



(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 both variants of Disc Signals 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.

3. Abbreviations and symbols

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

AC	Alternating current;
BA	British association;
BSF	British standard fine
BSP	British standard pipe
BSW	British standard Whitworth;
CPS	Critical Parameter or Setting
°	Degree (plane angle);
DC	Direct current;
DCN	Design Change Notice



dia.	Diameter;
EP	Electro-pneumatic
GE	Glass Enclosed
Hz	Hertz;
in.	Inch
lbs/ft ³	Pounds per cubic foot;
LU	London Underground
mm	Millimetre, $1 \times 10^{-6} \text{ m} = 1 \text{ mm}$;
MΩ	Megohm, $1 \times 10^6 \Omega = 1 \text{ M}\Omega$;
Ω	Ohm;
OEM	Original Equipment Manufacturer
p.s.i.	Pounds per Square Inch
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 Electro-Pneumatic Disc Signals which are used in the signalling system on the London Underground.

Disc Signals are classified as items of vital signalling equipment which means that they are used to perform a critical safety function directly affecting the safe movement of trains. They have been designed to be an ultra reliable piece 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 causes the unit to be detected in its 'ON' (signal at danger) position when it is not, 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.

A general view of a Tunnel Type and an Outdoor Type is shown in Figures A and B respectively.

Items supplied for overhaul will be complete units which may be in working order or may have failed in service. The failure mode of equipments will vary, ranging from simple causes such as open circuit contacts, 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.

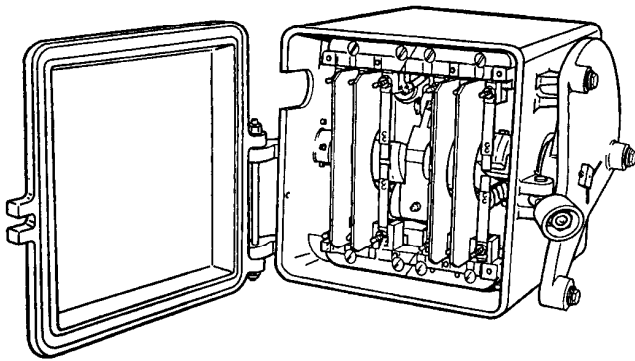


Figure A Tunnel Type Disc Signal

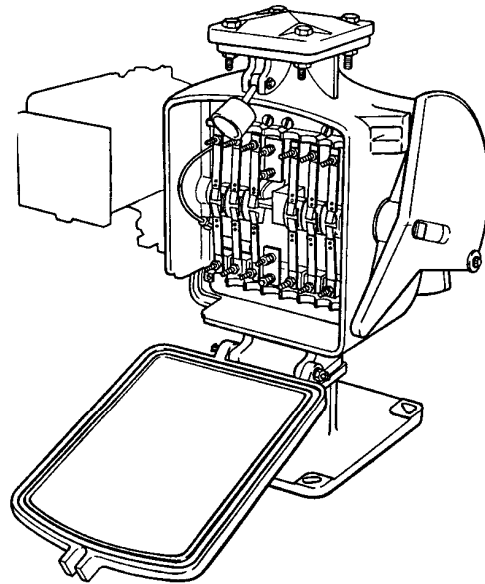


Figure B Outdoor Type Disc Signal

6. Usage of item

Disc Signals are used to authorise the movements of trains performing non-passenger movements onto and off the running lines. In open sections they may be either post mounted, generally when positioned in association with a stop signal, or track-bed mounted. In tunnel sections they are usually mounted low down either to the tunnel segments or on the track-bed.

Both types use a 15 inch circular plate (the disc) to indicate their status of either '**ON**' or '**OFF**'. The disc has a white background with a red band painted symmetrically through its centre. In the '**ON**' condition the red band is horizontal. The disc rotates approximately 30 ° in a clockwise direction in which position it is interpreted to be '**OFF**'.

The disc is not part of the equipment as described in this specification. It is treated as part of the fixed track-side apparatus and is thus not returned to the workshop when the signal is removed from site for maintenance activities.

Disc Signals are externally lit by a separate lamp unit which is part of the fixed track-side apparatus.

Outdoor Disc Signals contain their own integral Air Valve units and are therefore supplied with a constant supply of compressed air at nominally 60 p.s.i. pressure.

Tunnel Disc Signals are fed with an air supply controlled by a separate Air Valve.

7. Equipment design outline

Design features built into both types of Disc Signal include:-

- Construction that is designed to be, as far as is practicable, ultra reliable in operation



- Construction designed to resist the shock and vibration forces to which it will be subjected due to their mounting in close proximity to the running rails
- Six proving contact pairs to detect the state of the signal. Five 'ON' and one 'OFF' contacts are provided.

Both styles of Disc Signal are housed in a cast iron box with cast hinged lids allowing access to the internal components and connections. The size and layout of the boxes are different for each type.

A 3 in. diameter air motor is used to rotate a main shaft by pressing against an operating arm attached to the shaft. A spring return unit containing three springs acting in parallel operates on the same operating arm and is arranged to return the disc to its quiescent horizontal position when the supply of air to the motor is removed. The main shaft also carries six rotary contacts which align with pairs of stationary contacts mounted on insulated terminal blocks. Five of the rotary contacts are positioned to close with the fixed contacts when the signal in its 'ON' state. The sixth is positioned to close with the fixed contacts when the signal in its 'OFF' state.

The design of the contacts follows the usual practice of using contact tips riveted to phosphor bronze spring elements. The spring elements of the contact assemblies are stiffened and retained in position by keeper plates and plate washers.

8. Applicability

This specification applies to the following items.

Item	Stores List No.
EP Disc Signal - Outdoor Type (1937)	65S51
EP Disc Signal - Tunnel Type	65S103

This specification is **not** applicable to the single spring version of the tunnel type of Disc Signal housed in a shallow case which is too small to accommodate a triple spring return unit.

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

The above definition, and Stores List No. of the Outdoor type includes the attached GE Air Valve. This specification does not detail the overhaul processes used to overhaul the GE Air Valve unit. For details of this overhaul see Equipment Overhaul Specification for the GE Air Valve (document number MR-OS-3430).

9. Critical functions

Critical Functions of Disc Signals 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 or close to the track-bed.

Fail-safe detection of signal being in the 'ON' position. Whilst the operation of the Disc Signal is not itself fail-safe, the detection of it being in the 'ON' (danger) state is required to be.

Electrical Safety. Satisfactory earthing and bonding of the Disc Signal 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 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
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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 Disc Signals are defined and quantified below.

The 'ON' position of the Signal is defined to be the de-energised position at which the Spectacle Plate comes to rest under the action of the return springs after air pressure has been removed. A positive stop shall be achieved by the piston rod head touching the cylinder front casting.

The 'OFF' position of the Signal is defined to be the position that the Spectacle Plate achieves when driven by the air motor to the full limit of its stroke.

10.1 Operating pressure

The Disc Signal shall energise to the fully 'OFF' position with an applied air pressure of 35 p.s.i.

The normal operating air pressure is 60 p.s.i. at which pressure the Signal shall energise and de-energise smoothly with no signs of sticking during any part of the cycle.

10.2 Setting of 'ON' contacts

All 'ON' contacts shall close when the Spectacle Plate is within the range of $5^\circ + \text{nil} - 1^\circ$ of the 'ON' position.

10.3 Setting of 'OFF' contacts

The 'OFF' contact shall close when the Spectacle Plate is within the range of $5^\circ \pm 1^\circ$ of the 'OFF' position.

10.4 Contact resistance

The contact resistance, calculated from the voltage drop measured across corresponding pairs of Terminal Screws, of each pair of contacts, set to the conditions given in section 13.1.5.2 below and with 0.1 amps flowing through the contacts from a 100 volt AC source, shall be less than 0.2Ω .

10.5 Electrical insulation

The insulation resistance between any pair of electrical terminals and between each terminal and any other metallic component of the equipment shall be $\geq 10 \text{ M}\Omega$ when measured at 1000 V DC.

This parameter is applicable to the unit in the 'ON', 'OFF' and all intermediate positions.

11. Equipment configuration

An Illustrated Parts List is provided as Attachment 2 to this document, comprising an itemized list and exploded component drawings to describe the equipments 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 1-3 is the Front Cover of an Outdoor type of Disc Signal.



The Parts List does not include the component parts forming the GE Valve used as part of the complete unit. For details of this sub-assembly see the Equipment Overhaul Specification for the GE Air Valve (MR-OS-3430). The GE Valve attached to each Disc Signal is assumed to be operating within the parameters called for in the referenced specification.

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 conditions required of the workshop environment.

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

Services required to carry out this work include: -

A supply of compressed air regulated over the range 20 – 60 p.s.i. Air consumption is minimal.

A supply voltage adjustable over the range 0 - 110 volts at 125 Hz or 33 $\frac{1}{3}$ Hz to operate the GE Valve.
Current drawn is less than 1 amp.

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 signal 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

A full overhaul will be performed on items which generally will have been in service for their full routine service life, or which will have been removed from service as a result of a failure.

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 Disc Signal 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.

All parts of each unit shall be kept together as a kit of parts. This is particularly important with respect to the Piston Rod (items 4-108 and 8-88) and their mating Piston Head Nut (items 4-109 and 8-89).

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

Locking Plate (1-31)	Asset Plate	Aeronuts (all)
Cup Washer (4-111 and 8-91)	Felt Oil Band	Door and cable entry Gaskets
Spring Washers (All)	Oil Nipples (All)	Split Pins (All)
Contact Tips (All)	Copper Seating Washers (All)	Air Filters (1-26)
Sealing Washers (All)	Fibre Sealing Washers (All)	

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 finishes shall be removed before the individual components are examined.

All oil-ways and air passages shall be thoroughly cleaned to ensure they are not blocked and that there is no swarf, dried grease or foreign matter in them.

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. Signs of electrical tracking or arcing shall be treated as excessive wear.

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 All cast components

No cast components shall exhibit any sign of damage or cracking.

Tapped holes shall not exhibit signs of damage or wear to threads.

13.1.3.2 Case casting (Item 1-2 and 5-1)

The bearing hole in the back face of the Case shall be examined for wear. The maximum acceptable diameter for this bearing hole is 0.6290 in.

The bearing hole in the front face of the Case shall be examined for wear. The maximum acceptable diameter for this bearing hole is 1.509 in.

Cases with bearing holes worn to greater than the above dimensions may be refurbished as detailed in section 13.1.4.2.

Outdoor Cases previously drilled for fitted with an R.S.A. Terminal block shall be refurbished in accordance with section 13.1.4.2 of this specification.

13.1.3.3 Contact spring (Items 2-64a and 6-32a)

All Contact Springs shall have the elongated hole in accordance with drawing AS29862.

No item shall exhibit signs of peeling or corroded plating.

13.1.3.4 Rotary Contact (Item 3-74, 7-41 and 7-41a)

The moulding shall not be chipped or cracked and the inset contact shall be firmly embedded.

The surface of the contact shall be completely covered with plating which shall show no signs of electrical erosion through to the base material. The surface finish shall be suitable for restoring by buffing.

13.1.3.5 Operating Crank (Item 3-77)

The maximum acceptable diameter of the bore is 0.628 in.

13.1.3.6 Main shaft (Items 3-82 and 7-45)

The bearing surface at the rear end of the Main Shaft shall be examined for wear. The minimum acceptable diameter of this journal is 0.6180 in.

All threaded holes in the shaft shall have serviceable threads.

13.1.3.7 Main bearing (Items 3-89 and 7-56)

The Main Bearing shall be examined for wear. The minimum acceptable diameter is 1.4950 in.

13.1.3.8 Springs (Items 3-91, 3-92, 7-65 and 7-66)

The plating shall be examined for cracking and peeling. Items with cracked or peeling plating shall be re-plated after stripping off all existing plating.


13.1.3.9 Yoke, Top (Items 3-93 and 7-63)

The Plunger (item 3-93a) shall be firmly attached to the Yoke.

The maximum acceptable diameter of the pin holes is 0.628 in.

13.1.3.10 Spring Roller Pin (Items 3-95 and 7-67)

The oil passage shall be free of foreign bodies.

The surface of the Pin shall not be scored or otherwise damaged.

The minimum acceptable diameter of the Pin is 0.621 in.

13.1.3.11 Roller with Bearing Bush (Item 3-98 and 3-98a)

The maximum acceptable diameter of the bearing bush is 0.628 in.

Items not meeting this criterion shall be fitted with a new bush.

13.1.3.12 Cylinder body (Items 4-102a/b/c and 8-79a/b/c)

Three variants of Cylinder Body are recognized, these being the original nominally 3.000 in. diameter version, the bored oversize version and the sleeved version.

The maximum allowable size and the refurbishment procedure for each version are given in Table 1 below.

VERSION	MAXIMUM SIZE	REFURBISHMENT PROCEDURE
Original manufacture	3.007 in.	Bore to oversize dimension
Oversize	3.030 in.	Bore and Sleeve
Sleeved	3.007 in.	Re-sleeve

TABLE 1. MAX WEAR SIZE AND REFURBISHMENT PROCEDURE

For methods of refurbishing the different versions see section 13.1.4.4.

13.1.3.13 Cylinder cover (Items 4-103 and 8-81)

The maximum acceptable diameter of the bearing in the cover is 0.755 in. Items not meeting this criterion may be refurbished in accordance with section 13.1.4.5 of this specification.

13.1.3.14 Piston rod (Items 4-108 and 8-88)

The Piston Rod shall be free of blemishes over its entire length.

The minimum acceptable diameter of the rod is 0.7440 in.

13.1.3.15 Operating Crank (Item 7-44)

The maximum acceptable diameter of the Link Pin hole is 0.628 in.

The maximum acceptable diameter of the Roller Pin hole is 0.503 in.

13.1.3.16 Roller (Item 7-46)

The maximum acceptable diameter of the bearing is 0.503 in.

The minimum acceptable overall diameter is 1.118 in.

13.1.3.17 Roller pin (Item 7-47)

The minimum acceptable diameter of the Roller Pin is 0.495 in.

13.1.4 Refurbishment

13.1.4.1 Paint finishes

All un-machined surfaces of the following components shall be painted using the process detailed below.

Main case casting (item 1-2)	Main case casting (item 5-1)
Front Cover (item 1-3)	Cover (item 5-6)
Back Cover (item 1-5)	Operating Crank (item 7-44)
Cap (item 1-45)	Bearing Cap (item 7-52)
Base (item 1-49)	Spectacle Plate (item 7-57)
Operating Crank (item 3-77)	Cap (item 7-72)
Bearing Cap (item 1-80)	Yoke, Top (item 7-64)
Spectacle Plate (item 1-86)	Yoke, Bottom (item 7-63)
Yoke, Top (item 3-93)	
Yoke, Bottom (item 3-94)	

External surfaces of the Air Cylinder Assemblies (items 4-100 and 8-74+) shall be painted as detailed 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 – LU Part No. 17412/429, followed by a top coat of General Purpose Aluminium Paint – LU Part No. 17485/225.

Springs (items 3-91, 3-92, 7-65 and 7-66) shall be painted with a base coat of Red Oxide Primer – LU Part No. 17412/429, followed by a top coat of black gloss paint.

13.1.4.2 Case castings (Item 1-2 and 5-1)

Worn front bearing holes may be re-bushed using a press fitted Oilite bush finish machined to original manufacturing dimensions.

Worn rear bearing holes may be re-bushed by fitting an Oilite bush in accordance with AS27007 item 2.

On Outdoor Cases (item 1-2), holes previously used to attach an R.S.A. terminal block (2 off 2 BA tapped) located on front face of casting adjacent to air-motor access door, shall be countersunk on the outside to accept a countersunk head screw and lightly countersunk on the inside. A countersunk screw shall be fitted at each position and riveted over to prevent removal.

13.1.4.3 Contact spring assemblies (Items 2-64 and 6-32)

A new Contact Tip shall be fitted in accordance with drawing AS29862.

13.1.4.4 Cylinder body (Items 4-102a/b/c and 8-79a/b/c)

Original bodies which exceed the wear allowance shall be bored oversize to achieve a finished bore size of 3.025 in. +0.001 in. –nil with a depth of bore and a surface finish in accordance with the original manufacturing drawing.



Oversize bodies which exceed the wear allowance shall be converted into sleeved versions by boring out to a size to press fit a sleeve with a nominal wall thickness of $\frac{1}{16}$ in. The bore dimension, depth of bore and surface finish shall be in accordance with the original manufacturing drawing.

Sleeved versions which exceed the wear allowance shall be fitted with a new sleeve.

13.1.4.5 Cylinder cover (Items 4-103 and 8-81)

Worn bushed Cylinder Cover may have a replacement bush pressed into position.

Cylinder Covers which do not already have a bush fitted may be modified to use a flanged Oilite bush. The bush shall have a nominal flange thickness of 0.150 in. and a nominal wall thickness of 0.100 in. The bush shall be press fitted into position with the flange on the outside of the Cover.

For both refurbishing methods, the Cover shall be finish machined to bring all dimensions to within 'as manufactured' values. A $\frac{1}{16}$ in. diameter oil hole shall be drilled through the tapped hole for the Lubricating Nipple into the bore before finish machining of the bore.

13.1.5 Assembly criteria

13.1.5.1 Requirements applicable to both types

The Air Motor shall operate freely over the entire length of the stroke when operated by hand.

Assembly of the Piston, Piston Rod, Cup Washer and associated clamping components shall be performed in accordance with Figure 4 or Figure 8, as appropriate.

A 2 BA grub screw has been used in the past as an additional securing method to lock the Piston Head onto the Piston Rod. This component is no longer required to be fitted.

The threaded end of the Crosshead Bolt (items 4-115 and 8-95) shall be dressed back after assembly so that one full thread protrudes through the nut. The thread end shall then be riveted over to retain the nut. [CPS01]

In the 'ON' position the Spectacle Plate shall engage with the stop lug in the Case. In this position there shall be clearance between the Piston Rod End and the Drive Roller(s). [CPS02]

All Contact Spring Assemblies shall be adjusted to achieve engagement over the full width between the Contact Tip (item 2-64b) and the Rotary Contact (item 3-74).

After successful testing of all contacts (see section 10.1.6 below) all contact faces shall be sparingly coated with Electrolube 2GX Grease. [CPS03]

13.1.5.2 Outdoor type

Contacts shall be fitted to provide 5 'ON' and 1 'OFF' circuits in accordance with drawing CS29845. [CPS04]

Contact adjustments shall be made so that the make or break positions are accordance with drawing CS29845. [CPS05]

Contact pressures of all contacts shall be in accordance with drawing CS29845. [CPS06]

Two designs of the Spring Roller Pin (3-95) are in circulation. Either type may be fitted to Outdoor type signals.

The Air Inlet Nipple (1-30) shall be locked in position with a Locking Plate in accordance with drawing BS28479. The Locking Plate shall be fitted to the hexagon face of the Air Inlet Nipple to within 0.005 in. [CPS07]

A newly overhauled Glass Enclosed Air Valve, overhauled to the requirements of Equipment Overhaul Specification MR-OS-3430 shall be fitted to the Disc Signal. Air Valves used for this application will not need



to be fitted with the Mounting Bracket (item 1-76 in MR-OS-3430) and associated components. The Air Valve will be deemed to have been certified to the requirements of MR-OS-3430 before being fitted to the Disc Signal. [CPS08]

13.1.5.3 Tunnel type

The Operating Crank (7-44) and the Piston Rod End (8-96) shall be modified in accordance with AS28234.

Contacts shall be fitted to provide 5 'ON' and 1 'OFF' circuits in accordance with drawing CS29845. [CPS04]

Contact adjustments shall be made so that the make or break positions are accordance with drawing CS29845. [CPS05]

Contact pressures of all contacts shall be in accordance with drawing CS29845. [CPS06]

Only the latest design (see parts list for drawing details) of the Spring Return Unit Link Pin (item 7-67) shall be fitted to Tunnel type signals. [CPS09]

Contact Separators (item 6-23) shall be fitted in accordance with drawing AS28904.

13.1.6 Operational tests

13.1.6.1 Spring return test

With air at 25 p.s.i. fed to the cylinder there shall be no movement of the Spectacle Plate away from its at-rest position. [CPS10]

13.1.6.2 Minimum operating pressure test

The item shall operate to the fully 'OFF' position with the minimum air pressure as defined in section 10.1 of this specification. [CPS11]

13.1.6.3 Normal operating pressure test

The item shall be operated with an applied pressure of 60 p.s.i. It shall energise and de-energise smoothly with no signs of sticking during any part of the cycle. [CPS12]

13.1.6.4 'ON' contacts tests

All 'ON' contacts shall be tested to close within the range detailed in section 10.2 of this specification. [CPS13]

Contact pressures shall be checked to be in accordance with the requirements of drawing CS29845. [CPS14]

The contact resistance of all 'ON' contacts, measured between the appropriate terminal pairs shall be in accordance with section 10.4 of this specification. [CPS15]

13.1.6.5 'OFF' contacts tests

All 'OFF' contacts shall be tested to close within the range detailed in section 10.3 of this specification. [CPS16]

Contact pressures shall be checked to be in accordance with the requirements of drawing CS29845. [CPS17]

The contact resistance of all 'OFF' contacts, measured between the appropriate terminal pairs shall be in accordance with section 10.4 of this specification. [CPS18]