

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  $0.20\text{m/s}^2$ . 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  $20\text{N/mm}^2$  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  $\pm 2$ mm 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  $\pm 0.05$ m intervals throughout the full length of the handrail. The centres of the yellow circles shall be within  $\pm 2$ mm 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 finished 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*.