



(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 all variants of J type Trainstops 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 to this Specification.

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):

C.B.	Circuit Breaker
CPS	Critical Parameter or Setting
DCN	Design Change Notice
LU	London Underground
OEM	Original Equipment Manufacturer
p.s.i.	Pounds per Square Inch

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.

'ON' Contact – An 'ON' Contact is a contact that is closed when the Trainstop is in the 'ON' position. A Trainstop is in the 'ON' position when the Trip Arm is in the raised position.

'OFF' Contact – An 'OFF' Contact is a contact that is closed when the Trainstop is in the 'OFF' position. A Trainstop is in the 'OFF' position when the Trip Arm is in the lowered position.

5. Introduction

This specification has been written to detail the overhaul requirements of the style J Trainstop which is used in the signalling system on the London Underground.

J Trainstops 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 an item that has been overhauled shall have a functional performance, a safety integrity, a reliability, an expected service life in its installed condition and a shelf life equivalent to that of a new item.

Any failure condition which allows a J Trainstop to behave electrically as though it is in its 'ON' (raised) position when it is not in that position 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 or a misoperation showing a tendency towards 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 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 J Trainstop is shown in Figure A.

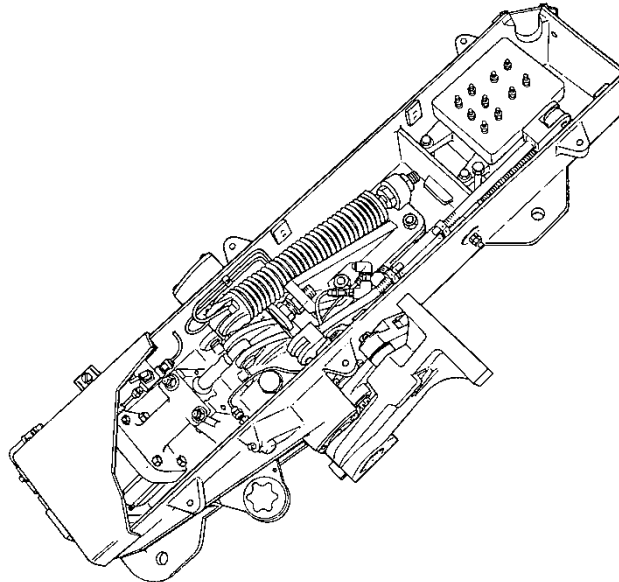


Figure A. General view of a style J trainstop

6. Usage of item

A trainstop is used to apply the emergency brake to a train which proceeds past a designated stop position on the railway e.g. a red signal aspect.

The emergency brake is applied by actuating the Trip Cock of the train by bringing it into contact with the Trip Arm on the Trainstop. To engage the Trip Cock the Trip Arm must be in its raised position.

When the signal clears and it is therefore safe to allow a train to pass the signal, the Trip Arm is lowered to a position where it will not engage with the train's Trip Cock.

The J Trainstop is one of three types of Trainstops that are commonly used on the Underground. Due to its size and configuration with the Trip Arm mounted on the side of the unit, it is only suitable for use on open or cut-and-cover track where there is sufficient clearance for it to be fitted.

The position of the Trip Arm is detected by electrical contacts in the Trainstop. Both raised and lowered positions are detected by contacts which close when the Trip Arm is sensed in its requisite position. The signalling system uses the raised and lowered ('ON' and 'OFF' respectively) contact closures to detect the state of the Trainstop and control the signal system accordingly.

The Trainstop is pneumatically operated by an air motor. Air at nominally 60 p.s.i. is fed to the Trainstop by an independent air valve.

A self contained Circuit Breaker box is fitted to provide detection of the status of the Trainstop. It may be exchanged on site if necessary.

The Air Motor is exchangeable on site to provide for easy maintenance.

Three variants of the standard J Trainstop are used in very small numbers. They are:-

Extended Arm version: This variant is used for wrong-road moves when the positive current rail prevents the fitting of a regular Trainstop. The main shaft is extended by approximately one foot and an extra external bearing is provided to support the end of the extended shaft. The secondary shaft is also extended to cater for the Trip Arm detection linkage.

Heathrow Extension version: This variant is required in areas where flat bottomed rail is used. The distinguishing feature of the variant is that the regular holding down feet on the Trip Arm side of the case are not present and a fixing bracket is used in place of the missing feet. This is because the Trainstop case is



required to fit very close to the bottom web of the rail for it to meet the gauging requirements of the trackside installation.

Fault Screen version: This variant is used in Fault Screen areas of the railway. The holding down feet of a regular Case have enlarged holes in them into which insulating bushes are fitted. Additionally an insulating plate is fixed to the top of the Cover, covering virtually the whole of its area.

7. Equipment design outline

Design features built into the J Trainstop 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.
- Construction designed to withstand the mechanical forces imposed on it by contact with a fast moving Tripcock, and under train failure conditions by displaced parts of a train
- An ability to re-furbish the main wearing components without the need to scrap major components.
- A site exchangeable Air Motor
- A site exchangeable Circuit Breaker Box
- An automatic oiling system for the bearings fed by an oil pump actuated at every operation of the Trainstop.
- An ability to be installed in a safe manner in close proximity to the traction rails

The unit is built using a cast iron case which has a sealed lid and sealed cable entry for the 10-core moulded cable used to attach the contacts to the fixed lineside infrastructure. The main shaft runs in two bronze bearings and carries the Trip Arm on the outside of the case. An operating crank and a return spring crank attach to the square main shaft inside the unit. A single compression spring is used to return the Trip Arm to the 'ON' position when the air pressure is released. A 3" diameter air motor is used to drive the operating crank to lower the Trip Arm to the 'OFF' position.

A self-contained Circuit Breaker Box houses the contacts which sense the position of the Trip Arm. The Circuit Breaker Box is field exchangeable and is treated as a separate item for the purpose of overhaul and is the subject of a separate Specification which details the requirements of the overhaul process.

To achieve the maximum possible integrity in detecting the presence of the Trip Arm, a separate linkage to the actual head of the Trip Arm is used to operate the contacts. The Trip Arm is linked to a secondary shaft which operates the linkage to an Operating Arm which couples with the C.B. Box. A separate spring on the secondary shaft linkage is designed to drive the C.B. Box to the 'OFF' state if the Trip Arm head becomes detached from the Main Shaft.

A non-lubricated air motor and non-lubricated bearings for the external linkages are fitted to this Trainstop. The main and secondary shafts are lubricated by an automatic oiling system using oil from a sump formed by the Trainstop case. The oil pump is operated at each stroke of the Trainstop and oil is supplied to the bearings through metering valves.

8. Applicability

This specification applies to the following items.

Item	Stores List No.
J Trainstop – Standard	73s13
J Trainstop – Extended Arm	73s168
J Trainstop – Heathrow Extension	73s169
J Trainstop – Fault Screen	73s174



The C.B. Box is a self contained component of the Trainstop. The overhaul of the C.B. Box is the subject of a separate Specification, Document Number SSL-SP-3435, Signal Equipment Overhaul Specification, Circuit Breaker Box for styles J and K trainstops.

Units will be supplied for overhaul without an Air Motor installed. An air motor ready to fit into a newly overhauled Trainstop will be free-issued to the Contractor.

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

9. Critical functions

Critical Functions of J Trainstops 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 structural integrity of Trip Arm: The Trip Arm and its associated shaft and bearings are designed to handle the significant forces imparted to the equipment when it is struck by the Tripcock of a train moving at up to 60 m.p.h.

Ability to detect the head of the Trip Arm: The mechanism to detect the position of the Trainstop Arm is linked directly to the head of the Trip Arm and is provided with a separate return spring which ensures that false detection of the Trip Arm is not possible even if it has become detached from the Trainstop.

Stability of gauging: The physical relationship of the Trip Arm in relation to the running rail is paramount in ensuring that Tripcocks engage with the Trip Arm when the Trainstop is in the 'ON' position.

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 setting of the make and break positions of both 'ON' and 'OFF' contacts is critical to ensuring that the Trip Arm is detected within its gauging window.

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 following table.



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.
5		Service critical – contributory Occurrence of this deviation, increases the probability 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 J Trainstops are defined and quantified below.

10.1 Trip arm gauging

With the Trainstop in the 'ON' position (Trip Arm fully raised) the top surface of the Trip Arm shall be $10\frac{1}{8}$ " $\pm\frac{1}{16}$ " above the underside of the Trainstop fixing feet.

For the Standard and Fault Screen versions, the distance from the centre line joining the inner feet bolt holes to the outer edge of the Trip Arm shall be $5\frac{3}{4}$ " $+\frac{1}{16}$ " –nil.

For the Heathrow version, the distance from the centre line of the inner foot bolt hole to the outer edge of the Trip Arm, measured at right angles to the centre line joining the outer feet bolt holes, shall be $5\frac{3}{4}$ " $+\frac{1}{16}$ " –nil.

For the extended Arm version, the distance from the centre line of the Trainstop Case to the centre of the Trip Arm shall be $18\frac{3}{8}$ " $+\frac{1}{16}$ " –nil.

10.2 Contact switching positions

Contact switching positions are defined in relation to the top surface of the Trip Arm when it is in its 'ON' position (see section 10.1).

The switching positions of 'ON' and 'OFF' contacts are as given in the Table 1 below.

Trip Arm depression from raised position	'ON' contacts state	'OFF' contacts state
0 " to $\frac{3}{8}$ "	closed	open
$\frac{1}{2}$ " to $2\frac{3}{8}$ "	open	open
$2\frac{5}{8}$ " to $3\frac{3}{8}$ "	open	closed

Table 1 Contact switching positions

10.3 Contact resistance

Contact Resistance shall be measured with 0.1 Amp flowing through the contact fed from a 100 V A.C. supply.

The Contact Resistance, calculated from the volt drop measured between terminal posts on the C.B. Box, shall be no greater than 0.1 Ω .

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 10 M Ω when measured at 1000 V DC.

10.5 Operating Air Pressures

The Trainstop shall operate to the full off position (Air Motor extended to the full extent of its mechanical stroke) with an applied air pressure of 40 p.s.i.

The normal working pressure is 60 p.s.i. at which pressure the Trainstop shall operate smoothly over the whole stroke and return to the 'ON' position with no signs of sticking at the limit of the stroke.

The Trainstop shall remain in its fully 'ON' position with an applied air pressure of 16 p.s.i.



11. Equipment configuration

An Illustrated Parts List is provided as Attachment 2 to this document, comprising an itemised list and nine 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 Case.

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 applicable the workshop environment.

A regulated (0 to 60 p.s.i.) supply of compressed air is required. 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 overhauling 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

Unless stated to the contrary, all parameters specified are applicable to all variants of the J Trainstop.

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

J Trainstops 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 Trainstop 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 (1-15)	Split Pins (all)	Lockplates (all)
Gasket (1-4)	Sealing Gasket (1-12)	Spring (3-89)
Washer (oil seal) (1-18)	Gasket (fibre washer) (5-150)	Bolt (2-44)
Nut (2-46)	Meter Valves (all)	Copper Washers (all)
Valve Seat Gaskets (6-185)	Sealing Washers (6-181)	'O' Rings (6-183)
Proving Shaft Gasket (4-122)	Main Shaft Gasket (4-111)	Snow Bellows (8-10)
Bearing Inserts (2-48a/c/d)	Proving Shaft Oil Seal (4-114)	Main Shaft Oil Seal (4-95)
Trunnion Units (9-32)	Taper Bolt (9-35)	Trunnion Units (9-44)
Plunger Retaining Pin (6-190)	Screwed rod & jaw (3-69)	Screwed rod & jaw (3-69)

Items listed below shall not be removed at the time of general dismantling. They may be required to be removed after they have been examined and found to be in need of replacement.

All bronze bushes		
Lid Stops and fixings (1-19 and 20)	Studs (1-30)	Studs (6-167)
Screws and Nuts (1-26 and 27)	Eyebolts and fixings (5-147)	Oilway Plug (1-25)
Bolts for blanking unused holes in Case (not itemised)	Trip Arm Pin (2-42)	Clevis Pin (3-60)
Operating Arm Pin (3-77)	Toggle Valve Bracket (5-132)	

The Circuit Breaker Assembly shall be removed as a complete unit and overhauled in accordance with the requirements of document MR-OS-3435, Signal Equipment Overhaul Specification, Circuit Breaker Box for styles J and K trainstops. No details of the overhaul of this item are included in this Specification.

Items 1-38 and 1-39 are provided as part of the C.B. Box assembly

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.

All paint shall be stripped off painted components.

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.

Any component which fails its 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 Case (Item 1-2)

The stripped Case shall be inspected for damage, particularly for signs of cracking in the area of the bearing bores. No cracking is acceptable.

Damage to the feet and the top edge of the Case may be repaired by welding (see section 13.1.4.1).

There shall be no cracking around the Main Bearing and Secondary Shaft Bearing bores.

6 Cover Stop Plates (item 1-19) shall be present and be firmly fixed to the Case. Loose plates shall be removed and re-attached.

All oilways shall be clear of debris.

The maximum acceptable diameter of the main bearing bores is 2.2595 ".

The dimension between the inside faces of the machined bosses for the Main Bearing bore shall be 6.370 " - 6.380 ".

The position of the stop-face behind the Main Bearing bore shall be gauged. The stop-face shall be 0.119 " - 0.131 " above the centre line of the Main Bearing bore. This face may be refurbished if worn; see section 13.1.4.1 below.

13.1.3.2 Cover (Item 1-3)

All fixing lugs shall be securely fixed to the Cover and be in their correct orientation in accordance with the manufacturing drawing. Loose or damaged fixing lugs may be re-attached as part of the refurbishment of the Cover (see section 13.1.4.2).

The Black Polyethylene coating shall completely cover the Cover and be keyed to the base metal without signs of blistering. Covers with a blistered coating shall be refurbished (see section 13.1.4.2).

The height of the internal angle straps inside the lid shall not be greater than 0.490 ".

13.1.3.3 Oil Strainer (Item 1-22)

The Oil Strainer shall be undamaged. The gauze material shall be unbroken and free from blocked pores.

13.1.3.4 Trip Arm (Item 2-41 and 8-9))

The Trip Arm shall be examined for damage to the operating face, the attachment boss around the square hole and the proving linkage pin.

The Trip Arm fitted to a Trainstop which has been subjected to a 'run-through' shall be discarded if the damage sustained in the 'run-through' caused the Main Shaft to be bent or the Case to be damaged sufficient to cause the Shaft or Case to be discarded.



The Pivot Pin (item 2-42) shall be securely attached to the Arm and there shall be no cracking or other damage to the boss into which the Pin fits. A loose Pivot Pin may be re-fixed provided that the boss is sound and the Securing Pin hole is dimensionally correct.

The minimum acceptable diameter of the Trip Arm Pin (item 2-42) is 0.620".

The boss around the square clamping hole shall be undamaged and show no signs of cracking.

Burrs and other superficial damage to the trip head may be removed by filing. Impact damage shall not be deeper than $\frac{1}{16}$ ".

The vertical height from the centre of the shaft hole to the top of the head shall be checked to be within the range 7.620" – 7.630".

For item 8-9 only, the Trip Arm shall be gauged to be within the dimensions given on drawing BS48409. Items with wear to the horizontal dimension between the square bore centre and the stop face may be refurbished (see section 13.1.4.10).

13.1.3.5 Main Spring (Item 3-59)

The plating on the spring shall not exhibit signs of flaking. Items with substandard plating may be refurbished (see section 13.1.4.3).

13.1.3.6 Clevis Pin (Item 3-66)

The minimum acceptable diameter of the Pin is 0.590".

13.1.3.7 Operating Arm Assembly (Item 3-75)

The Operating Arm Pin (item 3-77) shall be firmly attached to the Operating Arm (item 3-76). The minimum acceptable width of the Pin is 0.435" measured across the diameter used to drive the C.B. Box.

The maximum acceptable diameter of Bush (item 3-78) is 0.3770".

The maximum acceptable diameter of Bush (item 3-79) is 0.315".

The maximum acceptable diameter of Bush (item 3-80) is 0.755". The minimum acceptable length of the bearing is 1.039".

13.1.3.8 Operating Arm Assembly (Item 3-75)

The minimum acceptable diameter of the Pin (item 7-77) is 0.435". The Pin shall be firmly attached to the Operating Arm. Renew Pin if loose or undersize.

The maximum acceptable diameter of the Screwed Jaw Bush (item 3-78) is 0.755".

The maximum acceptable diameter of the Return Spring Rod Bush (item 3-79) is 0.315".

The maximum acceptable diameter of the Fulcrum Pin Bush (item 3-80) is 0.755".

13.1.3.9 Fulcrum Pin (Item 3-81)

The bearing surface shall be smooth all over and free of blemishes.

The maximum acceptable length of the bearing shoulder is 1.161".

The minimum acceptable diameter of the bearing surface is 0.745".

13.1.3.10 Headed Pin (Item 3-86a)

The Pin shall be unmarked on the bearing surface with no burrs around the cross-pin hole.

The minimum acceptable diameter of the Pin is 0.370".

13.1.3.11 Headed Pin (Item 3-86b)

The Pin shall be unmarked on the bearing surface with no burrs around the cross-pin hole.

The minimum acceptable diameter of the Pin is 0.309".

13.1.3.12 Headed Pin (Item 3-86c)

The Pin shall be unmarked on the bearing surface with no burrs around the cross-pin hole.



The minimum acceptable diameter of the Pin is 0.370 ".

13.1.3.13 Return Spring Rod (Item 3-88)

The maximum acceptable diameter of the Pin hole in the jaw end is 0.315 ".

Items not meeting the above criteria may be refurbished (see section 13.1.4.6).

13.1.3.14 Main Shaft Bearing Bush (Item 4-96)

The bearing surface and both sides of the flange shall be of a fine finish without any blemishes.

The minimum acceptable diameter of the bearing is 2.2405 ".

The maximum acceptable length of the journal part of the bearing is 2.820 ".

13.1.3.15 Main Shaft (Item 4-97)

The Shaft shall be examined for damage, particularly around the radiused notches where the Trip Arm and cranks are attached and where the main bearings fit. No damage is acceptable.

Twisting or bowing of the shaft causing the item to fall outside of a flatness tolerance of 0.005 ", measured over the whole length of the square section of the item is not acceptable.

The surface of the round section shall be unblemished with a polished surface finish suitable for seating an oil seal. The minimum acceptable diameter of this section is 1.682 ".

13.1.3.16 Stop Arm (Item 4-100)

The item shall be examined for cracking, particularly in the region of the boss around the clamping bolt hole and the stop face protrusion. No cracking is acceptable.

The maximum acceptable dimension through the centre line of the square hole to the stop face is 0.133 ".

Items worn beyond this dimension may be refurbished (see section 13.1.4.7).

13.1.3.17 Roller Crank (Item 4-104)

The item shall be examined for cracking, particularly in the region of the boss around the clamping bolt hole. No cracking is acceptable.

The maximum acceptable diameter of the Pin bore is 0.630 ".

This item may be refurbished by bushing the Pin hole if the casting wears beyond the limit above (see section 13.1.4.8). New bushes may be fitted to items which have already been refurbished.

13.1.3.18 Roller Assembly (Items 4-105 and 4-106)

The outside diameter of the Roller shall be free of flats and other defects.

The maximum acceptable diameter of the bearing bore is 0.630 ". A new bush may be fitted if the existing bush has worn beyond the limit above.

13.1.3.19 Headed Pin (Item 4-107)

The bearing surface shall not be scratched or scored.

The minimum acceptable diameter of the Pin is 0.620 ".

13.1.3.20 Spring Crank (Item 4-110)

The item shall be examined for cracking, particularly in the region of the boss around the clamping bolt hole. No cracking is acceptable.

13.1.3.21 Proving Shaft Bush, Large (Item 4-115a)

The bearing surface shall not be scored or otherwise damaged.

The maximum acceptable diameter of the bearing is 1.066 ".

The minimum acceptable thickness of the flange is 0.148 ".

13.1.3.22 Proving Shaft Bush, Small (Item 4-115b)

The bearing surface shall not be scored or otherwise damaged.



The maximum acceptable diameter of the bearing is 0.753 "

The minimum acceptable thickness of the flange is 0.148 ".

13.1.3.23 Proving Shaft (Item 4-116)

The bearing surfaces shall not be scored or otherwise damaged. The taper seating for the arm shall be unblemished and shall fit the arm without any movement between the two components.

The minimum acceptable diameter of the small bearing end is 0.746".

The minimum acceptable diameter of the large bearing surface is 1.057".

13.1.3.24 Pump Operating Arm and Bush (Items 4-120 and 4-121)

The item shall be examined for cracking, particularly in the region of the boss around the clamping bolt hole. No cracking is acceptable.

The minimum acceptable diameter of the bearing is 0.378 ". A new bush may be fitted if required.

13.1.3.25 Oil system pipes and fittings (General)

All pipes shall be examined. Crushed, restricted or leaky items are not acceptable.

All components shall be flushed through with clean oil to ensure they are free of foreign material.

13.1.3.26 Operating Lever Assembly (Item 6-170)

The maximum acceptable diameter of the bearing bush is 0.315 ".

A new bush may be fitted to items not meeting this criteria.

13.1.3.27 Headed Pin (Item 6-173)

The minimum acceptable diameter of the Pin is 0.309 ".

13.1.3.28 Roller and Bush (Items 6-174 and 174a)

The outside diameter of the Roller shall be undamaged with no flats worn into the periphery.

The maximum acceptable diameter of the Bush is 0.315 ". A new Bush may be fitted if the wear limit has been exceeded.

13.1.3.29 Headed Pin (Item 6-175)

The minimum acceptable diameter of the Pin is 0.309 ".

13.1.3.30 Pump Body (Item 6-176)

The maximum acceptable diameter of the pump chamber bore is 0.504 ".

The maximum acceptable diameter of the bearing holes is 0.315 ".

13.1.3.31 Oil Filter (Item 6-178)

All joints in the item shall be sound and the gauze material unbroken and clear of blockages to the pores. A new gauze may be fitted if required.

The item shall be free of foreign bodies and other contaminants.

13.1.3.32 Plunger Shaft (Item 6-187)

The maximum acceptable diameter of the pin hole is 0.315 ".

13.1.3.33 Plunger (Item 6-189)

The minimum acceptable diameter of the Plunger is 0.497 ". The surface of the item shall not be scored or otherwise damaged.

13.1.3.34 Framework – extended arm (Item 8-2)

All welds shall be visually examined for soundness. Cracked welds may be treated as described in section 13.1.4.9.



The Framework shall be checked to be within the limits of the manufacturing drawing in respect twist and alignment.

The horizontal distance between the centreline of the bearing housing and the stop face shall be $2\frac{7}{8}'' \pm \frac{1}{32}''$. Items not meeting this criteria may be refurbished (see section 13.1.4.9).

The maximum acceptable diameter of the Main Shaft bearing bore is 2.2595 ".

13.1.3.35 Main Bearing (Item 8-4)

The bearing surface and both sides of the flange shall be of a fine finish without any blemishes.

The minimum acceptable diameter of the bearing is 2.242 ".

The maximum acceptable length of the journal part of the bearing is 2.820 ".

13.1.3.36 Proving Shaft Bearing (Item 8-6)

The bearing surface shall be of a fine finish without any blemishes.

The minimum acceptable diameter of the bearing is 0.755 ".

13.1.3.37 Stub Shaft (Item 9-48)

The bearing surface shall be of a fine finish without any blemishes.

The minimum acceptable diameter of the bearing part of the shaft is 0.745 ".

13.1.4 Refurbishment

13.1.4.1 Case (Item 1-2)

The Trip Arm stop face may be restored by machining away the worn face before building it up with Stellite welding material and machining back to original manufacturing dimensions. The minimum acceptable thickness of the weld deposition remaining after machining back to final size is 0.025 ".

Damage to the feet and the top edge of the Case may be repaired using by welding.

Damaged threads in the Lid lugs may be repaired using $\frac{3}{8}''$ BSF helicoil inserts.

13.1.4.2 Cover (Item 1-3)

Covers requiring a new plastic coating shall be completely stripped back to bare metal. The surface shall be shot blasted or otherwise treated to prepare it so that the plastic coating adheres to the total surface area of the item. Blisters in the coating are **not** acceptable.

The Cover shall be completely coated with a coating of black High Density Polyethylene.

Fixing Lugs may be replaced to original manufacturing dimensions on Covers that have been stripped for re-coating.

13.1.4.3 Main Spring (Item 3-59)

The item may be replated to the original manufacturing specification after all the old plating has been stripped.

13.1.4.4 Return Spring Rod (Item 3-88)

The Pin holes in the jaw end may be refurbished using a press fitted bushes finish machined to original manufacturing dimensions

13.1.4.5 Stop Arm (Item 4-100)

The stop face may be built up with weld leaving a minimum thickness of deposition of 0.025 ".

13.1.4.6 Roller Crank (Item 4-104)

Oversize holes may be refurbished by using a press fitted bush finish machined to original manufacturing dimensions

13.1.4.7 Framework – extended arm (Item 8-2)

Cracked welds may be repaired by grinding out the faulty weld to a maximum depth of $\frac{3}{4}$ of the thickness of the base material before rewelding to the original manufacturing specification. A cracked weld shall be repaired over the whole of its length.

The Trip Arm stop face may be machined back and made up with weld before being machined back to the original manufacturing dimension.

13.1.4.8 Trip Arm (Item 8-9)

The stop face of the Trip Arm may be restored by machining away the worn face before building it up with weld and machining back to dimensions given on drawing BS48409. The minimum acceptable thickness of the weld deposition remaining after machining to size is 0.025 “.

13.1.4.9 Paint Finishes

All un-plated ferrous components shall be painted in accordance with the process specified below.

The items listed below shall be painted in accordance with the specification detailed in this section.

Case (1-2)	Trip Arm Assembly (2-40)	Link (2-47)
Lever Arm (2-52a)		Turnbuckle (3-74)
Cover Plate (4-94)		Stop Arm (4-100)
Roller Crank (4-104)	Operating Arm Assembly (3-75)	Spring Crank (4-110)
Cover Plate (4-112)	Retainer Plate (4-113)	Eye Bolt (5-142)
Cover Plate (4-123)	Pump Operating Arm (4-120)	Eye Bolt (5-147)
Framework (8-2)	Air fittings (5-151 to 165)	Main Shaft Coupling (8-3)
Trip Arm (8-9)	Secondary Shaft Coupling (8-5)	

The Air Pipe fittings, the Main Shaft Coupling and the Secondary Shaft Couplings on Extended Arm variants shall be painted after assembly has been completed.

All machined surfaces, mating surfaces, bearing surfaces, screw threads and threaded holes and oilway holes shall be protected from paint application.

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

Bare metal seating to the full diameter of the fitted components shall be provided on the inside and outside of the Case to provide a good electrical connection for the Earth Screw (item 1-8) and associated parts.

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

The Trip Arm side of the Case shall have a final coat of Grey High Build Car Body Paint (Ripothane, Williamson Ref. 31/PL123, LU Stores Part Number 17438/635) applied over the Aluminium coat.

The face of the Trip Arm shall have a final coat of white gloss paint applied over the Aluminium top coat.

13.1.5 Assembly Criteria

13.1.5.1 Assembly for all variants

All mating surfaces shall be lightly coated with a film of 10W grade general purpose lubricating oil before assembly.



The Main Spring (item 3-59) and the Secondary Spring (item 3-89) shall be liberally coated with Shell Alvania EP(LF)1 Grease (or other approved equivalent grease) at time of assembly.

Loctite Multi-Gasket compound, or approved equivalent, shall be used sparingly to make air-tight joints on the air pipe fittings. The compound shall not be allowed to penetrate to the inside of the fittings. [CPS01]

All split pins shall be fully opened and turned back round the retained component to the extent of their length.

The Gasket Material (item 1-4) shall be stuck into the recess in the Cover (item 1-3) using Evo-Stick or other approved equivalent product.

Cover Stop Plates (items 1-19) shall be fitted in accordance with drawing AS36516.

The Earthing Screw (item 1-8) and associated components shall be tightened down onto bare metal of the Case. The Case shall be cleared of paint over a 1 " diameter around the fixing hole on both sides of the case. [CPS02]

Loctite 574, or approved equivalent compound, shall be used when assembling the Main Shaft and Proving Shaft Cover Plates, Retaining Plates and associated gaskets (items 4-94, 111, 112, 113, 122 and 123). [CPS03]

The Main Shaft Oil Seal (item 4-95) shall be installed in accordance with drawing CS28225.

Spacing Washers (item 4-109 a-b) shall be installed on the Main Shaft (item 4-97) as required to prevent the Spring Crank (item 4-110) interfering with the Main Crank (item 4-104) and to adjust the end-play of the Main Shaft to be within the range 0.025 " – 0.040 ". [CPS04]

Shims (item 3-83) shall be used as required to align a slot in the Castle Nut (item 3-84) when tightening the Fulcrum Pin (item 3-81).

The Air Motor (item 5-125) shall be fitted in accordance with drawing BS55966.

The Air Motor Flexihose (item 5-135) shall be fitted in accordance with drawing CS49949. The open end of the pipe shall be proud of the outside of the Case by between 0 " and $\frac{1}{16}$ " to ensure expelled condensate is not able to drain into the Case.

The Trip Arm (item 2-41) shall be fitted to the Main Shaft (item 4-97) in accordance with drawing AS44514. [CPS05]

Clearance of at least $\frac{1}{16}$ " shall exist between the Trip Arm boss and the heads of the Main Shaft Retaining Plate fixing screws (items 4-92). [CPS06]

The connection between the Trip Arm and the Secondary Shaft Lever Arm (item 2-52) shall be made in accordance with drawing BS61296. Spacing Washers (item 2-50) shall be used as required to ensure correct alignment.

All bearings shall be lubricated with a 10W general purpose lubricating oil before assembly. All oil pipes, oil passages and the Oil Pump shall be primed with fresh oil.

When the Trip Arm is fully raised into the 'ON' position, the Stop Arm (item 4-100) shall be transferring the full return force of the Main Spring onto the stop face of the Case. It shall be possible to retract the Air Motor Piston to achieve an air gap between the Piston Head and the Roller (item 4-105). [CPS07]

The Stop Bolt and Nut shall be adjusted to allow the top surface of the Trip Arm to be depressed by $3\frac{1}{4}$ " + $\frac{1}{8}$ " – nil from its fully 'ON' position. The Stop Bolt and Nut shall be secured using Loctite Screwlock 222 compound or approved equivalent. When the Air Motor is fully extended and the Roller (item 4-105) is in contact with the Piston Rod end there shall be a gap of at least $\frac{1}{16}$ " between the Stop Bolt and the Roller Crank. [CPS08]

There shall be a minimum clearance of $\frac{3}{16}$ " between the Case partition and the Proving Rod Linkage at all positions throughout the stroke of the Trainstop as detailed in drawing AS61104.

The lubrication system shall be connected in accordance with drawing CS63855.

The sump shall be filled via the oil strainer with sufficient oil to test correct operation of the Oil Pump and oil distribution system.



The Oil Pump shall generate an oil pressure of at least 40 p.s.i. measured at the delivery port of the pump. [CPS09]

The C.B. Box contacts shall be set to make or break within the ranges given in table 1(see section 10.2).

There shall be a gap of at least $\frac{1}{16}$ " between the C.B. Box operating lever and the limit stops on the C.B. Box when the Trainstop is fully 'ON' and when it is fully lowered so as to engage the Stop Bolt. [CPS10]

The Pump Operating Arm shall not touch the Oil Pump Roller when the Trainstop is in the fully 'ON' position. The Oil Pump shall not reach the end of its stroke when the Trainstop is lowered to the limit of the Stop Bolt. [CPS11]

No part of the Air Motor or its fixings or the Terminal Studs of the C.B. Box shall project more than 0.440 " above the top edge of the Case. [CPS12]

13.1.5.2 Additional assembly for extended arm variant

The Case shall be drilled in accordance with drawing ES27978 to accommodate the fitting of two 3-way junctions and associated components.

The 3-way Junction (item 7-195) is replaced by a 4-way Junction (item 8-12) to allow extension of oil circuit to the outboard bearings.

The screws (items 9-37 and 9-47) which secure the Cover Plates (items 9-38 and 9-45) shall be locked by centre-punching metal from the Cover Plate into each end of the screwdriver slot of each screw. [CPS13]

13.1.6 Operational Tests

The tests in this section shall be carried out on a fully assembled and adjusted Trainstop.

13.1.6.1 Trip Arm Gauging

The vertical position of the Trip Arm shall be checked to be in accordance with the requirements of section 10.1 of this Specification. [CPS14]

The horizontal position of the Trip Arm shall be checked to be in accordance with the requirements of the relevant part of section 10.1 of this Specification. [CPS15]

The width of the top face of the Trip Arm shall be checked to be $5\frac{1}{2}$ " + $\frac{1}{32}$ " – nil. [CPS16]

13.1.6.2 Contact Gauging

The switching action of all contacts shall be tested by measuring electrical continuity across the terminals posts of the C.B. Box. The switching position of all contacts shall fall within the parameters given below.

Trip Arm depression from raised position	'ON' contacts state	'OFF' contacts state	
0 " to $\frac{3}{8}$ "	Closed	Open	[CPS17]
$\frac{1}{2}$ " to $2\frac{3}{8}$ "	Open	Open	[CPS18]
$2\frac{5}{8}$ " to $3\frac{3}{8}$ "	Open	Closed	[CPS19]

After adjustment of the contact switching point using the Turnbuckle (item 3-74), it shall be locked in position in accordance with drawing EES-A2-122739. [CPS20]

13.1.6.3 Air Operation Tests

The Trainstop shall operate to the full extent of the stroke of the Air Motor with an applied air pressure of 40 p.s.i. [CPS21]

The Trainstop shall operate smoothly over its whole stroke at an applied air pressure of 60 p.s.i. and show no signs of sticking at either end of its stroke. [CPS22]



With 60 p.s.i. applied air pressure, the depression of the top surface of the Trip Arm shall be $2\frac{7}{8}$ " – 3" below its 'ON' position. [CPS23]

The Trainstop shall remain in its fully 'ON' position with an applied air pressure of 16 p.s.i. [CPS24]

13.1.6.4 Contact Resistance Tests

The Contact Resistance of each closed contact shall be measured. The Contact Resistances measured shall be in accordance with the parameters specified in section 10.3 of the Specification. [CPS25]

13.1.6.5 Insulation Tests

The Insulation Resistance shall be measured between the contacts and the Case with all contacts posts of the C.B. Box connected together. The resistance between the connected terminals and the Case shall be in accordance with section 10.4 of the Specification. [CPS26]

The Insulation Resistance shall be measured between each terminal post of the C.B. Box and every other terminal post. Note that some tests will need the Trainstop to be operated to the 'OFF' position to cause the terminal pair to be open circuited. The resistance between pairs of terminals shall be in accordance with section 10.4 of the Specification. [CPS27]

13.1.6.6 Lubrication system check

The final oil pipe union before the point of oil delivery to each lubrication point shall be slackened in turn and a check made that oil is being delivered to every point. [CPS28]

13.1.6.7 Air seal test

Air shall be fed to the Trainstop from an airtight isolating cock via a 10' length of $\frac{1}{2}$ " air hose. A pressure gauge shall be connected to the isolated section of hose.

The Trainstop shall be pressurised at 60 p.s.i. before the isolating cock is closed. The air pressure in the isolated system shall not have dropped by more than 1 p.s.i. 1 minute after closing the air cock. [CPS29]

13.1.6.8 Proving Arm Test

On a fully assembled and adjusted Trainstop, the Link Pin (item 2-51) shall be removed from the Proving Shaft linkage with the Trainstop in its 'ON' position.

On withdrawal of the Link Pin the C.B. Box shall, unassisted except by the force exerted by the Proving Rod Return Spring (item 3-89), move to a position where all 'OFF' contacts are closed and all 'ON' contacts are open. [CPS30]

13.1.7 Certification and final inspection

13.1.7.1 Certification

A number of dimensions and settings are critical to the safe and reliable operation of the unit. The items considered to fall in this category are identified throughout the specification as CPSxx items (Certifiable Parameter or Setting) where xx runs from 01 through to 30 with no missing numbers. Parameters or settings which are subsequently withdrawn from being critical shall be removed from the list without removing the number allocated. Unused numbers shall be labelled 'Intentionally Blank' A complete list of all CPS items is included as Attachment 3 to this document.

A permanent hard copy of the build record shall exist for each unit. The primary identity of the build record shall be the asset number of the Trainstop. The build record shall record the following fields:-

- Asset number of Trainstop
- Asset number of fitted Air Motor
- Asset number of fitted C.B. Box
- Unit type
- Date of overhaul.
- Final Test operator identity (by stamp number)
- Final Inspector identity (by stamp number)