



(Minor changes to the previous edition are indicated by ◆ placed before the relevant paragraphs)

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1. Scope

This Specification is written to comply with Engineering Standard 1-202 in defining the requirements for the overhaul of the two types of Tripcock Testers which are used extensively in the signalling system on the London Underground.

The specification hierarchy which supports these requirements is detailed in Attachment 4 to the Specification.

2. References

The text of this document cites other documents that provide information or guidance. These are listed in Attachment 1.

References to British Standards or standards in other standards systems shall be taken to include the words 'or equivalent'.

3. Abbreviations

The following abbreviations are used in this document (if from a published source this is indicated):

CPS	Critical Parameter or Setting
DCN	Design Change Notice
LU	London Underground
OEM	Original Equipment Manufacturer
WSL	Westinghouse Signal Limited

4. Definitions

The Client – The Client is the Infracore representative responsible for administering the contract under which the overhaul work is being performed.

The Contractor – The Contractor refers to the organisation responsible for the delivery of overhauled equipment.

5. Introduction

This specification has been written to detail the overhaul requirements of the two types of Tripcock Testers which are used in the signalling system on the London Underground.

Tripcock Testers are classified as items of vital signalling equipment which means that they are used to perform a safety critical function directly affecting the safe movement of trains. They have been designed to be ultra reliable pieces of equipment whose mechanical and electrical integrity will be relied on throughout its extended working life. It is a mandatory requirement that every unit will perform to its original 'as manufactured' specification after it has been overhauled.

Any failure condition which allows a Tripcock Tester to close a contact when the mechanical conditions dictate that the contact should be open is classed as a 'wrong-side' failure. Wrong-side failures are investigated exhaustively to establish the cause of the failure. Investigations into wrong-side failures will examine materials, processes and the history of overhaul operations to establish the exact cause of the event and to ensure that no other items are likely to suffer a similar failure. An occurrence of a wrong-side failure, even if no accident or damage is caused, can be extremely costly to investigate and could result in the need to change many units in service.

Items supplied for overhaul will be complete units which usually will have failed in service although some may be in working order. The failure mode of equipments will vary, ranging from simple causes such as wear caused by a long period in service with frequent operation, to items which have suffered severe damage. In the latter case there will be an element of salvage involved in the overhaul process. The equipment will be supplied in an 'as found' condition after being removed from its working position on the railway.

The service life of this equipment is 15 years. The shelf life is 3 years.

A general view of a Tripcock Tester and a Motorised Tripcock Tester are shown in Figures A and B respectively.

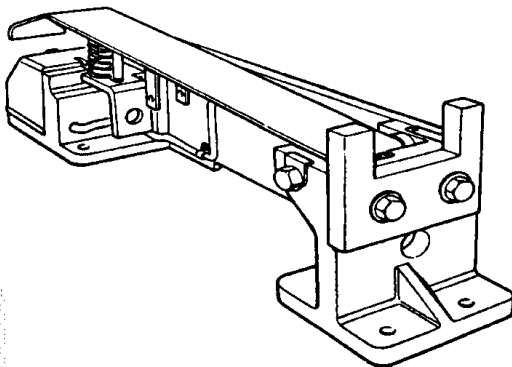


Figure A Tripcock Tester

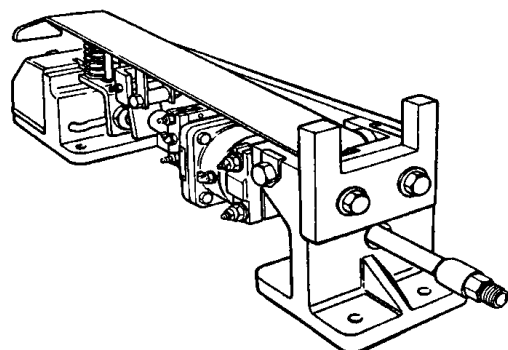


Figure B Motorised Tripcock Tester

6. Usage of item

Tripcock Testers are used to detect the presence of a Tripcock on a train during service runs. A Tripcock Tester is typically positioned in a platform area before the stop mark where the train should be travelling at a slow speed (10 – 15 mph).

The Tripcock Tester has a gauge plate at the entry end which ensures that the Tripcock is within the required position with respect to the running rail. A hinged ramp is depressed by the Tripcock as the train travels the length of the device. If a Tripcock is present the ramp will be depressed and sensed in the depressed condition by a microswitch. Tripcock Testers are unidirectional in operation where the train must approach the unit from the gauge end. This direction of approach provides a shallow angle of approach to the ramp which is required to ensure that the forces applied to the Tripcock are not sufficient to trip it.

Where Tripcock Testers need to be positioned on track where two-way movements can occur then a motorised Tripcock Tester needs to be fitted. This device acts in a similar manner to the un-motorised version for movements over it in the normal direction. When a reverse movement is signalled, the Tripcock Tester is lowered by the air motor to a position where the ramp will not engage with the Tripcock of the train.

7. Equipment design outline

Design features built into the Tripcock Testers include:

- Construction that is designed to be ultra reliable in operation
- Construction designed to withstand the severe vibration and shock forces present where the units are mounted on the track bed.
- An ability to re-furbish the main wearing components without the need to scrap major items.

The original design of the Tripcock Tester included an open style of contact consisting of large wiping chrome plated contact elements. All open style contacts are now to be replaced by a microswitch.

8. Applicability

This specification applies to the following items.

Item	Stores List No.
Tripcock Tester - un-motorised	87S3
Tripcock Tester - motorised	87S6

The Illustrated Parts List and accompanying figures, Attachment 2 to this document, forms part of this specification.

9. Critical functions

Critical Functions of Tripcock Testers are defined to be:

Ultra-reliable Operation: The equipment has been designed to be a highly reliable item which will work in a hostile environment where it is mounted on the track-bed and therefore subject to high levels of vibration.

High Integrity Electrical Switching Properties: Although not to a fail-safe design, the electrical contacts are designed to be ultra-safe in breaking the currents to which they are subjected. The mechanical integrity of the components of the contacts is paramount in achieving the desired performance from the equipment. The switch and its attachment to the equipment require to be to the highest standard achievable.



Electrical Safety. Satisfactory earthing and bonding of the equipment is crucial to ensure that leakage paths to the case or other extraneous metalwork in the event of faults do not give rise to electric shock hazards or to a loss of vital system integrity.

The ability of the item to meet the critical functions listed above throughout its life depends on many factors, not all of which are immediately obvious to people not familiar with all aspects of the design, overhaul and use of the equipment. To ensure that the significance of certain of the detailed requirements is understood and complied with, a number of Critical Parameters or Settings have been designated throughout the text.

Attachment 3 to this Specification lists all the Critical Parameters or Settings [CPS], a reference to the section from which the requirement originates and provides a Criticality Rating of the importance of each CPS item.

The Criticality Rating is based on the severity of the consequence if there is a deviation of the subject parameter from the value specified. Numerical values have been assigned to various levels of the Criticality Rating (CR) according to the table below.

Criticality Rating (CR)	SAFETY RELATED CRITERIA	RELIABILITY RELATED CRITERIA
10	Life critical – sole dependence Occurrence of this deviation alone may lead to an incident causing death or injury.	
8	Life critical – shared dependence Occurrence of this deviation, together with a second deviation which is potentially latent (i.e. not self announcing), may lead to an incident causing death or injury.	
7	Life critical – contributory Occurrence of this deviation increases the probability of an event which may lead to an incident causing death or injury.	Service critical – sole dependence Occurrence of this deviation alone may lead directly to an incident causing major service delays, and indirectly to the danger of a life threatening incident through enforced use of manual rules for operating the railway.
6		Service critical – shared dependence Occurrence of this deviation, together with a second deviation which is potentially latent (i.e. not self-announcing), may lead directly to an incident causing major service delays, and indirectly to the danger of a life threatening incident through enforced use of manual rules for operating the railway.



Criticality Rating (CR)	SAFETY RELATED CRITERIA	RELIABILITY RELATED CRITERIA
5		Service critical – contributory Occurrence of this deviation, increases the probability of an event which may lead to major service delays, and indirectly to the danger of a life threatening incident through enforced use of manual rules for operating the railway.
1	Not life critical	Not service critical

The criticality rating provides a scale of the importance of achieving the specified parameter and therefore of the care needed in designing the process or processes that will lead to the parameter being achieved. The design of the process or processes that will lead to the parameter being met are the responsibility of the Contractor and they shall be designed and documented in accordance with the requirements of Engineering Standard 1-202, Signalling equipment overhaul

10. Performance parameters

Performance parameters applicable to Tripcock Testers are defined and quantified below.

10.1 Defined gauging window

The height and width of the gauging window are as defined in drawings DS28222 and AS29382.

10.2 Defined operating forces

A 2 lb weight, when placed on the Ramp Arm directly above the Spring, shall depress the highest part of the Ramp Arm by at least $\frac{1}{4}$ ".

A 6 lb weight, when placed on the Ramp Arm directly above the spring, shall depress the Ramp Arm fully down onto the stop.

10.3 Contact resistance

Contact Resistance shall be measured with 1 Amp flowing through the contact fed from a 100 V AC supply.

The Contact Resistance calculated from the volt drop measured between terminal posts shall be no greater than 0.2Ω.

10.4 Insulation resistance

The Insulation Resistance between any item forming part of the electrical circuit and any other metallic part of the equipment shall be greater than 50 MΩ when measured at 1000 V DC.

11. Equipment configuration

An Illustrated Parts List is provided as Attachment 2 to this document, comprising an itemised list and three figures to describe the equipment as identified in Section 8 of this specification. The Illustrated Parts List contains all relevant drawing numbers.



A convention of using the figure number followed by the item number has been adopted in this document to uniquely refer to specific components where necessary. Thus, item 1-2 is the Ramp Arm.

With only minor exceptions which are detailed in the assembly section 13.1.5.1, figure 1 details an un-motorised Tripcock Tester. All components from figures 2 and 3 are required to be added to figure 1 to configure a motorised unit.

Unless specifically noted, drawings and figures used in this Specification are for reference only.

12. General requirements

12.1 Compliance with specification

No departures from the requirements of this Specification shall be permitted (either permanently or temporarily) without compliance with the relevant change control procedures.

Neither equivalence of process nor substitution of materials shall be recognised by the Client in receiving work performed against this specification. The Client shall have the immutable expectation that equipment overhauled to this version of the specification shall be 100 % compliant with the specification herein.

12.2 Workshop environment

There are no special requirements of the workshop in which this overhaul work is conducted.

A regulated (0 to 60 p.s.i.) supply of compressed air is required to operate motorised Tripcock Testers. Air consumption is minimal.

Calibrated test equipment shall be used to carry out all measurements specified.

12.3 Calibre of staff

Any staff involved in the overhaul process shall be competent in the tasks they carry out and the Contractor shall demonstrate this in accordance with the requirements of Engineering Standard 1-203, Competence of personnel working on signal and control systems.

12.4 Operator accountability

Process control documentation is required to be completed by identified certified (stamp-holding) operators and inspectors throughout the overhaul process. Each certified operator and inspector shall possess a uniquely numbered stamp which is traceable to the owner. Only competent operators shall be provided with a stamp. Records of the issue and withdrawal (if appropriate) of every stamp shall be kept and shall be made available to the Client on request. The retention period of these records is required to be indefinite.

13. Overhaul definition

Under certain failure modes of the compressed air supply system it may be possible for the air main to be charged at pressures of up to 10 bar. Pneumatically operated signalling equipment must withstand this pressure. It is not required in this Specification for the equipment to be tested at this pressure. However, the Contractor shall not perform any activity on the equipment which will impair its ability to withstand this pressure.

13.1 Full overhaul

Tripcock Testers are generally left in service until they fail. A full overhaul, including repair or replacement of failed component(s) will be performed on each item returned to the workshop.

No item returned after failing in service shall be overhauled until the failure report has been reviewed and accepted by the Client in accordance with a defined arrangement agreed with the Client.



Unless stated to the contrary, all processes detailed in this specification shall be performed for each overhaul.

13.1.1 Dismantle

The Tripcock Tester shall be dismantled in a manner that shall not damage or shorten the life of any component that is required to be re-used. The life of all recyclable components is indefinite.

The items listed below shall be discarded and replaced with new items at every overhaul.

Asset Plate (1-20)	Split Pins (all)	Locking Plates (all)
Lubricating Nipples (1-4 and 2-95)	Lead Seals and Locking wire	Terminal Screws (1-35)
Air Gasket (2-73)	Grommet (1-49)	Cup Washer (3-104)
Wear Ring (item 3-109)	Nuts (all)	Washers (all)

The Switch and Cable Assembly (item 1-43) shall be removed from the unit as a complete item.

Items 1-19, 1-29, 1-60, 2-74 to 2-80, and 2-87 to 2-89 (if fitted) need not be removed from the Mounting Plate (item 1-25) if the whole unit is securely assembled. This group of components forms an 'assembled chassis'.

Ramp Arm Bearings (items 1-3) shall not be removed from the Ramp Arm unless it is determined to be necessary at the examination stage.

Rocker Bearings (items 2-94) shall not be removed from the Rocker unless it is determined to be necessary at the examination stage.

The Piston Extension (item 3-124) shall not be removed from the Piston Rod (item 3-113) unless either part needs replacing or they are not securely fixed together.

13.1.2 CLEANING

The following shall be implemented after the relay has been dismantled in accordance with Section 13.1.1 above.

All components shall be cleaned and degreased using a technique suitable for that component. A 'suitable technique' shall not cause short term or long term degradation to the component nor shall any solvent used leave undesirable residues on the component which will affect the performance of the component when it forms part of an overhauled unit.

13.1.3. Examination and gauging

All components shall be examined for the effects of excessive or unusual wear, general damage, damage caused by misuse or age, electrical arcing or tracking or overheating. All thread forms shall be checked for signs of over-tightening. Items exhibiting damage that will not be corrected by the specified re-furbishing processes shall be discarded.

All occurrences of excessive or unusual wear or damage shall be catalogued and reported to the Client.

The subject items of such reports and as much of the unit from which they were removed as possible, shall be saved in their as near as original condition after being discovered and shall be clearly tagged and identified and shall be made available for Client inspection if so desired.

It is critical that **only** those components specified for refurbishment should be reclaimed after failing the wear tolerances specified.



Items not meeting the examination criteria shall be discarded if there is no refurbishment process detailed for it in this Specification.

Major components and items with specific examination criteria are listed below.

All component parts set aside for use at assembly shall be to a current approved design. Modification schemes may have been commenced which may not yet have been fully implemented. Units submitted for overhaul may not be to the current build standard. Some components may therefore require to be modified or discarded.

13.1.3.1 'Assembled chassis' (Items 1-19, 1-25, 1-29, 1-60, 2-74 to 2-80, and 2-87 to 2-89 (if fitted))

Mounting Plates (item 1-25) to drawing DS25417 item 16 are acceptable for use in an un-motorised Tripcock Tester.

Check the Assembly for general condition and secure fixing of all components. The Assembly shall be square and untwisted.

13.1.3.2 Ramp arm (Item 1-2)

The welds shall be examined for soundness. Items with unsound welds may be refurbished as detailed in section 13.1.4.1 below.

Surface gouging not greater than $\frac{1}{32}$ " is acceptable. Depth of gouging shall be determined after the top face of the item has been dressed smooth.

Wear caused by the passage of a Tripcock along the ramp is acceptable up to a depth of $\frac{1}{16}$ ". The wear limit stated shall be confined to the area of contact of the Tripcock and is not a relaxation of the general thickness of the Ramp Arm.

13.1.3.3 Gauging block (Item 1-22)

All Gauging Blocks shall be examined and measured to drawing AS29382. Damage to the gauging faces caused by being hit by Tripcocks is not acceptable.

13.1.3.4 Ramp arm bearing bushes (Items 1-3)

The maximum acceptable bore of each bush is 0.6280".

Bushes shall be replaced as pairs, as necessary.

13.1.3.5 Hinge bolt (Item 1-18)

The minimum acceptable diameter of the Hinge Bolt is 0.621".

13.1.3.6 Rocker bearing bushes (Items 2-94)

The maximum acceptable bore of each bush is 0.3780".

Bushes shall be replaced as pairs, as necessary.

13.1.3.7 Rocker spindle (Item 2-96)

The minimum acceptable diameter of the Rocker Spindle is 0.373".

13.1.3.8 Switch and cable assembly (item 1-43)

The switch and Cable Assembly shall be examined as a complete item.

Examine the wire loom for signs of damage. Replace extension wiring back to soldered joints at switch tails if necessary.



Switch operation shall be checked. Contact resistance of closed contact shall be checked to be in accordance with section 10.3.

Insulation resistance between open contacts shall be measured and shall be in accordance with section 10.4.

13.1.3.9 Air motor assembly (Item 2-67)

13.1.3.9.1 Cylinder Body

The maximum acceptable diameter of the cylinder body is 3.630".

The bore shall be in good condition, not corroded or pitted.

Items not meeting the above criteria shall be refurbished as described in section 13.1.4.4.1

13.1.3.9.2 Piston Rod (Item 3-113)

The minimum acceptable diameter of the Piston Rod is 0.7445".

13.1.3.9.3 Cylinder Cover (Item 3-102)

All new Cylinder Covers shall be in accordance with drawing DS51077. Existing Cylinder Covers are acceptable provided they are fitted with a Bearing (item 3-116) in accordance with drawing AS52009.

13.1.3.9.4 Cylinder Cover Bearing (Item 3-116)

The bearing shall be gauged in-situ in a Cylinder Cover.

The maximum acceptable diameter of the Cylinder Cover Bearing is 0.7575".

13.1.4 Refurbishment

13.1.4.1 Ramp arm (1-2)

The surface of the Ramp Arm shall be dressed smooth to remove all burrs from the edges of any gouge marks.

Unsound welds may be ground out and re-welded as necessary.

No reworking on the top face of the Ramp Arm is acceptable.

13.1.4.2 Ramp arm bearing bushes (Items 1-3)

New bushes may be fitted to Ramp Arms. Bushes shall be fitted as pairs and shall be reamed in line in position to finished size in accordance with drawing DS25416 items 1 and 7.

13.1.4.3 Rocker bearing bushes (Items 2-94)

New bushes may be fitted to Rockers. Bushes shall be fitted as pairs and shall be reamed in line in position to finished size in accordance with drawing DS28223 item 65 and DS25418 item 88.

13.1.4.4 Air motor assembly (Item 2-67)

13.1.4.4.1 Cylinder Body (Item 3-101)

Cylinders with an oversize bore may be re-sleeved in accordance with drawings 6174-A2-100822 and 6174-A2-100823.

13.1.4.4.2 Cylinder Cover (Item 3-102)

Worn front bearings may be replaced with a new part (item 3-116).



13.1.4.5 Paint finishes

The unit shall be painted as an 'assembled chassis' which shall be painted in accordance with the painting process specified in this section. Items 1-41, 1-48, 1-50 and 2-67 are not considered to be part of the chassis.

The underside of the Ramp Arm (item 1-2), including the welded attachments to the underside, shall be painted.

Items 2-92 and 2-93 shall be painted as separate items before assembly.

Painting shall be done after the item has completed any refurbishing required.

Parts other than the Ramp Arm shall be painted all over with the exceptions listed below.

All bearing surfaces, seating faces, screw threads, threaded holes and operating faces shall be protected from paint application.

Paint application shall be a base coat of Red Oxide Primer (manufacturer- Hadfields, reference 1313.006) – LU Part No. 17412/429, followed by a topcoat of General Purpose Aluminium Paint to LT Specification 174-27 – LU Part No. 17450/225.

13.1.5 Assembly criteria

13.1.5.1 Mechanical assembly

Items 1-5 to 1-8 are only required for configuring a motorised Tripcock Tester.

The height of the highest part of the Ramp Arm (item 1-2) shall be set to be $9\frac{3}{4}'' \pm \frac{1}{32}''$ above the base datum using the nut (item 1-28) on the adjuster (item 1-9).

For motorised Tripcock Testers, with the Ramp Arm fully depressed, adjust the Stop Bolt (item 1-61) to just touch the back face of the Rocker (item 2-93) when the Rocker is held in its driven position. [CPS01]

Loctite Nutlock 242 compound (or approved equivalent) shall be applied to the threads of the Microswitch retaining screws (items 1-42). [CPS02]

Mastic sealant shall be applied to seal the wire entry into the terminal compartment in accordance with drawing DS28222.

Bearings in the Ramp Arm hinge and the Rocker shall be oiled with a 10 W grade general purpose oil (LU Part Number 17616/879) before assembly.

The top surface of the Ramp Arm shall be coated with grease. (Shell Alvania EP (LF) – LU Part Number 17642/489)

Ensure a security chain is fitted between mounting plate (1-25) and terminal cover (1-64) in accordance with drawing number 7034-A1-109563. Also ensure that, during assembly, item 1-10B+ is locked into position by applying 'Loctite Screwlock 222' to its screw thread.

13.1.5.2 Contact settings

The Microswitch Support Bracket (item 1-50) shall be adjusted so that the contact closes when the highest part of the Ramp Arm is depressed between $\frac{1}{8}'' - \frac{1}{4}''$. Two dowel pins shall be inserted after drilling to hold the bracket in this position.