

East West Rail Alliance

Haul Road Traffic Signals: A1 Compound / Bicester Road, Launton, Oxfordshire.

VOLUME 2 – WORKS INFORMATION

APPENDIX 12/5: TRAFFIC SIGNAL EQUIPMENT REQUIREMENTS

East West Rail Alliance

12 February 2020

Notice

This document and its contents have been prepared and are intended solely as information for East West Rail Alliance (EWR) and Oxfordshire County Council (OCC) and use in relation to the Off-Line Haul Road Junctions Detailed Traffic Signal Designs.

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This document has 31 pages including the cover.

Document history

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
Rev 1.0	For Technical Review	MJF	SRH	<initials>	<initials>	Feb 2020

Client signoff

Client	East West Rail Alliance
Project	Off-Line Haul Road Signal Junctions /A1 Compound
Job number	5187843
Client signature / date	

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APPENDIX 12/5: TRAFFIC SIGNAL EQUIPMENT REQUIREMENTS

1. General Information

- 1.1 This document forms the specification for the supply, installation and commissioning of the traffic signals at the East West Rail Alliance (EWR) A1 Compound / Bicester Road, Launton as detailed in the MCH 1827 Configuration Forms amendments, Schedule of Equipment, Appendix 5/2 and as shown on the Traffic Signal Layout drawing.
- 1.2 The Traffic Signal Contractor shall include for any material and work which may not be expressly specified but which is implied and necessary for the satisfactory completion of the installation.
- 1.3 Where applicable, all signal equipment provided shall be Traffic Open Products And Specification (TOPAS) registered, issued with a TOPAS certificate of compliance and be registered on the TOPAS group website (www.topasgroup.org.uk).
- 1.4 The Contractor shall confirm in writing that the equipment being offered has been registered under TOPAS 0600B and has been tested and certified under the appropriate TOPAS specification
- 1.5 The works comprise the supply, installation and commissioning of all traffic signal equipment at the following site and as detailed in the signal design drawings contained in Annex F.
 - **East West Rail Alliance A1 Compound / Bicester Road, Launton, Oxfordshire**

- 1.6 This specification shall be read in conjunction with the MCH1827 Controller Specification Forms, Traffic Signal Layout drawing, latest version, Appendix 5/2 document, the applicable standards listed in Annex G and any other documents / instructions issued by the East West Rail Alliance in relation to this installation.

2. Contractor Responsibilities

- 2.1 The Contractor shall liaise with the nominated EWR Traffic Signals representative and OCC Traffic Signals Engineer at regular intervals during the installation to achieve approval for elements of the installation as the works progress. The approval process is essential in the lead up to a full Site Acceptance Test (SAT) of the installation.

3. Locations for:

Signal Poles

- 3.1 The installation of traffic signal poles (retention sockets) shall be at the positions shown on the Traffic Signal Design Layout drawing and are to be agreed with the EWR Traffic Signal representative on site prior to installation per each site.

Signal heads and associated equipment

- 3.2 The installation of street furniture and the alignment of signal heads shall be at the positions shown on the Traffic Signal Design Drawing and are to be agreed with the EWR Traffic Signal representative on site prior to installation.

Traffic Signal Controller

- 3.3 A new ELV traffic signal controller is to be supplied and installed at the positions shown on the Detailed Traffic Signal Layout drawing.

Cables and Routes

- 3.4 The Contractor shall complete a schedule detailing the location and function of each terminal block connection, as installed within the controller, the schedule to incorporate all existing cabling and modifications. A cable route schedule is to be supplied. The completed details shall be passed to the EWR Traffic Signal representative and OCC Traffic Signal Engineer prior to site acceptance.
- 3.5 All signal cables and feeder cables are to be correctly marked with tags and markers.

Duct network and equipment foundations

- 3.6 The construction of new ducts, access chambers, signal pole retention sockets, carriageway loop boxes and draw-pits shall be at the positions shown on the Traffic Signal layout drawing and referenced in accordance with Appendix 5/2.

Detection

- 3.7 Below ground vehicle inductive loop detectors and above ground radar vehicle detectors shall be installed at the positions shown on the Traffic Signal Layout drawing and are to be agreed with the EWR Traffic Signal representative on site prior to installation. In the event that detectors are not installed in accordance with the design, the Contractor will be liable for all costs associated with the re-installation of the affected detectors at the correct location(s).

Note: Loop BIN3 is to be configured as a UD loop.

Electricity supply

- 3.8 The Contractor is to arrange for the procurement, installation and commissioning of a new dedicated 230V 50Hz Single phase 20A mains power supply to the traffic signal mini feeder / isolation pillar

4. Equipment and Installation

General

- 4.1 The signal equipment and street infrastructure to be supplied and installed shall comply with the requirements of this document and the MCH1827 specification and OCC specifications.
- 4.2 The Signal Contractor shall arrange for the supply, transport to site, storing, on-site handling, installation, testing and commissioning of all traffic signal equipment associated with these works.
- 4.3 All street furniture shall be installed at the positions shown on the Traffic Signal Layout drawing and in accordance with EWR Traffic Signal representative's siting instructions.
- 4.4 All signal equipment supplied shall be ELV and new.

Traffic Signal Poles

- 4.5 All traffic signal poles are to be installed into signal pole retention sockets retention sockets in accordance with the provided specifications and are to be slotless.

- 4.6 Traffic signal poles in soft / unmade ground are to have a 1metre square concrete hard stand around them as shown on the Traffic Signal Layout drawing. This hard stand is to be to the depth of the retention socket reinstatement required in the manufacture's installation instructions.
- 4.7 The Contractor shall ensure that the signal pole retention sockets are installed to manufactures installation instructions so that the traffic signal poles are vertically aligned and that they are adequately stable before fitting the signal heads. The EWR Traffic Signal representative / OCC Traffic Signal Engineer will not accept a signal pole or signal head which is not in vertical alignment.
- 4.8 All 4m traffic signal poles shall be standard galvanised steel and finished with a grey UPVC coating.
- 4.9 Where possible, signal poles shall be installed so that they are orientated to enable any pre-drilled holes to be used. If this is not possible, any drilling of the poles shall be carried out by the Traffic Signal Contractor. All associated costs are deemed to be included in the Tender. Any incorrectly drilled poles must be replaced at the contractor's expense.
- 4.10 The signal poles shall be positioned so that there shall be an absolute minimum clearance of 450mm between any part of the street furniture (including edges of backing boards) and the top of the kerb face.
- 4.11 Tall (5.5m / 6m) traffic signal poles shall be of the Hydro Pole Products type or similar, be low access and hinged. They shall be installed so that they can be safely lowered in a direction away from the carriageway if possible. The low access door should open away from the carriageway.
- 4.12 All the traffic signal poles shall be labelled as referenced on the Detailed Traffic Signal Design Drawing, the 'X' height of the text shall be 75mm and the label shall comprise white numbers on an adhesive black background. The signal pole numbers shall be placed facing the traffic signal controller, 250mm beneath the lower traffic signal head bracket or at the top of the upright on 'Swan Neck' poles.
- 4.13 Regarding '3 in line' signal heads, poles are to be supplied and be of such length as to enable the centre of the yellow lens to be sited not less than 2.4m nor more than 3.1m above the finished footway level. The yellow lens of each vehicular aspect on any one approach shall be at the same height above carriageway level. The bottom of the signal head shall not be less than 2.3m above the finished footway level.

Signal heads and associated equipment

- 4.14 Signal heads shall be ELV LED CLS type.
- 4.15 Signal backing boards shall be supplied and fitted to all lanterns and shall be bolted to the signal head in a minimum of 8 positions.
- 4.16 All signal heads shall be installed so that, providing that it is reasonably practicable, all signal heads are at the same level relative to each other.
- 4.17 Tall poles shall have double signal heads mounted at normal height and high mount. Signal head heights to be as the pole manufacturers calculation sheet.

Traffic Signal Controller

- 4.18 The traffic signal controller is to be mounted on a raised base

Communications

Requirements to be confirmed with OCC Traffic Signals

- 4.19 These works shall include the provision of two EPROM amendments to incorporate any revisions or changes within 12 months of the commissioning / acceptance date of the modifications.

Cables and routes

- 4.20 All signal poles shall be cabled directly from the controller. All cables shall be PVC/SWA/PVC cables with the number and cross-sectional area of the cable cores determined by the Traffic Signal Contractor to suit the application and necessary cable size calculations. These cables shall be 600/1000-volt grade conforming to BS 6346 and shall be BASEC approved. All cores shall be of equal cross-section. The armouring is required to act as the Earth Continuity Conductor and hence shall be the responsibility of the Contractor.
- 4.21 Each drum of cabling shall be accompanied by duplicate copies of the relevant test certificated. The certificates shall bear the cable description and the name of the manufacturer and shall be delivered to the Overseeing Organisation.
- 4.22 The contractor shall allow for any charges made on the supply, rental or return of cable drums. All cables shall be supplied on drums with an indication of the length, size of cable and number of cores.
- 4.23 Cable drums shall be supported by suitable purpose made stands while the cables are being drawn off. Under no circumstances shall drums be rolled in a direction other than that indicated on the side of the drum. All cable shall be pulled directly into the ducting system and no cable shall be dragged across any surfacing.
- 4.24 Where low voltage (LV) cables carrying 230/160 volts are used these shall be grouped in ducts separate from ducts accommodating cables extra low voltage (ELV) carrying <50 volts.
- 4.25 Where cables are pulled into ducts, suitable rollers shall be used to guide the cables so as to prevent contact with the duct ends.
- 4.26 The Contractor, on his own calculations and measurements, shall make all allowances for the lengths of cables required. **The Contractor shall provide a comprehensive schematic diagram of the cabling, which shall be returned with his tender. Failure to provide this data may invalidate the return.**
- 4.27 When cables are pulled into ducts, a new draw rope shall be pulled into each duct for future use. The draw rope shall be free from snagging/drag, joints and knots. Each cable shall be identified at all termination points (top cap assemblies and within the controller) and access boxes (for controllers and road crossings only). The cable identification markers shall be as shown in Annex D of this Appendix.
- 4.28 Cables shall not be bent to a radius of less than 12 times their diameter or less than the radius recommended by the manufacturer, whichever is the greater.
- 4.29 Any cable left un-terminated following installation shall be sealed to prevent the ingress of moisture into the SWA and inner cores. The Overseeing Organisation reserves the right to have any cables, which appear to have become saturated, replaced at the Traffic Signal Contractor's cost.
- 4.30 The complement of cables/cores installed shall be such that either 2 additional spare cable cores, or 10% extra cores, whichever is the greater, is provided between each signal pole and the controller.
- 4.31 The termination of each cable at pole cap assemblies shall be made utilising CET type glands. Installed cables shall be passed through the ferrule and the armouring wires, bent back, secured by Jubilee clips, shrouded and the ferrule bolted to the bar using one of the terminal studs.
- 4.32 Each cable shall be made off to the gland unit with the minimum of armouring exposed, but with the armouring strands bent back over and laid along the full length of the outer knurled gland surface and clamped tightly with the associated Jubilee clip. The serving layer of the cable (between the cores and the armouring strands) shall project above the top edge of the gland by at least 10mm to ensure protection of the core insulation.

- 4.33 The cores shall be connected to the appropriate terminal block without leaving over-excessive lengths. All spare cores shall be long enough to reach the top of the controller case. These cores shall be connected to earth via a block secured in the controller. The same considerations shall apply to cables rising from push-button/wait units and the like.
- 4.34 All neutral returns for Signals, Solar cell switch and Regulatory Signs shall be wired independently.
- 4.35 Where any controller utilises eight or more multi-core cables, all cores relating to the installation shall be identified as stated in Annex D of this Appendix.
- 4.36 Any connection in a position other than the controller or pole cap assembly shall be completely insulated and enclosed in weatherproof junction boxes to IP65. The boxes shall be approved by the Overseeing Organisation prior to installation. The junction box shall be installed in a workmanship like manner so as not to reduce its weatherproof rating.
- 4.45 The Contractor shall complete a schedule detailing the location and function of each terminal block connection, as installed within the controller. The schedule may be in the form of a "Controller Works Specification" or a similar document. Terminal blocks may be identified by an annotated diagram or by clear labelling cross-referenced to the schedule. The completed details shall be passed to the Engineer prior to site acceptance.

Signal Head Arrangements

- 4.46 Where possible, the yellow lenses of each vehicular aspect on any one approach shall be at the same height above carriageway level. Any exception to the above shall be highlighted within the notes sections of any drawings provided.

Elexon Codes

- 4.47 All products supplied as part of the Works must be supplied with an Elexon agreed allocation code, as described in BSCP520 Unmetered Supplies Operational Information – Procedure for Allocating Load Ratings to New Equipment.

5. Detection – Slot Cutting

- 5.1 The layout of loops and feeder cables shall be in accordance with the Manual of Contract Documents for Highway Works, Volume 3, Drawings G22, G27, G28, and G32, or as agreed on Site between the Contractor and EWR
- 5.2 All inductive loop detectors shall be installed at the positions shown on the Traffic Signal Layout drawing and are to be agreed with the EWR Traffic Signal representative on site prior to installation. In the event that detectors are not installed in accordance with the design, the Contractor will be liable for all costs associated with the re-installation of the affected detectors at the correct location(s).
- 5.3 The Contractor shall be responsible for the correct setting out of all slots.
- 5.4 Where a physical obstruction, such as a sub-surface ferrous object, prevents the siting of any loop at the specified position, the Contractor shall agree a course of action with the Overseeing Organisation before proceeding. The layout of the loop configuration shall avoid areas of poor reinstatement in the road surface. Slots shall be cut at least 1m from any such disturbance.
- 5.5 Slot cutting operations shall not be conducted in wet weather nor when the ambient temperature is below 2°C. If in doubt, the Contractor shall consult the Overseeing Organisation.

- 5.6 Slot cutting shall be carried out with a water-cooled motorised saw. The Contractor shall satisfy all the necessary Water Authority requirements. Direct connection from a water hydrant on the Site shall only be made when all hoses and ancillary equipment are situated within a coned-off area. Where a mains supply water is not available, the Contractor shall make allowance for the use of a high-pressure water bowser. The Contractor shall make his own arrangements for the hire of a fire hydrant standpipe.
- 5.7 The loop cables in asphalt road surfaces shall have a width of 8mm with a tolerance of +1.0mm/- 0mm. The slot width shall exceed the maximum cable diameter by at least 2mm.
- 5.8 The twisted loop tails in asphalt road surfaces shall have a width of 16mm with a tolerance of +1.0mm/- 0mm. The slot width shall exceed the maximum cable diameter by at least 2mm.
- 5.9 The 1 pair SWA (steel wire armoured) feeder in asphalt road surfaces shall have a width of 14mm with a tolerance of +1.0mm/- 0mm. The slot width shall exceed the maximum cable diameter by at least 2mm.
- 5.10 The 2 pair SWA (steel wire armoured) feeder in asphalt road surfaces shall have a width of 16mm with a tolerance of +1.0mm/- 0mm. The slot width shall exceed the maximum cable diameter by at least 2mm.
- 5.12 The depth of slots shall be $(65.0 + 7n)$ mm with a tolerance of +10mm/- 0mm, (where 'n' is the number of cables and the first figure is the minimum depth of cover). The depth of each slot shall be checked with a depth gauge along the whole length of the slot and shall conform to the requirements. The Contractor shall ensure that there are no irregularities in the base of the slot.
- 5.13 The saw blade shall be lowered to form a dip in the floor of the slots, at the point where the slots cross, to maintain 50mm cover for the top cable.
- 5.14 Where the internal angles at the corners of the slots are 110° or fewer, the corners shall be truncated to an angle of 135° to ease the bend on loop cables. The truncation of the angle shall only be carried out at the apex of the corner. Creation of triangular section during truncation is unacceptable.
- 5.15 All slots shall be cleared of dust and debris and dried using a compressor and air line before the cable is inserted. It is unacceptable to lay cables in a wet slot as the backfilling materials will not bond with wet surfaces.
- 5.16 Cable entry to the footway access chamber shall be by carriageway loop box and under kerb 50mm ducting.
- 5.17 The Contractor shall supply single core multi-strand flexible cable complying with TOPAS 2029: Inductive Loop Cable for Vehicle Detection Systems.
- 5.18 The Contractor shall supply Twin-Flex Feeder Cable complying with specification TOPAS 2031: Insulated Cable for Inductive Loop Systems. The cable shall be sheathed in orange polyethylene with 2.5mm conductors and shall not exceed 300m in length from the controller housing to the most distant loop.
- 5.19 All feeder cables are to be tested before jointing to new loops. Any cable that does not meet specification is to be replaced.
- 5.20 Each loop (and pair of twisted tails if applicable) shall be one continuous wire which shall lie evenly and without tension in the bottom of the slot.
- 5.21 Each drum of cable shall be accompanied by duplicate copies of the relevant test certificates. The certificates shall bear the cable description and the name of the manufacturer and shall be delivered to the Overseeing Organisation.
- 5.22 The Contractor shall allow for any charges made on the supply, rental or return of cable drums. All cable shall be supplied on drums with an indication of the length, size of cable and number of cores.

- 5.23 Cable drums shall be supported by suitable purpose made stands while the cables are being drawn off. Under no circumstances shall drums be rolled in a direction other than that indicated on the side of the drum. All cable shall be pulled directly into the ducting system and no cable shall be dragged across any surfacing.
- 5.24 Cables shall not be bent to a radius of less than 12 times their diameter or less than the radius recommended by the manufacturer, whichever is the greater.
- 5.25 Any cable left un-terminated following installation shall be sealed to prevent the ingress of moisture into the SWA and inner cores. The Overseeing Organisation reserves the right to have any cables, which appear to have become saturated, replaced at the Traffic Signal Contractor's cost.
- 5.26 The cable shall be dry prior to installation.
- 5.27 Measures shall be taken to ensure that the cable insulation material is protected at all times. The use of sharp-edged tools to assist installation is not permitted.
- 5.28 Where twisted loop feeders are required, they shall be separately paired and twisted together with no fewer than 10 turns per metre.
- 5.29 It is permissible to install up to three armoured feeder cables or three pairs twisted tails in the same slot providing that the minimum depth of cover is maintained.
- 5.30 The loop furthest from the terminal unit shall be laid first.
- 5.31 Loop slots shall be filled with a low viscosity resin; the resin shall give a minimum of 5mm of cover above the uppermost cable. The resin shall have a dynamic viscosity of between 50 and 100 poise. The Contractor shall confirm the relationship between the ambient temperature of the resin and the subsequent variation in viscosity with time, after mixing, as curing proceeds. The Contractor shall comply with the manufacturer's directions to ensure the resin is poured at the required viscosity. The remaining volume of the loop slot shall be backfilled with oxidised grade bitumen R85/40 to BS3690 Part 2. The bitumen shall totally fill the slot and remain proud of the carriageway surface by 3mm. Any cooling shrinkage shall be topped up to restore the level. Any excessive over spill shall be removed by the Contractor prior to full setting.
- 5.32 The oxidised grade bitumen R85/40 shall be heated to a pouring temperature of 185°C and poured from an enclosed container which shall be preheated before use.
- 5.33 Where the slot cut is greater than 11.5mm, shall comprise a three-part process. The process shall be, the feeder cable shall be filled with a low viscosity resin, the resin shall give a minimum of 10mm of cover above the upper most cable. Then a 3mm size fine graded wearing course material to BS 4987 shall be rammed into the slot, finished with a minimum layer of 20mm hot bitumen to BS 3690: Part 2. The surface upper fill level should be left approximately 3mm proud of the road surface to allow for settlement. Any cooling shrinkage shall be topped up to restore the level. Any excessive over spill shall be removed by the contractor prior to full setting.
- 5.34 Re-usable cable joints shall be used. The joint shall be waterproof and able to withstand a vigorous "pull-test" of approximately 3 kg. The instructions issued by the joint kit supplier shall be supplied in writing to all site staff and shall be adhered to.

6. Maintenance Requirements

- 6.1 For Traffic Signal Equipment supplied and installed under this contract; prior to acceptance by EWR / OCC a fault free period of 28 days is required. The maintenance during the first 28 days shall be the responsibility of the Traffic Signals Contractor
- 6.2 Following the 28-day fault free period a twelve-month warranty shall be provided on all equipment and workmanship supplied under this contract. During the warranty period, the Traffic Signal Contractor shall be responsible for replacing any faulty part(s) within the controller supplied under this contract once the fault has been identified. The Traffic Signal Contractor shall replace the faulty part(s) within 24 hours of the time that the fault was notified.
- 6.3 All LED traffic signal heads shall be supplied with a minimum of five years fix on-site maintenance warranty. This is in addition to the twelve-month period as stated in item 6.2.

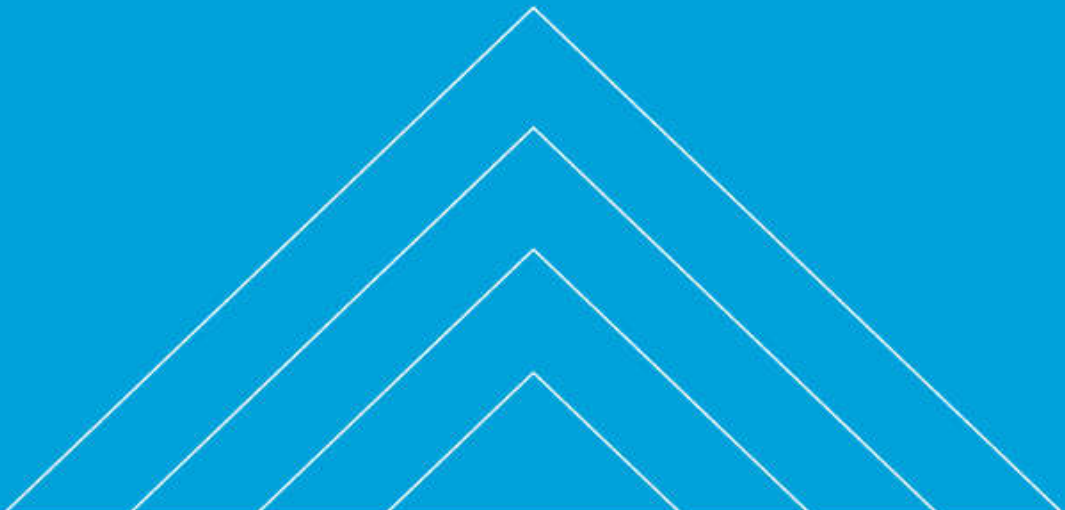
7. Testing

- 7.1 Where appropriate, the Traffic Signal Contractor shall give EWR / OCC at least 10 working days' notice of the controller(s) being ready for Factory Acceptance Testing and shall allow for attendance at those tests by EWR / OCC. The location of the acceptance tests is to be the Signal Contractors local depot. All costs shall be included in the tender price. Suitable signal lamp mimics and means of simulating inputs will be required and the test shall demonstrate compliance with the operational specification, including necessary green conflict monitoring; green conflict monitoring test are to be carried out on the controller to be installed.
- 7.2 After installation of the equipment, site testing shall be carried out by the Traffic Signal Contractor in order to demonstrate compliance with the Specification. The Traffic Signal Contractor shall give EWR / OCC at least two working days' notice of the controller being ready for Site Acceptance Testing and shall allow for attendance and also provide the Instation RMS/UTC/MOVA configuration for the testing of the site prior to switch on. Following this, the Traffic Signal Contractor shall carry out such tests as required by OCC so that the installation may be commissioned. During this period any de-bagging and re-bagging of the signal heads shall be carried out by the Traffic Signal Contractor at the discretion of EWR / OCC.
- 7.3 Abortive and return visits due noncompliance or failure during any testing shall be charged to the Traffic Signal Contractor.
- 7.4 Following full acceptance of the traffic signal works, the installation shall be handed over to SBC's traffic signal maintenance contractor who will also attend the commissioning of the works. EWR reserves the right to hold the Traffic Signal Contractor responsible for maintenance if the equipment develops faults which in the opinion of the Overseeing Organisation warrant such action.
- 7.5 The Contractor shall submit to EWR within seven days of commissioning:
 - a) Test certificates, Annexes A, B and C of this Appendix (all electrical installation completion certificates shall be in accordance with BS 7671 incorporating all amendments; these tests shall be completed and signed by a competent person); and
 - b) Elexon energy allocation code(s) as described in BSCP520.
- 7.6 The electrical design certificate and two copies of the cable diagram shall be provided.
- 7.7 Three paper copies and an electronic copy of the controller schedule shall be provided by the Traffic Signal Contractor. One to be placed within the controller within a uPVC folder. The other two paper and electronic copy shall be provided to EWR. Installation Test Certificates for inductive loops shall be in accordance with the format shown in Annex A of this Appendix. The Contractor shall notify the Overseeing Organisation prior to tests being undertaken so that the Overseeing Organisation may be present to verify the tests.

- 7.8 The following tests shall be carried out using at least 500 volts D.C. test equipment:
- a) Series resistance of loop feeder (The resistance shall not exceed 4 ohms)
 - b) Impedance to earth of the armouring of every feeder cable and connecting cable before the armouring is bonded to earth. (The reading shall not be less than 10 ohms).
 - c) Impedance to earth of cable armouring after the armouring has been connected to earth. (The reading shall not exceed 0.5 ohms)
 - d) Impedance to earth of connecting cable conductors with all conductors connected together. (The reading shall not be less than 10M ohms. The cable shall be disconnected at both ends during the test).
- 7.7 Any cables which fail any of the tests shall be replaced by the Traffic Signal Contractor at his own expense.
- 7.8 Where necessary, the Traffic Signal Contractor shall reset the detector card power supply and shall observe the monitor LED for correct operation of each loop connected to the detector card. Any defect or malfunction shall be reported immediately to EWR. This work shall be carried out for all detectors which have been affected by the Works.
- 7.9 Installation Test Certificates for Continuity and Insulation Resistance shall be in accordance with the format shown in Annex B of this Appendix. The Traffic Signal Contractor shall notify EWR prior to tests being undertaken so that EWR Traffic Signal representative may be present to verify the tests. The following tests shall be carried out:
- a) The continuity of the signal SWA shall be measured and recorded. All cores shall be connected together, at one end connected to the SWA. The reading shall not be greater than 5 ohms
 - b) Insulation resistance to earth of the signal SWA cable before the armouring is bonded to earth shall be measured and recorded. The reading shall not be less than 10M ohms.
 - c) Insulation resistance of bunched cores to signal SWA cable. All cores shall be connected together and the insulation resistance to the SWA shall be measured and recorded. The reading shall not be less than 10M ohms.
- 7.10 Any signal SWA cable which fails any of the tests shall be replaced by the Traffic Signal Contractor at his own expense.
- 7.11 All Residual Current Devices (RCDs) shall be tested utilising the integral test button and approved test equipment. Test equipment results shall be recorded on the Electrical Test Form shown in Annex C of this Appendix.
- 7.12 Tests to determine polarity shall be made throughout the installation. Note: the majority of exposed conductor tests can be shown utilising the Earth Loop Impedance tester, provided it has a polarity indicator.
- 7.18 Earth Loop Impedance testing shall be carried out and recorded on the Electrical Test Form shown in Annex C of this Appendix prior to spare cores being connected to earth. Testing shall be carried out between the phase conductor and earth at the following points:
- a) at the incoming source phase conductor and the main controller earthing point (this shall be recorded as the installation source ELI);
 - b) between the phase conductor and earthing points on cabinet doors;
 - c) between any phase conductor terminated at a top cap assembly and earth stud position of that same said assembly; and
 - d) between any remote housing or termination cabinet/box phase conductor and its common earthing point
- 7.19 Nominal supply voltage and frequency shall be recorded on the Electrical Test Form shown in Annex C of this Appendix.

7.20 All lamp monitoring tests shall be carried out by the physical removal of the lamps from the relevant street furniture. This test shall only be carried out in the presence of the Overseeing Organisation.

Annexes



ANNEX A: Installation Test Certificate for Loop Detectors

Site Name		Contractors Engineer: (Print name)	
SCN		Contractor's Engineer: (signed)	
Drawing No.		Date Tested	
Contractor (name and address)			

Loop Designation or Description	Test A Series resistance of loop Max 4Ω	Test B Impedance to earth of cable armouring, not connected to earth. Min 10MΩ	Test C Impedance to earth of cable armouring when connected to earth. Max 0.5Ω	Test D Impedance to earth of Loop and Feeder conductors (at 500V dc min) Min 10MΩ	Test D Loop Inductance μH	Settings Detector frequency and sensitivity

Polarity

Polarity Check:	Pass		Fail		Pass		Fail	
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Operation of RCD Devices

Device	Phase	Initial Integral Test	No Trip Test in mS	Trip Test in mS	Fast Trip Test in mS	Final Integral Test
	0°					
	180°					

Departures from I.E.E. Regulations and Comments

Test Equipment Used	Serial Number / Cal. No.	Calibration Date
Multimeter		
Insulation Resistance Tester		
Earth Loop Impedance Tester		
RCD Tester		
Inductance Tester		

ANNEX D: Cable Core Identification

All cores within SWA traffic signal cables terminated at top cap assemblies, traffic signal controllers and weatherproof boxes shall be identified using PVC grip type markers. All markers shall be positioned adjacent to their point of termination in such a way that they can be easily read.

D2 All Low Voltage cores shall be identified in the following manner when viewed in their termination position from left to right as per the table below:

- a) A colour coded marker(s) dictating the Pole Number (the colour code shall be accordance with the International Resistor Code).
- b) A specific Legend marker dictating the function of the core in red.
- c) A lettered marker indicating the phase in white.

First Marker		Second Marker			Third Marker
Pole Number		Function			Phase
Colour: Colour Coded		Red			White
0	Black	RED	YELLOW	GREEN	A
1	Brown	R/MAN	G/MAN	WAIT	B
2	Red	I.G/A	F.G/A	SIGN	C
3	Orange	P/EL	PE/SW	PE/N	D
4	Yellow	SIG/N	SIGN/N	SPARE	E
5	Green				F
6	Blue				G
7	Violet				H
8	Slate				etc
9	White				

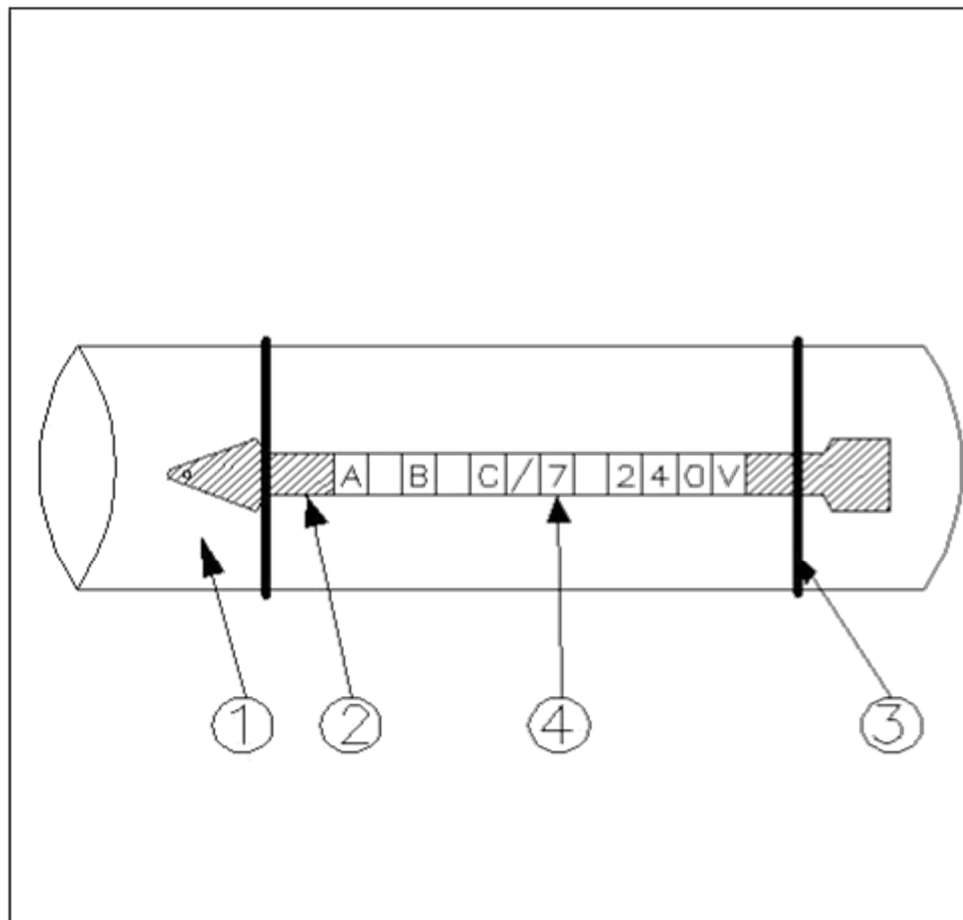
D3 All Extra Low Voltage cores shall be identified in the following manner when viewed in their termination position from left to right as per the table below:

- a) A colour coded marker(s) dictating the Pole Number (the colour code shall be accordance with the International Resistor Code).
- b) A specific Legend marker dictating the function of the core in red.
- c) A lettered marker indicating the phase in white.

First Marker		Second Marker			Third Marker
Pole Number		Function			Phase
Colour: Colour Coded		Red			White
0	Black	PUSH/B	BLEEP	TACT	A
1	Brown	COMM	INHIB	LINK	B
2	Red	DET+	PB/CO	SPARE	C
3	Orange	IRD		MVD	D
4	Yellow				E
5	Green				F
6	Blue				G

7	Violet				H
8	Slate				etc
9	White				

D4 Any function not covered by the second marker shall be clearly written on a blank marker in indelible ink and installed in the relevant position.



1. Multicore / feeder cable in duct and drawpit.
2. Plastic carrier strip.
3. Plastic cable tie.
4. Pre printed alphanumeric plastic hoop markers.
5. Multicore cables to be marked thus: –
Phase(s) / Pole No / max VOLTAGE CARRIED
6. Detector feeder cables to be marked thus: –
DETECTOR REF(S) max VOLTAGE CARRIED
NB Detector ref shall be the same as those identified on the scheme drawings.
7. The Contractor shall note that all cables in all drawpits shall be marked in accordance with the above number system.
8. The Contractor shall also note that all external cables entering the controller and all external multicore cables at the top of each signal pole shall be marked in accordance with the above number system utilising suitable tape.
NB The identification tape is to be approved by the Engineer prior to use on site.
9. Each cable is to be identified as it is pulled into place.

ANNEX E: Signing Procedures

- E1 When the Traffic Signal Contractor or Contractor has to leave site to obtain spare parts or when the signals are switched off for maintenance work. The site must be signed in accordance with paragraph E2 and E3.
- E2 All failed signals shall be appropriately signed in accordance with Diagram No. 7019 of the Traffic Signs Regulations and General Directions 2016, except for power cuts
- E3 All necessary signs shall be in place before the signals are turned off for maintenance or any other purpose
- E4 When controllers are open, signing and guarding shall be in place to prevent pedestrians from accessing the area.
- E5 Where portable signals are in use and permanent traffic signals have been switched off, it shall only be necessary to cover over the push button units with the appropriate cover.
- E6 For repair work, including slot cutting, the following safe working practices shall be used:
- i) The signing for road works must comply with Safety at Street Works and Road Works – A Code of Practice (red book) and Traffic Signs Manual Chapter 8 – Traffic Safety Measures and Signs for Road Works and Temporary Situation Part 1: Design 2009 and must be:
 - (a) reflectorised or adequately lit after dark;
 - (b) of the correct design colour;
 - (c) of the correct size for the type of road and speed of traffic;
 - (d) placed so that they are visible to all road users (this may require additional signs on the opposite side of the road);
 - (e) unobstructed by plant, vehicles, materials or vegetation; and
 - (f) kept clean at all times.
 - ii) The site must be clearly identified by cones having reflective sleeves and also by road danger lamps placed between cones at night, in poor daytime visibility and in bad weather.
 - iii) Safety zones must be created between the work area and the traffic. The minimum horizontal clearance is 0.5m (1.2m on high speed roads).
 - iv) Traffic barriers must be placed where necessary to protect the public and site personnel.

- v) When pedestrian movements are affected:
 - (a) continuous pedestrian barriers with tapping rails and the correct pedestrian signs shall be provided;
 - (b) obstructions shall be fenced off with continuous barriers and shall be lit at night;
 - (c) added protection, in the form of temporary pedestrian guard railing, shall be provided as necessary on pedestrian routes through the Works so as to assist pedestrians with a visual impairment;
 - (d) suitable, clearly identified road crossing points shall be provided; and
 - (e) a temporary pedestrian way shall be provided (at least 1.5m wide where there is sufficient space and under no circumstances less than 1.0m wide).

- vi) Oil drums must not be used as part of a barrier.

- vii) Works must be correctly lit at night.

- viii) Traffic control for two-way traffic must be used where the carriageway width is less than 6.75m, or 5.5m if the carriageway does not form part of a bus or HGV route. The exception to this rule is for the situation where minor work is being undertaken on a minor road. In these circumstances, shuttle working may be permissible during daylight hours provided that there is adequate visibility.

ANNEX F: Traffic Signal Design Drawings

133735_2A-EWR-OXD-CC_A1-DR-CH-002101 Access to Compound A1 traffic Signal Layout

ANNEX G: Traffic Signal Design Standards

Traffic Signals Applicable Standards

Document Number	Document Title
CD123	Geometric Design of At-Grade Priority and Signal-controlled Junctions
TSRGD 2016	Traffic Signs Regulations and General Directions 2016
Traffic Signs Manual	Traffic Signs Manual: Chapter 6 Traffic Control 2019
TAL 1/06	General Principles of Traffic Control by Light Signals
TAL 2/03	Signal-Control at Junctions on High-Speed Roads
LTN 1/98	The Installation of Traffic Signals and Associated Equipment
TOPAS 2500A	Specification For Traffic Signal Controller
TOPAS 2505A	Performance Specification For Above Ground Vehicle Detection Systems For Use At Permanent Traffic Signal Installations
TOPAS 2512B	Performance Specification For Below Ground Vehicle Detection Equipment

ANNEX H

Schedule of Equipment

For all traffic signal and associated equipment quantities, please refer to this specification and the Traffic Signal Design drawings.

The tables provided below are included for guidance purposes only and are not exhaustive. Any additional costs incurred as a result of failing to include required items in the original tender, will be borne by the respective Contractor/s. Tenders are to be submitted with a full breakdown of costs.

Item	Equipment	Description	Quantity
1	Traffic Signal Controller	New ELV 8 phase Controller and Cabinet provided in accordance with this specification	1
2	Electrical Feeder Pillar	Supply traffic signal feeder / isolation pillar, 150mm wide cabinet with ply-wood back board	1

Table H.1.1 – Controller Cabinets

Item	Equipment	Description	Quantity
3	Mains Power Supplies	Procure, Supply and Install new single phase 20A mains power supply to traffic signal mini feeder pillar	1

Table H.1.2 – Power Supplies

Item	Equipment	Description	Quantity
4	Communications	Procure, Supply and Install communications as per OCC requirements	1

Table H.1.3 – Communications

Item No.	Description	Unit	Quantity
5	Supply and deliver NAL type raised traffic signal controller base	Item	1
6	Install ELV 8 phase controller and associated equipment	Item	1
7	Supply and Install UTMC OTU / OMU unit including all required peripherals, wiring and licenses	Item	1
8	Supply and Install MOVA including all required peripherals, wiring, and licenses. Including configuration of all required software files i.e. CSV files etc.	Item	1
9	Install electricity supply from mini-pillar to controller cabinet.	Item	1
10	Supply and install 3-aspect ELV LED RAG (Primary Hood) signal head complete with backing boards and brackets.	Item	4
11	Supply and install 3-aspect ELV LED RAG (Secondary Hood) signal head complete with backing boards and brackets.	Item	2
12	Supply and install 3-aspect ELV LED RAGa (Ahead) (Primary Hood) signal head complete with backing boards and brackets.	Item	3
13	Supply and install 3-aspect ELV LED RAGa (Ahead) (secondary Hood) signal head complete with backing boards and brackets.	Item	1
14	Supply & install Photo-Electric Control Unit (PECU)	Item	1
15	Supply and install Standard traffic signal pole 114mm dia, 4m high, low access	Item	4
16	Supply and install traffic signal pole 165mm dia, 5.5m high, low access, hinged	Item	2
17	Supply and install Above Ground Vehicle Detector (MVD)	Item	1
18	Supply and install Above Ground Stopline Detector	Item	1
19	Supply and install 4 channel detector pack	Item	2

Item No.	Description	Unit	Quantity
30	Arrange and attend Factory Acceptance Test (F.A.T)	Item	1
31	Arrange and attend Site Acceptance Test (S.A.T)	Item	1
32	Attend MOVA Commissioning and Post commissioning Validation	Item	1
33	Supply 12-month warranty and maintenance period	Item	1
20	Supply and install 16/20 core (SWA) traffic signal cable (SEE NOTE 1)	mtr	260
21	Supply and install 12 core (SWA) traffic signal cable (SEE NOTE 1)	mtr	60
22	Supply and install 1 pair SWA inductive loop feeder cable (SEE NOTE 1)	mtr	300
23	Supply and install 2 pair SWA inductive loop feeder cable (SEE NOTE 1)	mtr	120
24	Install electrical connection between isolation / feeder pillar and controller	mtr	2
25	Supply & Install Inductive Loop vehicle detection as shown on traffic Signal Layout drawing (Approved Revision)	Day	1
26	Supply and Install reusable inductive loop bottle jointing kits	Item	4
27	Supply and install pole/phase/controller ID's (letters and numbers), including warning labels.	Item	As required
28	Supply and install cable identification tags / labels	Item	As required
29	Supply all required UTC/OMU/MOVA in-station configuration works	Item	1

Table H.1.4 – Signal Equipment

Note 1 – cable lengths are indicative only. The Traffic Signal Contractor is to define the Cabling requirements in accordance with current electrical regulations and this specification.

Item No.	Description	Unit	Quantity
30	Arrange and attend Factory Acceptance Test (F.A.T)	Item	1
31	Arrange and attend Site Acceptance Test (S.A.T)	Item	1
32	Attend MOVA Commissioning and Post commissioning Validation	Item	1
33	Supply 12-month warranty and maintenance period	Item	1

Table H.1.5 – Testing and Warranty

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