



(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 Point Auxiliary Valves 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
GE	Glass Enclosed
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 for Point Auxiliary Valves which are used in the signalling system on the London Underground. These items are more commonly referred to as Point Valves, a term which will be used throughout this document.

Point Valves 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 an extended working life. It is a mandatory requirement that a point Valve 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 Point Valve to change its state without a valid electrical input applied 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 mis-operation 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.

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

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.

A general view of a Point Valve is shown in Figure A.

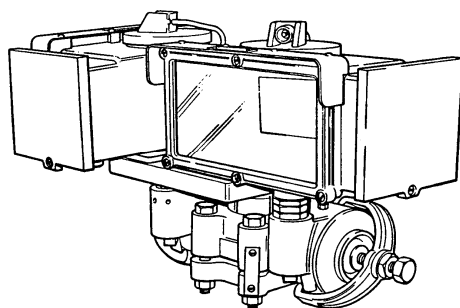


Figure A General View of a Point Valve



6. Usage of item

The Point Valve is used to supply air at a nominal 60 p.s.i. from the air-main to the air motors which operate the point mechanisms. The air motors are double acting cylinders which need air to be supplied continuously to their driven end even when electrical power is removed from the valve. To meet this requirement a mechanically latched slide valve is used to direct air to the driven end of the cylinder and to exhaust the air from the opposite end. Connections to and from the valve are made using ½" flexible hoses. The air flow to the point cylinder needs to be unrestricted by the valve so that the point mechanism can be fully operated in less than 1 second. An un-silenced exhaust port in the valve block is used to discharge air from the de-pressurized end of the point cylinder.

The Point Valves covered by this specification operate from a 100 volt supply at either 33¹/₃ Hz or 125 Hz.

Point Valves are usually post mounted, close to the air main from which they are fed by a hose connection coupled to the air main by a 4-way isolating air-cock. Air feed and equipment connections are made to a mounting plate which forms part of the fixed lineside infrastructure using flexible hoses terminated with ½" BSP fittings. The Point Valve is bolted to the mounting plate using 4 bolts supplied with each overhauled item.

The air main contains considerable quantities of water, glycol and rust deposits which are carried through the system by the air flow. These conditions make it very difficult to maintain good seals at the valve seats contained in the valve. A filter is fitted to the inlet hose connection in an attempt to keep particles from entering the valve from the air main.

7. Equipment design outline

Design features built into the Point Valve include:

- Construction that is designed to be ultra reliable in operation
- Construction designed to withstand the severe vibration conditions present where the units are mounted usually very near to the track bed
- An ability to re-furbish the main wearing components without the need to scrap major items
- A latching action whereby the air feed in the last energised direction is maintained through electrical supply interruptions. Additionally, the air supply will remain directed to the last energised output port throughout electrical and pneumatic supply interruptions. On resumption of the air supply the originally fed port will again be fed with air.
- Operated by two Glass Enclosed Air Valves which form sub-assemblies of the unit

Two variants of the Point Valve exist which are similar in operation. The Fault Screen version utilises Air Valves which, in addition to the components in the regular version, have a fault screen terminal and certain insulating components to insulate the transformer and fault screen terminal from the case of the unit.

A pressurised air chest is fed with air straight from the input connection. A flat valve face containing three ports is partially covered by a slide valve. The centre port exhausts to atmosphere and ports symmetrically placed on either side of the exhaust port feed air to each of the cylinder feed unions. The slide valve covers two of the ports and leaves the third open. A void in the underside of the slide valve connects the two ports covered by the valve. By this arrangement the uncovered port is fed with supply air direct from the valve chest while the covered port is connected to the exhaust port by the void in the slide valve.

The Slide Valve runs in a channel formed onto the face of the Valve Seat Base. It is moved by a Saddle which is held in place by a spring loaded detent plunger. The Saddle is held in one of two positions ensuring that it does not move if air pressure is removed from the air valve.

A Normal and a Reverse air valve magnet is provided to control operation of the Point Valve. These units are basically identical to those used in the G.E. Air Valve except that those used on Point Valves have a longer Armature Stem required to reach lower into the Point Valve body.



The Normal air valve supplies air to the Normal piston chamber. The Normal piston operates through a ½" stroke and moves the Saddle from the Reverse to the Normal position. Usually the Normal air valve will remain energized until the Point Valve is required to operate to its Reverse position. Then, after being energized by the reverse valve, the Reverse piston will operate on the opposite end of the Saddle to drive the Slide Valve to the Reverse position.

Three types of Piston Assembly are in current circulation:-

Type 1 utilizes a Piston to a LU design which uses a slotted lock washer to secure the assembly.

Type 2 utilizes a Piston to a Westinghouse design with a thin lock-nut to secure the assembly.

Type 3 uses the Westinghouse piston which has in the past been modified for use with a now obsolete Cup Washer design and which has been modified for a second time for use with the current design of Cup Washer.

8. Applicability

This specification applies to the following items.

Item	Stores List No.
Point Auxiliary Valve 100 volt 33 ¹ / ₃ /125 Hz (universal)	91-S-40
Fault Screen Point Auxiliary Valve 100v 33 ¹ / ₃ /125 Hz (universal)	91-S-48

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

The Air Valve magnets used are called up as sub-assemblies. For details of overhaul requirements and parts identification see the Equipment Overhaul Specification for the Glass Enclosed Air Valve (MR-OS-3430)

Testing of all aspects of Point Valve operation, including operation of the attached Air Valves, is covered by this Specification.

9. Critical functions

Critical Functions of the Point Valve are defined to be:

Retention of air feed to last selected output. It is critically important that the air feed is maintained to the last energized output port even in the event of simultaneous or sequential failures of electrical and air supplies to the valve. Any change of state of a Point Valve which occurs without a valid input signal applied to the corresponding Air Valve shall be deemed a wrong-side failure.

Delivery of full air flow when valve throws. The air passages within the valve have been designed to be very unlikely to become restricted so that the flow of air is reduced for any reason when the valve throws. The minimum cross section of the air passages is approximately 0.0625 square inches and any reduction of this figure will have an undesirable slowing down of the speed of operation of the points.

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 close to the track-bed and therefore subject to high levels of vibration.



Electrical Safety. Satisfactory earthing and bonding of the Point Valve 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.
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 the Point Valve are defined and quantified below.

10.1 Pick-up voltage

The Pick-up Voltage of the Normal and Reverse air valve, measured with supply frequencies of $33\frac{1}{3}$ Hz and 125 Hz and with an air supply of 60 p.s.i. shall be ≤ 80 volts.

10.2 Drop-away voltage

The Drop-away Voltage of the Normal and Reverse air valve, measured with supply frequencies of $33\frac{1}{3}$ Hz and 125 Hz and with an air supply of 60 p.s.i. shall be ≥ 30 volts.

10.3 Minimum pressure of operation

The Point Valve shall operate to fully throw the slide valve on an air supply of 10 p.s.i.

10.4 Maximum pressure of operation

The Point Valve shall operate normally with no signs of sticking, binding or air leakage on an air supply of 65 p.s.i.

10.5 Air flow

Air flow through the Point Valve shall be checked by measuring the Operating Time of a point cylinder in the manner described below.

The Point Valve shall be connected to a $9\frac{1}{2}$ " x 5" point cylinder using 12' long x $\frac{1}{2}$ " bore air hoses. The Point Valve shall be connected via an air-tight cock and $\frac{1}{2}$ " bore air hose to a source of air at 60 p.s.i. A pressure switch which closes at $60 \pm 0 -1$ p.s.i. and an air-tight cock shall be connected at the point cylinder end of each hose.

The Operating Time, which is to be measured electronically, is defined to be that time between energizing an Air Valve and the appropriate pressure switch closing. The Operating Time shall be measured for both directions of stroke of the point cylinder.

The Operating Time shall be ≤ 1.0 seconds.

10.6 Insulation resistance

For each valve, the Insulation Resistance measured between both input terminals T_0 and T_1 shorted together and all other metallic parts of the unit shall be $\geq 50M\Omega$ when measured at 1000V DC.

For each valve, the Insulation Resistance measured between the fault screen terminal FS (if fitted) and any other metallic part of the unit shall be $\geq 50\text{M}\Omega$ when measured at 1000V DC.

For each valve, the Insulation Resistance measured between the fault screen terminal FS (if fitted) and input terminals T_0 and T_1 shorted together shall be $\geq 50\text{M}\Omega$ when measured at 1000V DC.

11. Equipment configuration

An Illustrated Parts List is provided as Attachment 2, comprising an itemized list and two exploded component drawings 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 1-23 is the Slide Valve.

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 workshop conditions associated with the work detailed in this specification.

A regulated and adjustable (0 to 65 p.s.i.) supply of compressed air is required. Air consumption is minimal although the maximum demand is approximately 10 cu. feet per min. (volume measured at 60 p.s.i.) for a duration of up to 1 second.

An adjustable (0 to 110 volts) supply of A.C. voltage is called for at frequencies of $33\frac{1}{3}$ Hz ± 1 Hz and 125 Hz ± 1 Hz. Maximum current drain will be 1 amp.

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

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, including repair or replacement of failed component(s) shall 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.

The two Air Valve units attached to each Point Valve shall be overhauled to the requirements of the Signal Equipment Overhaul Specification – Glass Enclosed (GE) Air Valve, document SSL-SP-3430.

13.1.1 Dismantle

The Point Valve 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 two Air Valve units shall be removed from the Point Valve and shall be processed in accordance with the Specification as applicable to the particular items (see section 10 above). No further reference will be made to the overhaul of the Air Valves until the final assembly and test sections.

Point Valves are not assembled from interchangeable components, therefore the components must be kept together as sets of parts and identified as belonging to the left-hand or right-hand side of the valve.

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

Lubricating Nipples (1-10 & 1-12)	Copper Seating Washers (1-11)	Cylinder Head Gasket (1-45)
Air Filter (1-13)	Gasket (1-14)	Gland Packing (1-19)
Protective Plate (1-26) (may not be present on incoming item)	Locking Washer (1-36)	Pin Valve (1-32)
Cup Washer (1-34)	Valve Seat Gasket (1-24)	Asset Label (1-57)

The Cylinder Liners (items 1-38) shall not be removed from the Valve Body until they have been examined for wear.

Valve Bushes (items 1-3) shall not be removed from the Valve Body until they have been examined for wear.

13.1.2 Cleaning

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

13.1.2.1 All components

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.