

Schedule 3 Specification

SPC-LAE-TM00-0585434 REV 02 As well as the individual LUL drawings of related components in the "MPS Drawing Pack" shall form the specification for related Orders placed by the Contracting Authority.



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Title:

**Manufacture and testing of
escalator step chains**

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1. Scope

1.1. This specification covers the manufacture and supply of replacement step chains for escalators used on the London Underground network.

2. References

2.1. The text of this specification cites other documents that provide information or guidance. These are listed in Appendix 1.

3. Abbreviations

3.1. The following abbreviations are used in this specification:

C of C	Certificate of Conformity
LU	London Underground
QA/QC	Quality Assurance/Quality Control

4. Definitions

4.1. The following terms are used in this specification:

Ladder chain - Two step chains, joined together by their chain axles and delivered to site as a unit.

Strand - A single simplex chain assembly, two such strands being required per escalator.

5. Safety considerations

5.1. Escalator step chains form a safety critical component in the whole machine and, whilst LU escalators are fitted with safeguards against chain failure.

5.2. The potential for injury or even loss of life exists should chain failure occur. Escalator step chains must therefore be manufactured to the highest possible standards to minimise the possibility of failure.

5.3. The Employer requires evidence that the manufacturer is able to achieve the required breaking load for each chain design manufactured.

6. Dimensions and Tolerances

6.1. The Contractor is advised that some LU design drawings are still dimensioned in Imperial units. In this instance, the Contractor is permitted to substitute equivalent Metric values providing that equivalent drawing tolerances are maintained.

6.2. Due care shall be exercised when converting dimensions from Imperial to Metric, to ensure that cumulative errors are not introduced.



7. Procurement

7.1. All materials shall be supplied with a C of C, confirming that the material properties (including any heat treatment) stated on the drawings have been met in full. All C of C's shall be made available to the Employer as part of the quality submission.

7.2. Where chain wheels are indicated on the drawings as being part of the step chain assembly, the Contractor is responsible for their procurement. These are to be manufactured to LU specification SPC-LAE-TM00-0585435 and relevant drawings.

8. Manufacture

8.1. Pins, bushes, rollers

8.1.1. Where components require heat treatment, this shall be carried out by a suitable process to achieve the properties stated on the relevant drawings. All items shall be examined visually for cracking following heat treatment, and any parts found to be defective shall be rejected.

8.1.2. Where necessary, markings shall be applied to the ends of bushes to indicate the alignment of lubrication holes. Such markings shall not be proud of the surface.

8.1.3. Care shall be taken to flush all swarf out of lubrication ways prior to assembly.

8.1.4. Final machining of bushes (with or without polymer inserts) shall not be carried out as part of the inner link assembly.

8.1.5. Where bushes are fitted with a polymer insert, the final machining of the insert bore shall take place after the insert has been pressed into the steel outer sleeve.

8.2. Link plates

8.2.1. Link plates shall not be flame cut.

8.2.2. Link plate holes shall not be punched.

8.3. Assembly

8.3.1. The chains shall be assembled into nominal even number step lengths as required by the purchase order. Odd number-step lengths incorporating cranked links shall be configured, such that the chain length has male and female ends similar to the equivalent even number-step chain length.

8.3.2. Ladder chains shall comprise two chains complete with axles, fittings and wheels and shall be delivered fully assembled.

8.3.3. All chains shall be assembled complete with all ancillary items as indicated on the assembly drawing. It is accepted that joining components and loose items can be supplied separately for site assembly.

8.3.4. If the chain is of a grease-lubricated design, all bearing surfaces shall be pre-lubricated with grease as specified in LU drawing 26-01-015.

8.3.5. When assembling pins and bushes, care shall be taken to ensure that any lubrication holes are aligned strictly as shown on the relevant drawings.

8.3.6. If the chain is of a grease-lubricated design, it shall be charged with the specified grease (see 8.3.4) during and after assembly. Any protruding grease nipples shall then be replaced by plastic plugs for transit (flush fitting concave grease nipples may be left in situ). The grease nipples shall be supplied separately, for fitting on site by others.

8.4. Measurement

8.4.1. Each chain length shall be given a unique identity number and shall be measured between the first and last hole centres. To ensure that no kinks are present and all clearances are taken up in the chain, a tensile load of 10 to 20kN shall be applied, whilst the measurements are taken. Measurements shall be taken to the nearest 0.02mm and shall be recorded in the quality records.



8.5. Marking and labelling

8.5.1. Each length of chain shall be etched or engraved on the outside face of the last outer link plate with the manufacturers name and the year of manufacture.

8.5.2. Each chain length shall then be given an identity tag bearing the order number, chain part number and measured length, which shall be securely, wired to the last link plate.

8.5.3. For all chain types other than ladder chains, each tag shall additionally carry a unique identity, e.g. 1L, 1R, 2L, 2R, 3L, 3R, to ensure that the chains can be re-matched when delivered to site.

8.6. Match pairing

8.6.1. 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 0.5mm. The overall chain length when installed shall be matched left-to-right to within 1mm.

9. Testing and inspection

9.1. Step chain tensile test

9.1.1. The Contractor shall carry out a destructive test of a sample chain at an approved test house. Where the manufacturer has supplied a chain type previously and can provide the destructive test certificate, the Employer will generally waive the requirement for a destructive test.

9.1.2. Where the Contractor is manufacturing a chain design for the first time, a destructive test shall be carried out.

9.1.3. Where a chain has been in production for a prolonged period, The Employer reserves the right to request a repeat destructive test to ensure consistency with the original design.

9.1.4. These tests apply to all chain types. Where the chain is of a "ladder" configuration, the Contractor shall test a single strand.

9.1.5. Where the chain incorporates "cranked" male/female links in the design, the test shall be carried out on a sample of chain containing such links.

9.1.6. For the purposes of this test, the hollow outer link bushes shall be plugged with close-fitting solid bars to represent the axles, the material being the same as that specified for the axles. A tensile load shall then be applied to one end of the chain, the other end being firmly anchored to the test rig. A tensile breaking load in excess of that stipulated on the drawing shall be achieved.

9.1.7 Following this test, a certificate shall be presented to the Employer, who will place this on record as a type test for the given chain type and given manufacturer.

The destructive test certificate shall record:

- a) Date of test;
- b) Name of test house;
- c) Manufacturer of chain;
- d) Chain type;
- e) Drawing number(s) and revision status;
- f) LU purchase order number;
- g) Materials/equipment, traceable to the LU purchase order;
- h) Chain length;
- i) Tensile breaking load;
- j) Yield point;



- k) Elongation at point of failure;
- l) Failure mode and damage incurred by the components;
- m) Calibration certificate of the test equipment.

9.1.8. The test certificate shall form part of a test report. The report shall include photographic evidence of the failure, a tabular and graphical plot of the load/extension relationship, and a written summary. The Contractor shall supply report to the Employer in Adobe pdf format.

9.2. Quality Submission

9.2.1. The Contractor shall provide a quality submission for each chain as a comprehensive record of the manufacture and test (if applicable). The quality pack shall be made available to the Employer at the time of the inspection, or soon after. The quality pack shall include:

- a) C of C confirming acceptability of the chain showing the order number and signed by a representative of the chain manufacturer;
- b) Record of all drawings and revision used in manufacture;
- c) Material certificates for all materials used;
- d) Sample dimensional measurements for each component and sub assembly;
- e) Hardness, depth of hardness and any heat treatment (if applicable);
- f) Results of any NDT processes carried out (if applicable);
- g) Dimensional measurements of complete assemblies;
- h) Destructive test report (if applicable) see clause 9.1.1.

9.3. Audit

9.3.1. The Employer shall audit the Contractor's manufacturing process, relevant drawings, and the Contractor's QA/QC procedures to ensure continued compliance with this specification. This factory audit shall include dimensional or hardness checks of a sample of components. The Contractor shall afford every facility for such inspection, for which the Employer will give adequate notice.

9.3.2. The Employer may also request samples of components for inspection at his own, or a third party's premises.

10. Delivery

10.1. Each complete chain shall be dipped in a suitable light protective oil (e.g. Mobilarma 522' or similar), and allowed to drain prior to packaging.

10.2. Any bushes or joining links, which are to be supplied as loose items, shall be securely wired to the end of the chain. Grease nipples as appropriate shall be bagged and securely taped to the chain.

10.3. The chains shall be packaged on 1200 x 1000 mm two-way pallets, and shall be coiled, banded and shrink wrapped. The number of complete chain lengths to be arranged on each pallet is dependent on size and weight. This shall be agreed with the Employer at receipt of purchase order.

10.4. Wheels shall not be stacked on wheels to avoid flat spots on the tyres.

10.5. Each consignment shall be clearly marked with the LU order number, LU part number, the Contractor's name and the total number of deliveries in the consignment.

10.6. The Contractor shall deliver the chains to a designated LU store, by prior arrangement with the Employer.



Document history

Edition	Date	Notes
01	October 2009	First issue, based on and superseding Metronet specification 2297BCV.
02	February 2016	Revised to incorporate latest quality requirements to DCN LU721.



Appendix 1 - References

References in the text are made to latest editions unless specific editions are cited. Where references are made to other corporate engineering documents that are not yet published, existing documents shall be followed until new documents have been authorised for use.

European and British Standards

BS EN 95-1:2008 Safety rules for the construction and installation of escalators and passengers
+ A1: 2010 conveyors

LU Engineering Standards and Guidance

S1092 Heavy Duty Type Escalators and Moving Walks
S1094 Heavy Duty Metro Type Escalators and Moving Walks

LUL Specification

SPC-LAE-TM00- Manufacture and testing of replacement escalator wheels
0585435

LU Drawings

26-01-015 Lubrication Specification

