. The radius of track curvature at the upper landing, passenger side, shall be not less than 3.6m.

3.3. The radius of track curvature at the lower landing, passenger side, shall be not less than 2.4m.

3.4. All joints in the track system shall be scarfed (mitred) or dovetailed and shall not be perceivable by passengers using the escalator. Gaps at track joints shall be less than 0.8mm in the direction of travel except where a sliding half-track joint is employed. Track surfaces shall be flush within 0.8mm across each joint.

3.5. Where fixings are used in the running surface of the track and are within the running path of the wheels, they shall have countersunk heads flush to within +0.0/-0.8mm of the track surface. All other types of fixings shall be no closer than 10mm to the path of the wheels.

3.6. Support brackets shall provide a precise vertical and lateral location for all tracks, which guide the step band. Provision shall be made to permit accurate alignment and levelling of the tracks, without the aid of shimming.

3.7. The deflection of the tracks shall not exceed 1mm between any two adjacent track supports under static passenger loading. The *Contractor* shall provide calculations verifying this deflection, prior to manufacture.

3.8. The individual track sections and support brackets shall be of designs that are resistant to fatigue failure. The *Contractor* shall provide evidence, prior to manufacture, that tracks and support brackets are designed to meet all load conditions during the design life.

3.9. A step and chain wheel upthrust system shall be provided which shall be continuous, so that it shall be impossible for the wheels to rise more than 3mm from the running track, or for the steps to fail to form correctly at the upper and lower curves. The upthrust system shall be provided for both left and right hand sides of both upper line and return line tracks, and shall cover the tension carriage track gap.

3.10. Slide tracks shall be provided for all upthrust and running tracks, to span the gap between tension carriage and fixed tracks. These shall support the wheels on nominally half their width, over the gap area. The design of the tracks shall ensure free movement of the carriage.

3.11. A method of guiding the steps shall be provided which shall ensure that the specified clearances are maintained between steps and skirting.

3.12. Where an overhead chain guidance system is used, the upthrust system (see clause 3.9 above) shall be designed such that no step chain upthrust loads are applied to it.

3.13. The chain wheel tracks shall be adjustable in the vicinity of the top and bottom sprocket, in such a way that the chain shall lie tangential to the sprocket pitch line on both the upper and lower sides of the sprockets.

3.14. Reversing tracks shall be made in precision matched pairs. They shall be provided with rigid mountings and shall have a means of accurate location by reference to the main and idler shafts. The reversing tracks shall not be mounted directly onto the shafts.

3.15. A guard track shall be provided at the lower landing to ensure that the step chain cannot become unmeshed with the sprockets.

3.16. Auxiliary tracks shall be provided at both landings, covering the length of two steps, which shall be designed to support the steps and maintain meshing of the steps through the comb, in the event of failure or loss of a step or chain wheel.

3.17. Tracks, support brackets and upthrusts shall be designed to withstand maintenance staff using these as a foothold. This shall be taken to mean that a load of 1.5kN applied vertically downwards at any point shall cause no permanent deflection.

4. Steps

4.1. The nominal step width shall be 1.0m.

4.2. The complete step and chain axle assembly shall meet the type test requirements stated in Part 4, Appendix 4.2 of this specification.

Note: that this exceeds the requirements of BS EN 115-1

4.3. The *Contractor* shall demonstrate that, under the “worst case” of uneven chain wear and maximum loading conditions, the stress levels and ranges will not lead to failure of the step.

4.4. The manufacturing process shall ensure that the steps are dimensionally consistent and are fully interchangeable, without the use of shims, spacers etc.

4.5. The steps shall be removable from the chain axles without removal of the chain axles from the step chain.

4.6. The step shall have an electronic tag (micro-chip) permanently attached, in a position which will enable the tag to be read by a transponder. The tag is required to store information which includes the step type, *Employers* step part number, manufacturer, serial number and date of manufacture. The tag shall be of robust construction and have its serial number marked in a position where it can be easily read on site by maintenance staff. The tag shall consist of a passive RFID on metal tag, with a UHF tag inside a fully encapsulated body. The operational frequency range of the tag shall be 865 - 868 MHz and the read range shall be 4-8 metres. It shall have a memory capacity of at least 96 bit EPC inlay. The serial numbers for the batch of steps shall be agreed with the *Employer* on placement of the contract. It is the *Contractors* responsibility to write to the tags and validate the data by reading the tags.

4.7. Sagged step detectors shall be mounted such that they are not affected by track deflection.

5. Wheels

5.1. Chain wheels and step trailer wheels shall be fitted with sealed rolling element bearings.

5.2. The static loading on each chain wheel shall not exceed 1kN per 25mm of diameter, at any point on the escalator with a load of 120kg per exposed step.

5.3. The hub rim to bearing bore concentricity shall be within 1mm (to ensure consistent tyre thickness).

5.4. Tyres shall be made of polyurethane elastomer material.

5.5. Full details of the polyurethane material (including trade name, vendor, chemical composition and formulation) shall be submitted to the *Employer*, prior to manufacture, with relevant calculations proving that the material is suitable for this application.

5.6. The tyre material and bonding adhesive shall be resistant to attack by, and dimensionally stable in the presence of, lubricants and water.

5.7. A procedure for preparation of the hub surface and subsequent bonding and moulding of the tyre shall be available for audit by the *Employer*, prior to manufacture.

5.8. Tyres may be moulded to finished size if the drawing dimensional and geometric tolerances can be maintained. Hollowing of the tread surface is allowable providing that the diameter is within tolerance across the width of the tyre. If the finished dimensions are not achievable by moulding, the outside diameter shall be machined to size, with a surface finish of 3.2µm or better.

5.9. Tyres shall be free from surface blisters, and free from air bubbles over 1mm in diameter.

5.10. Tyre hardness testing shall be in accordance with BS ISO 7267-2.

5.11. Wheels shall meet the test criteria defined in Part 4, clause 4.7.2 of this specification.

5.12. Bearings shall be press fitted, using an interference fit appropriate to the hub material.

5.13. When assembled, the inner races of the ball bearings shall be free to rotate without any tight spots being apparent during hand rotation.

5.14. Wheels shall be clearly and permanently marked with the Manufacturer's name, drawing or part number and batch identification. Raised characters, engraving and stamping are acceptable methods of marking.

5.15. Batch identification shall be traceable to the date of tyre moulding.

6. Comb plate

6.1. Comb sections shall be renewable. The tread surface shall have a grooved profile running across the width.

6.2. The comb plate assembly and supporting structure shall be designed not to deflect by more than 3mm under a load of 7.5kN uniformly distributed over the whole plan area of the plate. No permanent deflection shall be present on removal of the load.

6.3. The comb plate shall be structurally independent of the adjacent floor plates. (Any interlocking feature between the comb plate and floor plate shall not be regarded as structural). The back of the comb plate shall be level with the floor plates within 1mm.

6.4. The comb sections shall be not less than four in number and of no more than three types (inner, left hand outer and right hand outer). Each type of comb section shall be fully interchangeable with others of the same type.

6.5. The mesh depth of the combs into the grooves of the treads shall be at least 6mm.

6.6. Adjustable guides shall be provided at each landing to ensure that the steps enter the comb safely.

6.7. Two suitable tools shall be provided to allow removal of comb sections. Storage brackets for these tools shall be provided, in positions to be agreed with the *Employer*.

6.8. The *Contractor* shall state the amount and direction of movement and the force required to move the comb plate and operate the switches. The sensitivity of the assembly shall be adjustable so that nuisance tripping is avoided.

6.9. Comb plates shall be coloured to give a contrast to the step.

7. Main drive shaft

7.1. Shafts shall have no potential for failure by fatigue, under all operating conditions described in this specification. Any welding shall be done to BS EN 1011-1, or agreed equivalent, and shall be inspected by an appropriate method to demonstrate integrity. Keyways shall have corners with radii, which shall be inspected before assembly of the shaft and the results made available for review by the *Employer*.

7.2. All sprockets shall be mounted on hubs. Where auxiliary brakes are located on the main drive shaft these shall also be mounted on hubs. The hubs may be welded or keyed to the shaft.

7.3. Where welded joints are used they shall be fully accessible for periodic examination. Examination shall be possible with the shaft in-situ and without the need to dismantle the shaft.

7.4. The deflection of the main shaft, due to its own weight, between bearing supports shall be defined.

7.5. It shall not be possible for a failure of the shaft at any single point, to disengage the drive and render all mechanical brakes ineffective, simultaneously.

7.6. The shaft assembly shall be supported on self-aligning bearings. Means shall be provided, to enable accurate positioning of the shaft. The bearing mountings shall be fixed in a manner which prevents horizontal and vertical movement after positioning. The bearings shall be capable of replacement without removing the shaft.

7.7. All sprockets shall be located against shoulders on the hubs to ensure accurate location, and to ensure that the loads due to chain tension are not taken wholly by the retaining bolts.

7.8. The shaft shall be marked with a suitable datum related to the mid-point between the escalator chain sprockets, after final machining. The method of marking shall not be detrimental to the fatigue life of the shaft.

7.9. The shaft assembly shall be designed for accurate re-assembly on site following factory assembly.

8. Sprocket characteristics

8.1. The design shall take account of the "polygon effect" whereby the chording of the step chain around the sprockets causes a variation in the linear speed (velocity) of the steps. The maximum velocity shall be taken as the normal running speed and the minimum velocity shall be the vectorised component of the nominal velocity, arising from the angular rotation of the sprocket by one tooth pitch. The time taken for the velocity to fluctuate by one half-cycle shall be taken as the time for the sprocket to rotate by one half tooth pitch. The mean acceleration of the step chain shall be taken as the velocity variation divided by the time elapsed. By this means of calculation, the mean acceleration shall not exceed 0.20m/s^2. The *Contractor* shall furnish calculations to prove that this requirement is met.

8.2. The pitch circle diameter of step chain sprockets (and hence the number of teeth) shall be selected to ensure that the drive characteristics defined above are met.

9. Tension carriage

9.1. The tension carriage shall comprise an idler shaft and reversing tracks mounted on a moveable frame.

9.2. Both step chain sprockets shall be fixed to the idler shaft to maintain accurate alignment of the sprocket teeth throughout the life of the step chain. The sprockets shall be located on shoulders to ensure accurate location, and to ensure that the loads due to chain tension are not taken wholly by the retaining bolts.

9.3. The deflection of the idler shaft, due to its own weight, between bearing supports shall be defined.

9.4. Where welded joints are used they shall be fully accessible for periodic examination. Examination shall be possible with the shaft in-situ and without the need to dismantle the shaft.

9.5. The shaft shall be marked with a suitable datum related to the mid-point between the escalator chain sprockets, after final machining. The method of marking shall not be detrimental to the fatigue life of the shaft.

9.6. The shaft assembly shall be supported on self-aligning bearings. Means shall be provided, to enable accurate positioning of the shaft. The bearing mountings shall be fixed in a manner which prevents horizontal and vertical movement after positioning. The bearings shall be capable of replacement without removing the shaft.

9.7. The tension carriage shall be mounted on guides, providing both horizontal and lateral location and accurately positioned. A means shall be provided to ensure parallel movement throughout travel and achieve the same degree of control as would be achieved by linear bearing. A means of levelling the guides shall be provided.

9.8. Tensioning devices shall be fitted to each side of the carriage to maintain tension on the step chain. The devices shall be adjustable and shall provide a constant force throughout the travel of the carriage. They shall be provided with stops to prevent excessive travel in either direction.

9.9. Each tension device shall incorporate a "fusible link", such that sudden inward movement of the carriage shall not cause damage to the structure. The "fusible link" shall be safely constrained in the event of breakage.

9.10. An energy absorbing device, or a means that ensures that damage in controlled (i.e. sacrificial part), shall be provided to arrest the carriage at the limit of its inward movement. These shall be positioned such that the carriage travel is halted before any damage can occur due to the sudden closing of the slide track clearance gaps.

9.11. When the carriage is installed and step chains are fitted and tensioned, the clearance gap between sliding and fixed tracks shall be not less than 15mm to allow free movement of the carriage. The gap shall be consistent within 3mm across all of the tracks in the escalator.

9.12. A scale and fixed pointer shall be arranged on one side of the tension carriage, (not adjacent to a wall), to indicate the amount of movement of the tension carriage. This scale shall be positioned so that the pointer on the carriage indicates zero when the track gap is nil. An adjustable pointer shall be provided to indicate the initial position of the carriage before the escalator is put into passenger service.

9.13. A switch shall be provided, to detect an outward carriage movement of 7mm or inward movement of 5mm. The switch shall be manual reset type. The switch-operating device shall be adjustable to allow for movement of the tension carriage, throughout its normal operating range.

9.14. Shafts shall have no potential for failure by fatigue, under all operating conditions described in this specification. Any welding shall be done to BS EN 1011-1, or agreed equivalent, and shall be inspected by an appropriate method to demonstrate integrity. Keyways shall have corners with radii, which shall be inspected before assembly of the shaft and the results made available for review by the *Employer***.**

9.15. Sprockets shall be mounted on hubs. The hubs shall be welded or keyed to a common shaft.

9.16. The tension carriage including the shaft assembly shall be designed for accurate re-assembly on site following factory assembly.

9.17. Refer to annexe.

10. Step chain

10.1. The step chains shall be of a roller type.

10.2. The nominal step chain pitch shall be 135mm.

10.3. The chain shall be supplied in precision-matched pairs. For each pair of the *Contractor's* standard length units, the lengths of individual left and right hand chains shall be matched within 0.2mm. The overall chain length when installed shall be matched left-to-right to within 1mm.

10.4. The dimensions and tolerances of the chain components shall allow for the specified step, comb and skirting clearances to be maintained throughout the service life of the chains.

10.5. The *Contractor* shall state the predicted service life of the chains, and shall provide documentary evidence (calculations and test reports), prior to manufacture, to assure the *Employer* that the predicted service life will be achieved in practice.

10.6. Each chain length shall be etched, stamped or engraved with the manufacturer's name and part number on the outer link plates.

10.7. The bearing pressure in the bushes shall not exceed 20N/mm^2 under a load of 120kg per exposed step.

10.8. The step chain shall be monitored for kinking, by detection device(s). (See Part 3, section 23 of this specification for operational requirements).

10.9. The *Contractor* shall demonstrate by calculation and type test that the materials and heat treatment used in the construction of the chain have been selected to give the required strength, ductility, fatigue and wear resistance. The calculations shall address all potential failure modes for each component. The materials used for the link plates shall have adequate shock resistance to endure all normal and abnormal loadings due to a sudden arrest of the step band.

10.10. A type test certificate and supporting documentation, confirming the tensile breaking load of the assembled step chain, shall be provided from a recognised test authority. The chain shall satisfy the factor of safety defined in Part 1, clause 10.4.2 of this specification. This shall include a load/extension diagram and photographic evidence of the failure mode.

10.11. It shall be possible to remove the chain wheels without dismantling the step chain.

10.12. A means shall be provided to allow the step band to be mechanically anchored/locked without the use of the brakes. The design of the anchoring/locking device shall be capable of sustaining the live load

of walking passengers and satisfy the factor of safety defined in Part 1, clause 10.4.2 of this specification. The *Contractor* shall demonstrate how repairs are carried out in the event that the step chain is required to be disconnected. The method of engagement of the anchoring/locking devices shall be clearly defined.

10.13. An electrically interlocked safety switch shall be provided, to prevent the escalator being started while the step band is anchored.

10.14. A method shall be available to compensate for chain elongation and maximise chain life (i.e. cranked links or adequate carriage movement).

10.15. The chain wheel axle shall be either:

a) A rigid member connecting both step chains; or:

b) A stub axle design, whereby the left and right chain axles are separate. In this instance the chain axles shall be connected to the step in such a way that the step maintains the axial alignment of the stub axles whilst still allowing rotation of the step.

10.16. The complete step and axle assembly shall pass the deflection test requirements defined in Part 4, Appendix 4.2 of this specification.

10.17. Where chain wheel unloading ramps are required (in order to meet the maximum wheel loading constraint defined in clause 5.2 above), these shall have a wear-resistant renewable surface and shall be provided with a means of setting up and adjustment which does not require the removal of the step chain. The ramps shall be designed to prevent overloading of the chain wheels.

11. Lubricator

11.1. An electrically driven central lubrication pump shall be fitted in an easily accessible location to lubricate all chains, including the step chains. This system may also be utilised to lubricate other escalator components.

11.2. The lubrication pump shall be controlled as described in Part 3, section 24 of this specification.

11.3. The lubrication pump shall provide one outlet per delivery point. The rates of feed for each outlet shall be adjustable.

11.4. The lubricator reservoir shall have sufficient oil capacity to run under the required duty cycle for a period of not less than four weeks, without topping up. A visual oil level gauge shall be provided. The filler shall be provided with a fine gauge strainer.

11.5. Oil feed pipes shall be run in positions where they are not prone to damage and will not preclude maintenance. All pipes shall be labelled. A notice shall be provided near the pump to give the destination of each feed pipe.

11.6. A means shall be provided to precisely deliver oil, directly to the points that require lubrication. The design shall make efficient use of the lubricant and keep pipe runs to a minimum.

11.7. Non-return valves shall be fitted, as recommended by the lubricator manufacturer.

12. Handrail system

12.1. General

12.1.1. The escalator shall be provided with two endless handrails, with factory made joints where practicable. Where this is not possible, control processes and procedures for ensuring quality and consistency of jointing shall be agreed with the *Employer*.

12.1.2. The handrail moulding shall be of the 'V' profile.

12.1.3. The width of the handrail shall be no less than 75mm and no more than 85mm.

12.1.4. Cleaning of the outer (hand held) surface of the handrail shall not cause any degradation. The *Contractor* shall provide details of a suitable cleaning procedure in the operation and maintenance manual.

12.1.5. Handrails shall meet the test requirements of Part 4, Appendix 4.4 of this specification.

12.1.6. Each handrail shall have only one joint.

12.2. Handrail construction

12.2.1. The base compound shall be rubber of a suitable type, to BS 6716. The rubber shall be fully vulcanised to maintain the integrity of the whole assembly.

12.2.2. The base compound material shall be reinforced with a band of steel cords. Each cord shall be continuous, and shall not touch the adjacent cords. The inner surface of the handrail shall be of capable of sliding easily on the guide track.

12.2.3. The joint shall be fully spliced and vulcanised, and shall be virtually indistinguishable from the rest of the handrail. The tolerance on the stated length of handrails with factory made joints shall be +0/-25mm.

12.2.4. When mounted on the guide track, the handrail shall be straight (i.e. free of kinks) within ±2mm measured over any 500mm length.

12.2.5. Outer cover surface defects shall number not more than one in any 3m length of handrail and shall meet the following acceptance criteria:

a) Dents and bumps shall be acceptable, if they deviate less than 0.5mm from the general surface of the cover. Over a length of 500mm, which includes the vulcanised joint, a deviation of up to 1.5mm is acceptable;

b) Outer cover surface scratches shall be acceptable, providing their width is less than 0.1mm and their length less than 100mm;

c) There shall be no blisters, caused by air pockets.

12.2.6. The tensile breaking load of a sample length of handrail, without a join, shall exceed 28kN. The tensile breaking load of a sample length containing one joint shall exceed 25kN.

12.2.7. The external surface of the handrail shall be black in colour, except for the direction indicators.

12.2.8. Direction indicators, consisting of 18-25mm diameter circles of yellow coloured (e.g. RAL 1003 Signal Yellow) rubber, shall be formed within the handrail cover at the vulcanisation stage. These shall be on the centre line of the handrail, spaced at 1m ±0.05m intervals throughout the full length of the handrail. The centres of the yellow circles shall be within ±2mm of the handrail centre line. Circles adjacent to the handrail joint may be spaced between 0.5m to 1.5m.

12.2.9. Each handrail shall be indelibly marked, by a minimum of 2 markings, preferably by means of sunken moulded characters, with the manufacturer's name or logo, the manufacturer's drawing number and a serial number, traceable to both the purchase order and date of manufacture. The marking shall be on the lower edge of the handrail.

12.2.10. The *Contractor* shall demonstrate by drawings and type test results, that the performance and design requirements have been met. A cross-section drawing shall be provided, confirming the materials, dimensions and tolerances. The position of the neutral axis relative to the running surface shall be advised.

12.3. Handrail guidance

12.3.1. The handrail guide tracks shall be manufactured from either mild steel with a dry anti-corrosion coating, or stainless steel. The cross section profile shall be of a solid, rolled or extruded shape. The

balustrade shall provide an accurate location for the handrail track. The radii of the track at the curves shall be accurately formed at the factory, with the lower landing radii not less than 2.4m.

12.3.2. On its return path, the handrail shall be carried on rollers of suitable diameter and spacing.

12.4. Handrail drive system

12.4.1. Newel wheels shall be provided at both landings, and shall be fitted with rolling element bearings.

12.4.2. The newel wheel shall be imperforate, so as not to present a hazard to maintenance staff.

12.4.3. The drive for the handrails shall be mechanically linked to the main drive shaft, to ensure synchronisation with the step band within the limits of BS EN 115 at all times. Chains shall have a means of tension adjustment, which shall be easily accessible.

12.4.4. Where drives are supplied in addition to the upper drive, they shall be mechanically driven and synchronised with the upper drive.

12.4.5. All sprockets in the driving system shall be replaceable without the need to remove the carrying shafts.

12.4.6. A means of tensioning the handrail shall be provided.

13. Overspeed and underspeed detection device (step band)

13.1. The overspeed and underspeed detection shall be located such that any single point failure will not render the device ineffective.

14. Brakes

14.1. Electro-mechanical brakes shall be fitted to the high speed side of the gearbox and may form part of the coupling between the motor and gear.

14.2. The escalator shall be fitted with brakes such that there is always at least one mechanical brake that can act in the capacity of an auxiliary brake.

14.3. The braking logic shall be as defined in Part 3, section 13 of this specification.

14.4. Mechanical brakes shall be spring applied, and electro-magnetically released, acting on a drum or disc.

14.5. Mechanical brakes shall be adjustable, throughout the life of the friction material. The brakes shall be designed such that all wearing components shall be easily replaceable.

14.6. Brake linings shall be asbestos-free. It shall be possible to inspect the lining thickness without dismantling the brake.

14.7. The brake springs shall be of the compression type and shall be arranged to ensure equal pressure on each brake shoe.

14.8. A switch shall be provided to detect that each brake shoe has lifted fully. It is permissible for the escalator starting circuit to bypass this switch but it shall not be possible for the escalator to continue to run unless the switch has been activated.

14.9. Inverter braking may be used as the primary method for bringing the escalator safely to a stop. Operational and functional details are given in Part 3, sub-section 13.2 of this specification.

14.10. The escalator brakes shall be entirely fail safe in their operation.

14.11. The escalator shall not exceed 120% of the nominal speed under any circumstances, including fault conditions. This shall take account of the calculated increase in speed that would occur during mechanical and electrical response times.

14.12. Detailed braking performance calculations shall be supplied to the *Employer*, prior to manufacture.

14.13. Suitable measures shall be taken to ensure that oil cannot drip or spread onto the brake drum or disc.

15. Drive layout

15.1. The complete drive and braking system shall be mounted within the upper landing truss, but not within the step band (i.e. integral drives).

15.2. A dual drive system shall be provided, with the escalator main shaft (headshaft) being driven at both ends by means of reduction gears. Each drive unit shall comprise a motor, a reduction gearbox and one or more electro-mechanical brakes.

15.3. The drive motors and gearbox shall be easily accessible for routine maintenance and replacement.

15.4. The main drive and control cabinet(s) shall be free-standing within the machine room/electrical equipment room.

16. Drive unit

16.1. General

16.1.1. Each drive unit shall consist of a motor, brake(s) and a gearbox.

16.1.2. Means shall be provided to ensure that accurate alignment of the motor and gearbox is maintained at all times. Any coupling alignment shall be within the manufacturer's specification.

16.1.3. Speed reduction shall be achieved by use of a gear train enclosed in a gearbox.

16.1.4. Lifting eyes shall be provided to lift the drive unit.

16.1.5. For requirements of motor details, see Part 3, section 26 of this specification.

16.1.6. It shall be possible to remove and replace the motor in the drive unit without disturbing the brake. If this is not practical, the *Contractor* shall demonstrate that the brakes can be reset to meet the stopping requirements, without the need to verify by weight test.

16.2. Gearbox

16.2.1. The expected life for strength and wear shall be calculated in accordance with the appropriate standard, and shall be in excess of 146,000 hours. For the purpose of calculations, a steady load, equivalent to that which would be transmitted to the gearbox when the motor is running at full speed, supplying 75% of its normal rated maximum motor power shall be assumed.

16.2.2. All bearings shall be of the rolling element type. A lubrication facility shall be provided unless the bearings are of the sealed-for-life type.

16.2.3. A method of determining the oil level shall be provided. This shall also indicate the maximum and minimum permitted levels. A low oil level switch shall be provided (see Part 3, clause 8.3 of this specification).

16.2.4. A drain point, fitted with a valve or tap at an easily accessible point, shall be provided.

16.2.5. A plate shall be fixed to the reduction gear casing, stating:

a) Manufacturer;

b) Date of manufacture;

c) Type or model number of gearbox;

d) Serial number;

e) Recommended lubricant;

f) Quantity of lubricant;

g) Gearbox ratio.

16.2.6. Performance data shall be provided for the shaft oil seals used.

16.2.7. An inspection port and cover, which is easily accessible, shall be provided.

16.3. Coupling

16.3.1. Where couplings are used between drive elements they shall be of the flexible type. Calculations shall be provided by the *Contractor* to demonstrate the suitability of the design for all operating conditions.

17. Balustrade and skirting

17.1. The balustrade, including interior panels, decking, and any outer return panels shall form a rigid and total enclosure around the escalator.

17.2. Balustrade

17.2.1. The horizontal distance between the outer edge of the handrail and any fixed part of the escalator or station fabric shall be not less than 150mm, except for the clearance between the outer face of the handrail and inner face of the newel boxes. This shall be not less than 80mm. However, where this is not possible due to spatial constraints agreement will be reached with the *Employer* as to these distances.

Note: The 150mm horizontal distance between the outer edge of the handrail and any fixed part exceeds the requirements of BS EN 115-1.

17.2.2. Balustrade and decking panels shall be supported on a steel framework. The design shall be suitable for use in a public service environment. (See clause 17.2.8 below).

17.2.3. Balustrade interior panels shall be readily removable from the passenger side, at locations where access for maintenance is required, without having to gain access from behind the panels.

17.2.4. Refer to annexe.

17.2.5. Refer to annexe.

17.2.6. Refer to annexe.

17.2.7. Refer to annexe.

17.2.8. The *Contractor* shall be responsible for integrating the decking panels with the adjacent station fabric or adjacent existing escalator or staircase and shall submit a design proposal, showing how this is to be accomplished. Individual site requirements will be stipulated in the site-specific documentation for each site location.

17.2.9. The decking panels between two adjacent escalators shall be designed such that when one escalator is removed, hoardings can be erected on the decking of the retained escalator without compromising the requirements of clause 17.2.1 above.

17.2.10. Balustrade decking panels shall have all external faces linished to 120 grit or finer in the direction of passenger movement. The *Employer* may request samples of finished parts, for inspection, prior to manufacture.

17.2.11. Where there is a drop of more than 1.5m at the outside of the escalator decking, a safety barrier shall be provided to stop persons and objects from falling over the edge of the decking. The design of

this barrier is to be agreed with the *Employer*. The site-specific documentation will clarify any requirements for such barriers.

17.2.12. Means shall be provided to prevent vibration (drumming) of the balustrade panels.

17.2.13. Refer to annexe.

17.2.14. Refer to annexe.

17.3. Skirting

17.3.1. Where guidance of the step is achieved by the wheels or step chain, the skirting shall be designed to allow fine adjustment towards and away from the sides of the steps, at the top and bottom of each panel.

17.3.2. The skirting shall deflect no more than 2mm under a single force of 1500N acting at right angles over an area of 50mm x 50mm, at the most unfavourable point.

17.3.3. The depth of the skirting panels shall be such that the loss of a wheel tyre and/or tread cleat will not cause a visible gap to occur between the top of the step tread and the bottom of the skirting panel, at any point.

17.3.4. The panels shall be stainless steel or painted with a semi-gloss finish (see Part 1, sub-section 10.13 of this specification), with the lowest practicable coefficient of friction.

17.4. Brush Guard

17.4.1. A continuous flexible skirt guard of the double brush type, shall be mounted on the skirting panels, to protect the step-to-skirting gap. It shall be designed such that it shall allow the outer comb sections to be lifted without removing the brush guard. It shall be possible to replace any part of the brush guard without dismantling the balustrade.

17.4.2. The brush guard shall extend from a point 140-150mm from each comb line, (going towards the EWP). The length of extension shall be matching on both sides.

17.4.3. The brush material shall be nylon, of black colour. The brushes shall be held captive in slotted aluminium extrusions fixed to the skirting panels.

17.4.4. The ends of the brush guard shall be tapered towards the skirting panel over a length of 150mm and shall terminate in a tapered aluminium capping piece.

17.5. Newel end equipment

17.5.1. Newel boxes shall be provided at each landing. The *Contractor* shall provide a design for acceptance by the *Employer*. The following facilities shall be provided at each landing:-

a) ‘Start up’, ‘start down’ key operated switches and where inverter braking applies, 'stop,' key operated switches. See Part 3 of this specification, clause 7.10.1 and section 16 for operational requirements. Refer to annexe;

b) Fixings for attaching an engineers’ maintenance barrier, refer to annexe;

c) Retractable ‘Tensator’ tape barriers;

d) The escalator number (as described in the site-specific documentation). The characters shall be 75mm high New Johnston font. The engraving shall be infilled with paint, colour black unless instructed otherwise by the *Employer*;

e) Lockable enclosures, with standard lock barrels, housing an inching socket (see Part 3, clause 17.1.7 of this specification);

f) The escalator manufacturer’s name and ‘CE’ marking, in a location to be agreed with the *Employer.*

17.5.2. The keys specified in clause 17.5.1a) and e) above, shall be identical. The key type shall be LUL standard escalator key RKL271.

17.5.3. Guards, of the nylon brush type, shall be provided to protect the entry of the handrail into the balustrade. The design of the guard and switch assembly shall negate the possibility of nuisance tripping, due to accidental contact with the body of the guard. The guard shall be removable for ease of access for cleaning.

17.5.4. Unless stated otherwise in the site-specific documentation, a means shall be provided to detect the entering of a user, onto the escalator, for stand-by operation as described in BS EN 115-1 and Part 3, section 14 of this specification. Details shall be agreed with the *Employer*.

17.5.5. Passenger emergency stop switches shall be fitted to the balustrade decking. See Part 3, sub-section 7.4 of this specification for further information, including quantity and location.

17.5.6. Refer to annexe.

18. Passenger signs & notices

18.1. Stand On The Right, No Smoking' notices (as appropriate) shall be mounted on the centre decking panels between adjacent escalators, spaced at a maximum pitch of 8m, provided that no such notice shall be positioned within 1m of an emergency stop 'half-diamond' switch. Where the decking at the side of an escalator exceeds 750mm in width, notices shall be fitted in a position corresponding to those on the centre decking. The notices shall be secured to the steelwork below the decking and not to the decking panels only. Refer to annexe.

18.2. Passenger warning notices shall be provided on the wall adjacent to the escalators, one per landing in a location as instructed by the *Employer*. Refer to annexe.

19. Floor plates

19.1. Hinged floor plates shall be provided at each landing, to cover the area between the back of the comb plate and the end of the escalator truss.

19.2. Floor plates with infill shall be provided for the areas between two adjacent escalators and for the areas between the escalator and surrounding finished floor, at the upper and lower landings. A suitable means of fixing the floor plates shall be provided and agreed with the *Employer*.

19.3. Floor plates shall have a renewable non-slip tread surface, which shall be in the form of stainless steel or extruded aluminium sections with an anti-slip pattern profile. The remaining plates shall be either infilled with the same material, or shall have a finish to match the surrounding floor.

19.4. Each floor plate shall be capable of supporting the greater of:

a) A total imposed load of 7.5kN uniformly distributed over the whole plan area of the plate;

b) A uniformly distributed load of 5kN/m^2 over the whole plan area of the plate.

19.5. The loads stated in clause 19.4 above, shall not cause:

a) Deflection by more than 3mm;

b) Deflection by an amount such that the clearance between the underside of the plate and the top of the escalator steps is reduced to less than 5mm;

c) Permanent deformation.

19.6. The design of the floor plates and supports shall be fatigue resistant. The design shall take into account the loading parameters applied by the maximum passenger throughput on the escalator, according to the duty cycle quoted in Part 1, sub-section 10.6 of this specification.

19.7. The *Contractor* shall advise the *Employer* of the maximum weight, at the design stage. Each floor plate shall be clearly marked with its weight.

19.8. The plan area of each floor plate shall be as large as possible whilst taking due consideration for manual handling requirements.

19.9. Each floor plate shall have a fire resistance of thirty minutes.

19.10. The slip resistance of unprofiled flooring shall achieve a minimum Slip Resistance Value (SRV) of 36, when tested under dry and wet conditions using a TRL Pendulum Tester with 4S(96) rubber.

19.11. The slip resistance of profiled flooring shall achieve a minimum coefficient of friction value of 0.40 when tested in the wet according to SATRA test method TM144.

19.12. A suitable means of sealing the joints between floor plates, adjacent flooring and surrounding station fabric against water seepage shall be provided. No gaps shall be present between the floor plates and trays when finally installed.

19.13. Floor plate fixing screws shall be flush with the finished surface within +0/-1mm and shall be of a corrosion resistant material e.g. stainless steel. An escutcheon shall be provided to retain the infill material around the screw head.

19.14. Floor plates shall be accurately levelled to within 2mm of each other and adjacent flooring. Levelling shall be achieved by means of metal packers, which shall be bolted or screwed to the supporting steelwork.

19.15. The supporting steelwork shall be drilled and tapped to receive the floor plate fixing screws. There shall be no loose items e.g. clamping devices, which could fall free into the machinery space below on removal of the fixing screws.

19.16. Screw threads shall be provided in the floor plates, to enable the insertion of lifting eyes or jacking screws and to permit lifting and handling by mechanical means. The sockets for the lifting eyes shall be concealed when the fixing screws are in place.

20. Guarding

20.1. General

20.1.1. Guarding shall meet the requirements of the Supply of Machinery (Safety Amendment) Regulations 2008, and PD 5304.

20.1.2. The removal or fitting of individual guards shall not require the dismantling of other guards or escalator components.

20.1.3. The guards shall be fitted following the installation of fire protection systems and all other auxiliary works.

20.1.4. Electrical interlocking of the guarding with the operation of the escalator is not required.

20.1.5. Refer to annexe.

20.1.6. Refer to annexe.

20.2. Passenger side guarding

20.2.1. For maintenance purposes, the following barriers shall be provided to prevent access by unauthorised personnel and the *Contractor* shall implement safe systems of work, which shall be submitted to the *Employer* for acceptance.

a) Where floor plates are not raised, lockable Maintenance Engineers' barriers shall be provided across the newel ends. One barrier shall be provided for each of the upper and lower landings, per flight of escalators. Refer to annexe.

b) Where floor plates are to be raised on the passenger side, a lockable barrier shall surround the escalator working area. The barrier shall give 300mm minimum working space either side of the floor plate opening, 600mm minimum working space behind the opening and a minimum height of 1100mm. The design of the guard shall meet all of the *Employer's* operational and safety requirements. The design of the barrier shall be agreed with the *Employer.*

One barrier shall be provided for each of the upper and lower landings, per flight of escalators.

20.2.2. Refer to annexe.

20.2.3. Where floor plates are to be raised on the passenger side for maintenance purposes, the *Contractor* shall implement a safe system of work, to prevent unauthorised access. The details of safe system of work shall be submitted to the *Employer* for acceptance.

20.3. Machine room guarding

20.3.1. In the upper machine chamber and lower machine chamber, guarding shall be fitted to both sides, the ends and the bottom of the escalator truss. The guards shall extend upwards to a minimum height of 2.5m above floor level, and for a distance of nominally 1m beyond the incline access gates.

20.3.2. The guards shall allow easy access to the dust collection areas under the truss.

20.3.3. The design of guarding shall enable access to items requiring frequent attention, without having to remove complete guard panels. To meet this requirement, small access doors shall be provided within the guarding panel where appropriate. The doors shall be of the same material as the guarding, hinged from the top and fitted with a lock. The access aperture shall be fitted with stops at the bottom left and right hand corners. Locations of any such doors shall be agreed with the *Employer* prior to manufacture.

20.3.4. Refer to annexe.

20.3.5. The clearance between the guards and machinery shall be in accordance with The Safety of Machinery Directive 2006/42/EC, as interpreted by BS EN 115-1 and the HSE/ORR.

20.3.6. The clearance between the guards of adjacent escalators shall be adequate to maintain a personnel access route between the escalators (600mm minimum). Where this requirement cannot be met, and where alternative walking routes exist, the guarding shall be arranged to restrict personnel access into that area.

20.3.7. Refer to annexe.

20.3.8. Refer to annexe.

20.3.9. Guards shall be of wire mesh or sheet steel construction, which shall be welded into a rigid tubular or angular steel sub frame. The mesh size shall conform to PD 5304 Appendix A with the wire gauge being adequate to withstand distortion or breakage of fittings from a person suffering an accidental fall onto the guarding. The use of sheet steel shall be kept to a minimum to reduce dust traps, to ensure maximum visibility of machinery, structures or other persons, and to reduce weight.

20.3.10. No single panel shall weigh more than 10kg and shall not be larger than 1.5m x 1m in either width or height. A maximum height and width of 1m applies for guards that are fixed in confined spaces or that require the use of a ladder for their removal.

20.3.11. The guards shall not give rise to any handling risk, i.e. all panel mesh strands shall be spot welded, cut-outs and edges shall be smoothed and rounded, and any protruding metals shall be cut flush with the sub frame or truss.

20.3.12. Personnel access gates shall be fitted at the top and bottom of the incline maintenance stairways between adjacent escalators, and between the escalators and tunnel walls, where appropriate. Where it is impractical to fix an access gate between the escalator and tunnel wall due to restricted space, a fixed mesh guard is to be fitted. This guard shall be secured with a design of fixing that will allow egress from the incline in the case of an emergency.

20.3.13. The access gates shall provide the maximum clear width and height possible. They shall be hinged and fitted with a lock. The gates, frames and any fixed panels shall be removable, as required for major maintenance or repair activities.

20.3.14. Refer to annexe.

20.3.15. All guards shall be secured by captive fixings that cannot be removed without the use of tools. In order to prevent a guard panel falling when the captive fixings are released, each panel shall be fitted with a fall arrest mechanism bracket welded to the bottom left and right hand corners pointing inwards, and seating onto a fixed member.

20.3.16. Screwed fastenings shall be of grade 8.8 and shall make use of tapped holes or captive nuts. Self-tapping screws shall not be used.

20.3.17. No drilling or welding of the truss members shall be carried out without prior confirmation by the *Contractor* through the provision of calculations, that the integrity of the truss is not compromised.

20.3.18. Each guard shall be painted in accordance with Part 1, sub-section 10.13 of this specification.

20.3.19. Each guard shall be identified by a code letter/number stamped onto a small plate fixed to one corner of the guard. The code identification shall correspond to that shown on the location diagram.

20.3.20. Refer to annexe.

21. Access stair handrail

21.1. Refer to annexe.

22. Oil and dust trays

22.1. Drip trays shall be fitted under sprockets, auxiliary drive chains and step chains, to prevent oil drips falling onto the floor or onto equipment (particularly the brakes). These shall be integral with the guards where appropriate. Means shall be provided for collecting and removing the waste oil from the lowest point of the system. The facility for waste oil removal shall be easily accessible. (See clause 14.13).

22.2. A dust tray system shall be provided at the upper and lower reversing stations, to catch dust and other debris thrown from the steps. Deflector plates shall be fitted as required to direct debris into the tray.

22.3. Due consideration shall be given to access for cleaning the whole oil and dirt collection system. The design of the above items shall take account of site conditions, and shall be agreed with the *Employer* prior to manufacture.

23. Insulating mats

23.1. Insulating mats shall be provided in front of all the access door(s) of electrical equipment.

Document history

Revision	Date	Notes
01	October 2010	First issue.
02	April 2011	For document change detail see separate document.
03	May 2011	Approved for use in Pan-TfL escalator PQQ. For document change detail see separate document.
04	August 2011	For document change detail see separate document.
05	September 2011	For document change detail see separate document.
06D	February 2012	DRAFT for use – Pan-TfL. For document change detail see separate document.
06	April 2012	APPROVED for use – Pan-TfL. Changes since DRAFT rev.06 = clauses 20.2.1 and LUL 20.2.2 revised. No other changes.
07	July 2012	APPROVED for use – Pan-TfL. No changes.

Appendix 2.1 – Sample template for escalator truss CDS

Vendor Limited,
XXXXXXXXXX
XXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXX

Conceptual Design Statement For

Escalator Truss Design
For
Heavy Duty Metro Escalator Nos. XX - XX

At

XXXXXXXXX Station

Document Ref. No.: VENDOR-XXXXXX-CDS-XXX

Rev.	Date		By	Checked	Approved

Contents

Case No	Load Type	Load Description	Magnitude
1	Dead Load	All loads/weights of materials associated with the permanent installation	Calculated from Structure Mass
2	Live Load	Loads incident on the structure from the use of the escalator by passenger traffic,	Passenger Load Applied to plan area of steps
3	Braking Load	Loads from Emergency Braking while in Passenger Service	Passenger Load PLUS The dynamic forces from the passenger load stopping within the minimum braking distance recommended in EN115.
4	Brake Test Load	Loads from the testing of the Escalator braking systems prior to passenger service	The load is applied over sufficient incline to give an equivalent brake test load. Load is applied in various locations to give the critical member and support stresses under testing.
5	Lock-Up loading	The lock-up condition will be used to determine the potential for load transfer to the concourse floor steelwork and to ensure that catastrophic collapse of the truss does not occur	Passenger Load PLUS The dynamic forces from the passenger load stopping within a distance of **XXX**mm

A combination of dead, live and special loads will be made, using appropriate load factors or the particular limit state under consideration.

The factors will be as follows:-

Serviceability Limit State (Deflection):
Live Loads **XXX**

Ultimate Limit State (Operating, Braking):
Dead Loads **XXX**
Live Loads **XXX**

Ultimate Limit State (Brake Test):
Dead Loads **XXX**
Live Loads **XXX**

Accidental Limit State (Lock-up):
Dead Loads **XXX**
Live Loads **XXX**

Special loads – these are loads incident on the structure which have their origin in the drive or braking forces, or any pretension applied to the step chain.

Other loads considered under this section include test loading, and where the specification or condition dictates a lock-up condition.

A stopping distance of **XXX**mm will be taken for the lock-up. The lock-up condition will be used to determine the potential for load transfer to the concourse floor steelwork and to ensure that catastrophic collapse of the truss does not occur.

5.2 Consideration of load cases

5.2.1 Fatigue is not critical for the truss therefore not been further addressed in the calculations.

5.2.2 i) For serviceability, deflection is limited to L/1500 or 3mm (under an imposed load of 5KN/m^2.

ii) For lock up load cases deflection is to be limited such that entrapment will not occur.

5.3 Assumptions of restraint provided by adjacent floor areas

The concourse floors will provide no restraint to the head and tension end steelwork of the escalator truss.

5.4 Concrete strength

The civil truss supports will be by others, the vendor to supply loading applied by truss.

5.5 Support Restraints

The supports to the truss at the head and tension ends will be bolted down to the concrete foundations to restrain against lateral movement.

The design of the support arrangement is to ensure adequate longitudinal and lateral rigidity to maintain overall structural deflection limits within specification.
The supports will be analysed as a pin joint to the concrete sub structure

6. Proposed method of structural analysis

The truss will be analysed as a fixed joint truss, continuous over the supports. The compression boom will be assumed to be laterally and torsionally restrained by U-frame action.

7. Proposals for an independent Category 2 or 3 design check

A category 2 design check is proposed.

Approval in Principle Certificate

Approval in Principle of the Conceptual Design Statement
for the Structural Design of Escalator Trusses and Supports
for new Escalators Nos. XXXXX at XXXXXX Station

Sign off sheet to be agreed by project team

Submitted by (signed)
Name (printed) Date:

Recommended by (signed)
Name (printed) Date:

Approved by (signed) Systems Engineer
Name (printed) Date:

Appendix A - Reference Drawings

Drawing No	Description	Date
	List Main GAs only	

Appendix B - Escalator Loading – Include diagram

Annexe - for LUL

LUL 2. Truss

LUL 2.1. Truss framework

LUL 2.1.1. The truss width shall not exceed 1.66m at the lower landing and throughout the length of the incline, and shall not exceed 1.8m at the upper landing.

LUL 9. Tension carriage

LUL 9.17. It shall be possible to access and reset the switch from the lower machine chamber without entering a guarded area.

LUL 17. Balustrade and skirting

LUL 17.2. Balustrade

LUL 17.2.4. All balustrade cladding shall be made of metal. Balustrade interior panels shall have all external faces linished to 120 grit or finer in the direction of passenger movement.

LUL 17.2.5. The balustrade shall be designed such that a point load of 50N applied by hand, at the centre of a panel adjacent to any edge, shall deflect the panel by less than 0.5mm relative to the adjacent panel.

LUL 17.2.6. The balustrade and decking shall be designed and supported such that it can support a weight of 1000N applied over an area of 50mm x 50mm without any permanent deformation.

LUL 17.2.7. When a force of 500N is applied to the balustrade panels at any point of the panelling at right angles over an area of 50mm x 50mm, there shall be no gap greater than 1mm and no permanent deformation.

LUL 17.2.13. Where the escalator is a replacement for an existing escalator or fixed staircase, and there are adjacent escalators in the same inclined tunnel or shaft way, which do not form part of a current or planned modernisation project, the *Contractor* shall be responsible for the interfaces between the new escalator and any existing escalators, fixed staircases and advert panels.

LUL 17.2.14. Not applicable for LUL.

LUL 17.5. Newel end equipment

LUL 17.5.1.

a) To LUL drawing 584-12005;

b) To LUL drawing 559-905;

LUL 17.5.6. Where specified in the site-specific documentation, traffic light signalling shall be provided at both the upper and lower newel ends to indicate if the escalator is accessible to passengers and denote the direction of travel.

LUL 18. Passenger signs & notices

LUL 18.1. To LUL drawing 36-913 or 36-917.

LUL 18.2. To LUL drawing 384-991.

LUL 20. Guarding

LUL 20.1. General

LUL 20.1.5. The guards shall not permanently prevent access to any area, nor shall they prevent egress from any area in the case of an emergency.

LUL 20.1.6. The guards shall not affect the operation of the escalator in any way or prevent access to emergency stop switches or inching sockets.

LUL 20.2. Passenger side guarding

LUL 20.2.2. Engineers' maintenance guards shall be provided to LUL drawing 34-905. These shall be stored in the upper machine chamber.

LUL 20.3. Machine room guarding

LUL 20.3.4. Each access door in the guard panels shall be fitted with a budget lock (LUL Part No. 348-7919).

LUL 20.3.7. The position for mounting the guard location diagram, described in Part 1, clause LUL 10.24.1 of this specification, shall be agreed with the *Employer*. The manufacturer of the guarding shall incorporate its company name and date of fixing, on the diagram.

LUL 20.3.8. HSE/ORR have granted London Underground an exemption from the requirement to guard the incline truss, provided suitable guards are provided across the whole of the top and bottom of the incline. These shall effectively prevent access to any part of the escalator from the upper machine chamber and lower machine chamber areas, except by means of locked access gates (see clause 20.3.12).

LUL 20.3.14. Each access gate shall be fitted with a budget lock (LUL Part No. 348-7919).

LUL 20.3.20. Where applicable, the *Contractor* shall fit safety notices on access gates or fixed guards (see Part 1, sub-section LUL 10.24 of this specification). Locations for these shall be agreed with the *Employer*, prior to fixing.

LUL 21. Access stair handrail

LUL 21.1. Site-specific documentation may require the installation of a galvanised steel handrail to be fitted to the sides of the escalator, in conjunction with the incline maintenance stairways. If required, the following shall apply:

a) The stair handrail shall consist of a 'Kee Clamp' or similar system;

b) Where an incline handrail is above the lowest truss member, an appropriate mesh or sheet guard, depth of 200mm, shall be fitted behind the handrail;

c) A clear walking route of 600mm minimum shall be maintained between the handrails (the *Employer* may agree to waive the requirement for one or both handrails if this clearance cannot be achieved).

Annexe - for CRL

CRL 2. Truss

CRL 2.1. Truss framework

CRL 2.1.1. The truss shall be designed to fit within the station spatial requirements.

CRL 9. Tension carriage

CRL 9.17. It shall be possible to access and reset the switch from the lower truss area without entering the guarded area.

CRL 17. Balustrade and skirting

CRL 17.2. Balustrade

CRL 17.2.4. All balustrade panels shall be made of toughened laminated glass, which is non-structural and complies with the requirements of the following CRL documents:

a) C100-ATK-A-RST-CRG02-50001: Escalator constructability & maintenance C100 Architectural Components;

b) C100-ATK-N2-RSP-CR002-00001: Architectural common components design stage F1 specification – JX10 Extract.

CRL 17.2.5. Not applicable for CRL.

CRL 17.2.6. Not applicable for CRL.

CRL 17.2.7. Not applicable for CRL.

CRL 17.2.13. Not applicable for CRL.

CRL 17.2.14. To isolate an escalator to enable refurbishment or major repair works to be carried out on an individual machine without removing adjacent escalators from service an integrated hoarding system shall be provided between escalators within the decking panels. It shall consist of fire resistant panels and supports that fit in sockets together with top and bottom end panels fitted with lockable doors.

CRL 17.5. Newel end equipment

CRL 17.5.1.

a) To CRL drawing C100-ATK-A-DDD-CR001_Z-53002;

b) To CRL drawing C100-ATK-A-DDD-CR001_Z-53003;

CRL 17.5.6. Traffic light signalling shall be provided at both the upper and lower newel ends to indicate which escalators of a flight are accessible to passengers and denote the direction of travel.

CRL 18. Passenger signs & notices

CRL 18.1. In accordance with CRL drawing C100-ATK-A-DDD-CR001_Z-53000 and the CRL Signage Strategy.

CRL 18.2. In accordance with the CRL Signage Strategy.

CRL 20. Guarding

CRL 20.1. General

CRL 20.1.5. Not applicable for CRL.

CRL 20.1.6. Not applicable for CRL.

CRL 20.2. Passenger side guarding

CRL 20.2.2. Not applicable for CRL.

CRL 20.3. Machine room guarding

CRL 20.3.4. Not applicable for CRL.

CRL 20.3.7. The location of the guards shall be agreed with the *Employer*.

CRL 20.3.8. Where there are two or more escalators in a flight, guarding shall be fitted to the side of one truss, between two adjacent escalators, to permit safe working on one escalator, whilst the other is in service. If the escalators are sufficiently spaced so as not to present a risk to safe working, this guarding will not be required.

CRL 20.3.14. Not applicable for CRL.

CRL 20.3.20. Not applicable for CRL.

CRL 21. Access stair handrail

CRL 21.1. Not applicable for CRL.