

Yunex Traffic Technical Note

A600 Bedford Road, Ickleford, Hertfordshire
Cala Homes
871246526-YU-00-XX-TN-Y-0001
A - Issued for construction
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Change History

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1 Introduction

1.1 Document Scope

1.1.1 This document provides a traffic signal design pack for the provision of a traffic control system at Bedford Road, Ickleford, Hertfordshire in accordance with Hertfordshire County Council (HCC) specification and contains:

- Design Considerations
- Design Risk Assessment

1.2 Project Overview

1.2.1 A new Puffin crossing is to be installed using an ELV controller and ELV on-street equipment.

1.2.2 A new duct network shall be introduced to allow installation of traffic signal cables.

1.2.3 The crossing shall operate under Microprocessor Optimised Vehicle Actuation (MOVA) control.

1.3 Design Brief

1.3.1 To produce a detailed traffic signal design, including all associated documentation, in accordance with our responsibilities as CDM designer.

1.4 Related Documents

1.4.1 This document supports the following documents:

- Traffic signal design drawing(s) - 871246526-YU-00-XX-DR-Y-0001
- Controller Specification – 8712546526-YU-00-XX-SP-Y-0001

2 Design Considerations

2.1 Personnel

- 2.1.1 The key personnel involved in the traffic signal design hold all relevant and necessary qualifications. Competence of staff is established under Yunex Traffic QA procedures.

2.2 Scheme Safety Argument

- 2.2.1 The following safety argument is intended to;

- make the case that potential hazards have been reduced to an acceptable level;
- establish that any aspects of the scheme outside the scope of, or not in accordance with, Departmental Advice, Standards or TSRGD are adequately safe;
- justify the speed related design standard applied to the scheme

Potential Hazards

- 2.2.2 A design risk assessment has been completed detailing a list of possible hazards and an assessment of the risks posed using the severity × likelihood = risk rating methodology (refer to section 3 Design Risk Assessment for further details). Steps have been taken to ensure, where reasonable and practical, risks are eliminated from the design.
- 2.2.3 Where eliminating risk has not been possible and the risk rating is evaluated to be higher than an acceptable level, proposed control measures have been introduced to control the risk. For a full list of residual hazards, refer to paragraph 3.4.1, Residual Design Risks..

Speed Related Design

- 2.2.4 The signed speed of the road is 30mph. An informal speed survey conducted on 05/08/2022 has been undertaken, the recorded 85th percentile speeds were 38.46mph and 30.48mph, northbound and southbound respectively.
- 2.2.5 Whilst an informal speed survey has been completed, it is not a substitute for a detailed speed survey to determine an accurate 85th percentile speed. This is recommended to confirm various elements, such as, but not limited to;
- Site stopping distance (forward visibility)
 - Detector type
 - Speed detection requirements
 - Signage requirements and locations
 - MOVA loop locations
 - High friction surfacing requirements

Traffic signal layout

- 2.2.6 The pedestrian controller is to be installed on a new hard standing area at the back of the eastern footway, north of the tactile paving.
- 2.2.7 1x nearside primary and 1x closely associated secondary signal heads have been proposed on both approaches.
- 2.2.8 The crossing is 3.6m wide and 7.3m in length. For each pedestrian approach, there is a right-hand ELV LED nearside Puffin display with combined pedestrian demand unit, and high-level repeater, as well as a left-hand pedestrian demand unit. Each right-hand unit is to be fitted with tactile rotating cones and audibles. Each left-hand unit unit is to be fitted with tactile rotating cones. Audibles are to be timetabled for activation initially set to activate between 07:00 and 22:30.

Method of control and detection

- 2.2.9 Due to the northbound 85th percentile speed being greater than 35mph, MOVA control utilising MOVA induction loops has been proposed.
- 2.2.10 On- crossing and kerbside detection has been proposed to extend the all-red pedestrian period and cancel spurious pedestrian demands respectively

Intergreens

- 2.2.11 All intergreens have been calculated in accordance with Traffic Signs Manual Chapter 6, Traffic Control. Calculated intergreens have been assessed and adjusted by an experienced traffic signal design engineer to suit local conditions.

Red Lamp Monitoring (RLM)

- 2.2.12 On detection of a RLM2 fail in the controller, the signals will extinguish.

Passive / Non-passive poles

- 2.2.13 A pole risk assessment has been carried out to determine whether the use of passive equipment is appropriate at this site. The assessment evaluates the relative risk of traditional steels poles vs. passive poles taking account of pedestrian presence and environmental conditions such as location of the pole, equipment on the pole, likely speed of vehicles etc. If the assessment shows a limited benefit from one to the other, economic factors are introduced to help determine the most suitable solution for this site.
- 2.2.14 The passive pole risk assessment completed for this site has determined that there is no requirement for passively safe poles.

2.3 Standards and Approvals

- 2.3.1 The proposed layouts are in accordance with the Departmental Advice, Standards, the TSRGD and HCC specification.

3 Design Risk Assessment

3.1 General

- 3.1.1 A design risk assessment (DRA) has been completed to assess and consider the implications of the proposed traffic signal design with regards to safety. The risk assessment considers the severity and likelihood of a hazard to cause harm or loss in the form of a risk rating.
- 3.1.2 Any hazards with a risk rating of 8 or below are deemed to be at an acceptable level of risk. Any hazards above are considered unacceptable and a control measure should be introduced to reduce the likelihood of a hazard causing harm or loss.
- 3.1.3 Where reducing the risk rating to a level of 8 or below has not been possible, even after the introduction of a control measure, the hazard in question is deemed as having a residual risk associated with it. All hazards within the DRA which have a residual risk are listed in section 0 of this document.
- 3.1.4 The residual risks identified in the DRA have been split into two sections: residual design risks (risks present due to the design of the site), and residual construction risks, which are present due to the construction types or methods required.
- 3.1.5 Where residual design risks have been identified, they are distinguished on the drawing with a hazard symbol, as shown in Figure 1. Residual construction risks are only detailed in this document, not on the drawing.
- 3.1.6 There may be other hazards identified in the DRA which, although brought down to an acceptable risk rating, it is felt are worth highlighting. These hazards are listed in section 0 of this document.



Dx
Figure 1

3.2 Severity Explained

No injury or loss (1)

- 3.2.1 In effect this is a near miss.

Minor injury or loss (2)

- 3.2.2 A minor injury can be treated using first aid and does not result in lost time beyond the application of first aid. Minor loss would be any costs incurred by the incident which together amount to less than £100.

Significant injury or loss (3)

- 3.2.3 A significant injury to be treated using professional medical attention and would result in lost time beyond the application of medical assistance. Significant loss would be any costs incurred by the incident which together fall between £100 and £2,500.

Major injury or loss (4)

- 3.2.4 Any reportable accident resulting in permanent injury or disfigurement is considered as a major injury. Major loss would be any costs resulting from an incident which together fall between £2,500 and £10,000.

Fatality (5)

- 3.2.5 Any incident resulting in a fatality or losses in excess of £10,000 is considered as a severity 5 incident.

3.3 Risk Rating

3.3.1 The risk rating is calculated as:

$$\text{Risk Rating} = \text{Severity} \times \text{Likelihood}$$

		Likelihood				
		Very Unlikely (1)	Unlikely (2)	Possible (3)	Likely (4)	Very Likely (5)
Severity	1	1	2	3	4	5
	2	2	4	6	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
	5	5	10	15	20	25
		Low risk	Medium risk	High risk		

3.4 Residual Design Risks

3.4.1 Any residual design risks identified as part of the DRA are detailed below.

Hazard Identified	Initial Risk Rating	Control Measure	Revised Risk Rating
<i>D5 - Visibility of traffic signal heads</i> Good forward visibility exists on A4600 Bedford Road from the DMSSD to each of the proposed traffic signal heads on all approaches. Side road located near the pedestrian crossing has an adequate view of the traffic signal heads. Excessive foliage surrounding the area of the crossing which could obscure the traffic signal heads.	12	Primary and secondary signal heads angled to give better visibility of the traffic signal heads from the side road. Surrounding foliage should be cut back and maintained to allow increased visibility of the traffic signal heads.	12
<i>D14 - Visibility of pedestrians</i> Pedestrian visibility may be impacted by the excessive foliage surrounding the crossing on both approaches.	10	Surrounding foliage should be cut back and maintained to allow increased visibility of the pedestrians.	10

3.5 Residual Construction Risks

3.5.1 Any residual construction risks identified as part of the DRA are detailed below.

Hazard Identified	Initial Rating Risk	Control Measure	Revised Rating Risk
<i>S1 - Electricity</i>	20	Only suitably trained operatives to work with electricity. Non live working to be undertaken wherever possible.	10
<i>S3 - Falling object</i>	20	Any tools and equipment should be tethered when working at height.	10
<i>S13 - Working at heights</i>	20	Only trained operatives to use ladders or working platforms. Ladders and platforms to be checked for damage or wear before each use. Suitable PPE to be provided and worn.	10

3.6 Other Notable Hazards

3.6.1 Other hazards which have been deemed as being beneficial to be highlighted, even though the risk rating has been lowered to an acceptable level, are detailed below.

Hazard Identified	Initial Rating Risk	Control Measure	Revised Rating Risk
<i>D11 - Private access affected</i> Side road and residential properties located close to the crossing area.	8	Primary and secondary traffic signal heads angled to give good visibility. PE cell to be installed on Pole 3 to help with light pollution. Audibles timetabled to switch off between 22:30 and 07:00 to reduce noise pollution.	4
<i>D15 - Visibility of pedestrian signals</i> Standard nearside combined pedestrian units have been proposed. High level of pedestrian flow due to proximity near school and residential housing could obstruct pedestrian signals.	8	Nearside puffin high level repeaters have been proposed to increase visibility of pedestrian signals. Left-hand pedestrian demands provided due to increased crossing width.	4
<i>D18 - Location of duct chambers</i> Duct chamber and ducting locations believed to avoid any services. Not believed to cause any major hazard or slip risks	4	Up-to-date statutory undertaking drawings should be provided and used prior to works being carried out.	4
<i>D19 - Speed of the carriageway</i> Signed speed of the road is 30mph. Speed survey provided 85th percentile speeds of 38.46mph northbound and 30.48mph southbound.	12	Due to the 85th percentile speed being greater than 35mph, the crossing will operate under MOVA (Microprocessor Optimised Vehicle Actuation) control via induction ground loops. MOVA operation will ensure a forced change from traffic to pedestrians, providing additional intergreen from traffic to pedestrians.	8

<i>D20 - Street lighting</i> No street lighting has been assessed or designed as part of this scope of work by Yunex Traffic.	8	A competent street lighting engineer should review the existing equipment to ensure that it meets current standards. Remedial works must be carried out if the street lighting does not meet current standards.	8
<i>D21 - Location of maintenance bay</i> No specified maintenance bay on site.	6	Engineer to park safely on new development side road located nearby.	3
<i>D22 - Condition of crossing road surface</i> No High Friction Surfacing (HFS) present in proximity to proposed crossing.	6	Buff High Friction Surfacing (HFS) should be applied for an absolute minimum distance of 50m from the stop line and grey HFS from pedestrian studs to the stop line on each approach.	3
<i>D23 - Condition of white lining</i> New white lining corresponding with the new crossing required.	8	It is recommended new white lining be applied. All new white lining to be laid in accordance with Traffic Signs Regulations and General Directions 2016.	8

Appendix A – Appendix 12/5

3.7 Traffic Signals General Requirements.

- 3.7.1 A new Puffin crossing shall be installed. This shall incorporate 4m straight non-passive traffic signal poles, ELV LED primary traffic signal heads, solar cell, combined Puffin signal and pedestrian demand units with audio units, tactile rotating cones, on-crossing and kerbside detectors, MOVA below ground induction loops, ELV pedestrian crossing controller installed on NAL base and RS115x600 NAL pole retention sockets.
- 3.7.2 Pedestrian crossing controller shall operate under the latest MOVA licence.
- 3.7.3 All street furniture shall be grey in colour.
- 3.7.4 The Contractor shall supply a 3 core and Earth 6mm² SWA link cable between the feeder pillar and the Controller.
- 3.7.5 The Controller shall not be installed on site until there is operable electricity company power installed within the Traffic Signal Services Pillar. The controller shall be connected to the electricity supply and left powered unless isolation is required for safety reasons.
- 3.7.6 The site shall not be taken into maintenance by Hertfordshire County Council until all defects including remote monitoring are resolved unless otherwise agreed with a HCC traffic signal engineer representative.
- 3.7.7 Specialist traffic signal sub-contractors considered suitable must hold an ISO 9001 Certificate or similar approved accreditation.
- 3.7.8 Ducting and access chambers shall be installed in accordance with Appendix 5/2.
- 3.7.9 This specification is to be read in conjunction with standard detail drawing 871246526-YU-00-XX-DR-Y-0001.

Table 12/5 – Applicable Standards	
British Standards BS7671. (IET Wiring Regulations) 18 TH Edition	
HSE Avoiding Danger from Underground Services.	
Institution of Electrical Engineers; Safety Related systems.	
IEC61508 Functional Safety of Electrical, Electronic and Programmable Electronic system.	
The Traffic Signs Regulations and General Directions 2016 inc. Chapter 6	
Manual of Contract Documents for Highway Works (MCHW)	
LTN 01/98	The Installation of Traffic Signals and Associated Equipment.
TA,TD,TM,TS 101 (DMRB)	Traffic Signalling Systems
TOPAS 0600D	Self Certification Procedures for Statutory Approval of Traffic Control Equipment.
TOPAS 2130B	Environmental Tests for Road Traffic Control Equipment
TOPAS 2500B	Specification for Traffic Signal Controller.
TOPAS 2506A	Specification for Above Ground On-Crossing Pedestrian Detection Systems.
TOPAS 2511A	Performance specification for nearside signal and demand units
TOPAS 2508C	Performance specification for tactile equipment for use at pedestrian crossings
TOPAS 2512B	Performance specification for below ground vehicle detection equipment
TOPAS 2522A	Remote Monitoring and Control of traffic signal equipment via a telecommunication network

TOPAS 2523B	Traffic Control equipment interfacing specification
MCH 1969 A	Traffic Control System Design for all Purpose Roads.
MCH 1827D	Traffic controller <i>works</i> specification and controller forms.
MCS 0206	List of Drawings, Specifications and Instructions.

- 3.7.10 All materials and equipment shall comply with the relevant TOPAS specifications and with the latest Department of Transport TA, TR, MCE, MCH and MCK specifications, requirements and recommendations for Traffic Signal control equipment including, but not limited to those listed in Table 12/5 above.
- 3.7.11 The Contractor is to liaise directly with the Overseeing Organisation and statutory undertakers, prior to, at the commencement and during the signals associated works regarding detailed requirements.
- 3.7.12 All equipment, including cable, shall be supplied in a new and unused condition except insofar as it has been tested during the course of manufacture. Only equipment of the most recent type approved model currently in production shall be used.
- 3.7.13 Where an approved list for a particular type of equipment is incorporated in the Work/Job Order for the individual scheme, only equipment on that list shall be supplied, subject to the requirements of the general specification. Alternative equipment may be submitted for inclusion in the approved lists and alternative quotations may be provided assuming use of that equipment.
- 3.7.14 Traffic signal controllers shall comply with TOPAS 2500 issue B "Specification for Traffic Signal Controller" including all released amendments. All controllers shall comply with appropriate sections of this general specification as required by the technical specification for the individual scheme.
- 3.7.15 Street furniture shall comply with all relevant TOPAS specifications, Regulatory signs on traffic signal heads shall comply with BS 873: Part 5: 1983 "Specifications for internally illuminated signs and external lighting luminaries".
- 3.7.16 Tactile equipment mounted in pedestrian push button boxes shall comply with TOPAS 2508 issue C "Performance Specification for Tactile Equipment for use at Pedestrian Crossings".
- 3.7.17 One printed copy of the user handbook or guide shall be supplied to the Overseeing Organisation for each type of controller and item of ancillary equipment. The documentation shall include a full list of operator commands and their functions and details of the functions of all switches accessible to the Overseeing Organisation. The Contractor shall supply the above documentation at the time of the Factory Acceptance Test (F.A.T.).
- 3.7.18 All equipment supplied shall be type approved for its purpose, including any modifications required by this specification.
- 3.7.19 All necessary blank forms/certificates and/or schedules referred to in this document are contained in Appendix A.

- 3.7.20 The Contractor is to notify the Overseeing Organisation of any problems that would affect installation of traffic signal equipment prior to the works.
- 3.7.21 The Contractor shall include for the supply and delivery of all equipment within this section, together with the testing of the installation and leaving it in working order to the satisfaction of the Overseeing Organisation. He shall also include for any materials and work which may not be expressly specified but which are implied and necessary for the satisfactory completion of the installation.
- 3.7.22 No equipment or street furniture is to be located within the working width of any existing or proposed road restraint system (safety barriers).

3.8 Equipment Specification Requirements.

- 3.8.1 The Contractor shall confirm in writing that the equipment has Department of Transport Type Approval for use on Public Roads or alternatively that the Department of Transport has granted provisional approval to Stage 3 where Type Approval is pending.
- 3.8.2 The traffic signal installation company shall be approved to BS EN ISO 9002 (Ref.1) certification against QAS 3433/287 (Ref.1) or QSS 015 (Ref.8). A copy of the respective approval certificate shall be submitted with the returned tender document.
- 3.8.3 The Contractor shall make provision in his tender for providing such facilities as may be required by the Electricity Supply Company to carry out such inspections and tests as they may require.
- 3.8.4 The regional electricity supply cables shall be provided and installed by the local Electricity Company who shall be responsible for bringing the service into the feeder pillar.

3.9 Traffic Signal Controller Electricity Supply.

- 3.9.1 A new DNO supply shall be fed into the new feeder pillar. This shall be arranged by the Client / Principal Contractor.
- 3.9.2 The electricity supply to a traffic signal controller unit shall be fed from an independent feeder pillar/cabinet housing the Electricity Company's Cut out. The Feeder Pillar shall be installed adjacent to the controller. The feeder pillar shall have an independent double pole lockable isolator installed in conjunction with the Electricity Company's Drip proof cut-out both being attached to a 10mm thick non hygroscopic wooden Back Board.
- 3.9.3 The Contractor shall be responsible for the installation of the connecting cable between the feeder pillar and the Traffic Signal Controller Unit. Including the connection of tails in the Electricity Company's cut-out. The interconnecting cable shall be 3 cores PVC insulated SWA with a minimum conductor size of 6mm.
- 3.9.4 The Contractor shall be responsible for arranging/purchase of new or re-routing of existing controller electricity supplies to the new controller/cabinet locations with the Electricity Company. The supply shall be a minimum of 32 Amps 240Volts 50HZ, 24Hr single phase with a source impedance of <0.35 Ohms.
- 3.9.5 The Contractor is to notify the Electricity Board of the service requirements and the installation of the controller supply cabinet pillar. The Contractor is to arrange the necessary service *works* onsite.

- 3.9.6 The controller electrical connection is to be as per drawing 871246526-YU-00-XX-DR-Y-0001.

3.10 Traffic Signal Controller Installation.

- 3.10.1 Unless specified by the Overseeing Organisation, all Traffic Signal Controllers and termination cabinets supplied under this contract are to be of the large case type and shall be capable of accommodating a standard 465mm rack for the installation of transmission equipment.
- 3.10.2 All controller and termination cabinets shall be finished as per Overseeing Organisation specification. Space shall be made available within the cabinets for the Outstation Monitoring Units.
- 3.10.3 The locations of the controllers and termination cabinets shall be confirmed on site with the Overseeing Organisation prior to installation.
- 3.10.4 The cabinet is to be mounted on a NAL controller base.

3.11 Traffic Signal Controllers.

- 3.11.1 Functional safety requirements are to conform to TOPAS 2500B including all appendices and TOPAS 2523B and be capable of offering UTC interface and UTC bits as described. Attention is drawn to I.E.T. Regulation number 471-12 and the requirement to ensure that the maximum earth disconnection time for low voltage circuits does not exceed 0.4 seconds.
- 3.11.2 Twin 13 amp switched maintenance sockets to BS 1363 shall be provided in all controllers and termination cabinets. The switched outlet sockets circuits are to include a residual current device (RCD) having a rated residual operating current not exceeding 30 mA. The RCD shall have a disconnection time not exceeding 0.4 seconds. The sockets are to be left spare and the connection of permanent site equipment such as an OTU or OMU shall not be allowed into the sockets.
- 3.11.3 All equipment shall be suppressed against interference with, or from, mobile phone, radio and television signals as stipulated by the Highway Agency.
- 3.11.4 The Contractor shall provide a Factory Acceptance Test (FAT) of the actual controllers to the Overseeing Organisation, by the Signal Company's Engineer at the local depot/factory prior to the installation on site. The FAT shall include the provision of all lamp and detection simulation. The Factory test shall also test all the controller PCB cards, Transformers and any other associated equipment to be used in the controller cabinet.
- 3.11.5 The Contractor shall not give less than 7 days notice to the Overseeing Organisation of the intention to carry out any of the (FAT) testing above.
- 3.11.6 In order that the Overseeing Organisation may witness the works tests carried out on the Traffic Signal Controller Unit prior to delivery to site, the Contractor is to give the Overseeing Organisation at least fourteen days advance notice that such tests are to be performed. Such tests are to be performed at the Contractor's expense.
- 3.11.7 The signal company shall allow for up to 3 requests for re-blowing of any PROM(s) with additional/amended information supplied to the Signal Company following commissioning of the installation. The time between installation and re-blowing could be up to twelve months. The PROM is to be collected from & fitted back on site within a maximum of 2 days from the requested amendments being received from the Overseeing

Organisation. Arrangements shall be in place for maintaining traffic signal control during the re-blowing period.

3.11.8 Manual Panel facilities are to include the following: -

- Dimming override switch.
- VA / FIXED TIME / MANUAL control switches.
- DFM lamp/LED test switch.
- Signals ON / OFF switch.
- All Red switch.
- VA / MANUAL / FIXED TIME / UTC / HURRY CALL /PRIORITY MODE and MOVA LED Indicators.
- The DFM lamp shall be visible from outside the controller cabinet.

3.12 Controller Configuration & Data set-up.

3.12.1 Controller specification forms ("MCH1827D") Rev. 2 shall be included with this specification at Appendix B. The Contractor shall satisfy themselves that the data on these forms is satisfactory & sufficient. Any proposed changes shall be subject to the agreement of the Overseeing Organisation.

3.13 Traffic Signal Poles.

3.13.1 The Traffic Signal poles to be installed are at locations shown in the Work/Job Order. Final positions are to be agreed on site with the Overseeing Organisation.

3.13.2 All traffic signal poles are to be installed in NAL RS115 Retention Socket with Duckfoot Bend. The contractor shall ensure that:

- The retention socket shall be installed as per the manufacturer's guidance.
- If the planting depth of the retention socket is to be shortened, this shall be carried out in accordance with the manufacturer's guidelines.
- The RS115 Retention Socket with duck foot swivel bend shall be inserted in the centre of the excavation with the locking chamber of the cast iron body positioned furthest from the tactile paving (usually 180°).
- The drainage tube shall extend to outside the concrete foundation.
- A stump pole is obtained prior to installation of retention socket, this is used to obtain correct vertical alignment of the socket.
- Foundation is constructed as stated by the manufacturer.
- No poles containing cable slots to be cut, if there is a need for a shorter pole, poles not containing a cable slot shall be used.
- If a pole is cut, galvanising spray shall be used at the point of the cut.
- Concrete of grade ST4 or better shall be used for filling the excavation.
- The soakaway shall be drained into the subbase.
- Pole wedges shall be used if poles are installed at 500mm from tactile paving. Block pavements do not need to be cut to 25mm; they can be directly bedded into the concrete foundation.

- 3.13.3 All traffic signal poles are to be numbered in accordance with the Overseeing Organisation's requirements.
- 3.13.4 Standard steel signal poles are to be installed as per Standard Detail Drawing 871246526-YU-00-XX-DR-Y-0001.

3.14 Traffic Signal Heads.

- 3.14.1 All traffic signals heads shall comply with the requirements of BS EN 12368 (Traffic Control Equipment – Signal Heads).
- 3.14.2 Unless agreed by the Overseeing Organisation, signal heads shall be high intensity LED, type approved, compatible with ELV controllers and capable of full lamp monitoring via the integral lamp monitoring facilities of the controller.
- 3.14.3 Heads shall be Class IV: IP55 in accordance with EN60529
- 3.14.4 The Head shall have a Class A temperature range +60°C to -15°C
- 3.14.5 All cable entry points into signal heads shall have a secure & permanent watertight seal.
- 3.14.6 Retro-reflective backing boards shall be supplied by the Contractor and fitted to all Traffic signal heads. They shall be fitted using the correct number and type of fixings as specified by the manufacturer.
- 3.14.7 Appropriate Hoods as indicated on the scheme drawings shall be provided by the Signal Company on all signal heads, pedestrian signal heads shall also be fitted with anti-phantom screens. Primary hoods shall be used on secondary heads at Pelican, Puffin, Toucan crossings and where closely associated secondary signals are used.
- 3.14.8 The centres of the amber lenses are to be located not less than 2.65 m, and not more than 3.10 m, above carriageway level. The lower most part of the signal head at toucan crossings shall be not less than 2.4m.
- 3.14.9 Primary Signal Heads are to be aligned to a point approx. 1.5m above the centre of the approach, at a distance in accordance with Stopping Sight Distance (SSD) of the approach unless otherwise agreed by the Overseeing Organisation.
- 3.14.10 Secondary heads shall be aligned to a point 1.5m above the approach stop-line, unless instructed otherwise by the Overseeing Organisation.
- 3.14.11 Heads shall be securely clamped to prevent movement post alignment.
- 3.14.12 Any traffic signal head located on a traffic signal pole that is adjacent to an active carriageway shall have a minimum clearance of 600mm and an absolute minimum of 450mm from kerb face to the edge of the associated sighting screen where permitted by the overseeing organisation. Traffic signal head mounting brackets shall be supplied as required to achieve this minimum requirement.
- 3.14.13 The signals shall not be visible to motorists or pedestrians during installation and pre commissioning tests. All new signal heads shall be covered with a purpose made; opaque, orange tarpaulin/canvas cover (with no advertising on) and securely attached to the signal head. Push buttons including tactile devices shall also be covered. The coverings shall be fitted as soon as the new signal heads are positioned and shall not be removed until the Overseeing Organisation commissions the signals.
- 3.14.14 A Photo Electric Control Unit (PECU), plug-in type rated 55 lux on/100 lux off, with a 10-year guarantee shall be mounted on the signal head furthest away from any artificial light source.

- 3.14.15 Failure of the solar switch shall cause the signals to automatically assume the 'bright' condition. A Dimmer override switch is to be provided in the Police Flap.
- 3.14.16 Solar cell for dimming is to be of the type that shall ensure the correct dimming operation of the controller under street lighting conditions at the site location.
- 3.14.17 All regulatory (box) signs mounted within or on signal heads shall be illuminated using ELV LED energy saving lamps.

3.15 Outstation Monitoring (Control) Unit.

- 3.15.1 Where remote monitoring is required, the Contractor shall supply and install a compatible 5port 4G router for the use with the OMCU unit.
- 3.15.2 OMCU's are to be compatible with the Overseeing Organisation's SWARCO in-station R.M.S. Peek Chameleon OMU will be provided.
- 3.15.3 Each OMCU is to be capable of being monitored and configured via the in-station, RS 232 to 485 Communications links, laptop computer, PDA and controller handset connected directly to the controller or OMCU port or termination cabinet port.
- 3.15.4 The Contractor shall liaise direct with the Overseeing Organisation, regarding the provision of the SIM and be responsible for ensuring that the SIM cards are setup and working prior to the SAT/OMCU testing.
- 3.15.5 Cabinet mounted aerials are to be used unless a signal strength test indicates that a separate aerial is required. When required any separate aerial shall be located on a signal pole which is to be positioned to ensure adequate signal strength that enables both outgoing and incoming calls to the OMCU. Signal strength tests are to be carried out by the Contractor prior to installation. Approval shall be sought from the Overseeing Organisation prior to installation of any pole mounted aerial.
- 3.15.6 Each OMCU shall be mounted within the traffic signal controller cabinet.
- 3.15.7 All necessary mounting equipment and racking shall be provided by the Contractor to enable each OMCU to be suitably installed within the controller.
- 3.15.8 The Contractor shall supply and install all necessary cabling/interface leads between the traffic signal controller and the OMCU to provide the required monitoring facilities.
- 3.15.9 The OMCU shall also be supplied with facilities to enable interrogation of the traffic signal control equipment remotely by the in-station operator. This shall enable the operator at the in-station terminal (via the OMCU) to communicate with the control equipment to carry out 'manual' checking and amendment of RAM data if required.
- 3.15.10 Cable forms for OMCU installations are to be of a standard length and are not to be cut down to fit the dimensions of the traffic signal controller during installation. All excess and spare cables are to be coiled and tied to an appropriate part of the controller chassis in such a way it shall not impede any subsequent maintenance *works* to the controller or the OMCU.
- 3.15.11 The OMCU shall be able to monitor variable all red periods and report violations as faults.

3.16 Inductive Loop Detection

- 3.16.1 Inductive loop detection equipment shall comply with TOPAS 2512 issue B “Performance Specification for Below Ground Vehicle Detection Equipment”. Unless specified otherwise, the location of detector loops shall conform with MCE 0108C “Siting of Inductive Loops for Vehicle Detecting Equipment’s at Permanent Road Traffic Signal Installations”, and shall be installed in accordance with MCH 1540 issue F “Specification for the installation of detector loops on Motorways and All Purpose Trunk Roads” and set out as per Highway Construction Details drawings G01-G32.
- 3.16.2 Reference shall be made to the signal design drawing and this document for the proposed arrangement and location of all loops.
- 3.16.3 Unless specified by the Overseeing Organisation, detector loops are to be installed only after the road markings and any high Friction surfacing have been laid.
- 3.16.4 All loops shall be cut and cabled as individual loops, although it shall be permissible to joint to a common cable at an inspection chamber where loops share the same detector pack.
- 3.16.5 The detector feeder cables shall feed direct to the controller in 100mm Orange ducting to be laid under the footpath or verge. Slot cutting and cable feeding along the kerb edge in the road surface is not permitted without the agreement of the Overseeing Organisation.
- 3.16.6 Re-useable re-enterable I.P. 68 rated cable joints shall be installed in accordance with the joint kit instructions. Jointing shall not take place in wet weather conditions unless suitable protection is erected to ensure that moisture cannot enter the joint during the jointing operation.
- 3.16.7 Feeder Cables shall be continuous throughout their length from origin to destination and shall NOT be jointed.
- 3.16.8 The Contractor shall provide the Overseeing Organisation with reasonable opportunity to inspect each joint.

3.17 Loop Detector Packs

- 3.17.1 Any loop detector packs supplied shall be of the plug-in self-tuning type and shall comply with the TOPAS 2512B, all appendices. Packs shall be installed within the controller and termination cabinets in a 3U rack and every detector shall have a minimum of 4 channels of detection. All Individual packs/channels, including spares shall be labelled with their respective loop identification.
- 3.17.2 The detector shall be capable of operating with a feeder cable up to 300 metres in length.
- 3.17.3 The equipment, including loop and feeder shall operate without any reduction in performance under the following conditions: -
 - Temperature -10 to 50 deg C
 - Relative humidity up to 100% (non-condensing)
 - Carriageway flooded under 1cm of water.
- 3.17.4 The detector shall not operate from electrical noise pick-up on the detector loop or feeder cables.

- 3.17.5 Detector packs for the signals wired into any termination cabinet shall also be installed within termination cabinet.
- 3.17.6 A certificate of detector performance shall be completed and signed before the commissioning of the installation.

3.18 Above Ground Pedestrian Detectors.

- 3.18.1 Any above ground pedestrian detectors that may be required as part of a signal installation, shall be capable of operating from a nominal supply of 24 Volts a.c. or d.c.
- 3.18.2 The type of above ground pedestrian detector unit, may be one of the following:
- Above ground Microwave On-Crossing Detector.
 - Above ground Digital Vision Kerbside Detectors that shall incorporate an adjustable pick up zone.
- 3.18.3 Above Ground Pedestrian Detectors shall be the most recent statutory type approved model fit for the purpose, produced by the supplier.
- 3.18.4 Plug and socket cable connections shall be supplied for termination purposes. These connectors shall be fitted to the signal head assembly to enable the detector units to be easily removed for maintenance purposes.
- 3.18.5 All above ground detection units shall have clear viewing zones and brackets shall be installed accordingly to ensure detection beams are not hindered by any backing board or other equipment arrangements

3.19 Pedestrian Facilities.

- 3.19.1 Pedestrian Signals shall be 'Near-sided'.
- 3.19.2 Near-sided indicator and pushbutton demand units shall be of the combined type as specified and shall comply with the requirements of TOPAS 2511A (Performance Specification for Nearside Signal and Demand Units)
- 3.19.3 Where audible units are installed, it shall be possible to mute the audible signal using the controller's internal master time clock.
- 3.19.4 The push button case and front panel is to be manufactured from Die cast Aluminium.
- 3.19.5 All push-button units are to be installed with the underside of the push-button unit 1000mm above footway level, unless otherwise specified.
- 3.19.6 When separate indicator and demand units are installed, there shall be a minimum of 100mm between the top of the demand unit to the hinge of the nearside indicator unit.
- 3.19.7 Where separate or high-level repeater nearside indicators/display units are specified they shall be narrow field of view. The installation height of repeat indicator units is to be agreed on site with the Overseeing Organisation.

3.20 Cabling.

- 3.20.1 All cables are to be provided with a minimum of 25% spare dedicated cores between each pole position and the controller. Each Pole is to be individually fed from the Controller. Series cabling of poles is NOT permitted. All cable sheaths shall be coloured Orange unless otherwise agreed by the Overseeing Organisation and marked "Traffic Signals".
- 3.20.2 Each cable shall be clearly labelled in waterproof lettering at the Pole cap termination, in access chambers, termination cabinets and the controller giving a unique cable identifier for ease of maintenance. Labelling to be in accordance with appendix 12/70
- 3.20.3 Each Detector cable shall be clearly labelled in waterproof lettering at the controller base.
- 3.20.4 The connections in the pole cap assembly for 4m poles SHALL not contain more than two cores per connector. To take into account the extra terminations that may be required when a Puffin / Toucan facility is installed then as appropriate an extended pole cap assembly shall be employed. It shall be noted that additional termination blocks strapped to the standard arrangements of a standard pole cap would not be allowed.
- 3.20.5 All wire-armoured cables, which are to be installed into the traffic signal controller cabinet, shall be terminated using the compression gland technique and bonding shall satisfy the requirements of BS7671.
- 3.20.6 Adjacent metalwork not forming part of the installation shall NOT be bonded to any part of the Traffic Signal installation.

3.21 Testing and commissioning of the completed Traffic Signal Installation.

- 3.21.1 The Contractor shall be responsible for the testing, inspection and commissioning of the completed installation (Clause 1424), and for certifying that all such *works* comply with the current edition of BS 7671 by issuing a Completion Certificate and a copy of the associated test results.
- 3.21.2 The completed installation shall be designed and tested electrically in accordance with the I.E.T. Wiring Regulations (BS 7671). The Electrical tests shall be completed and submitted to the Overseeing Organisation at least 1 day prior to commissioning of the signals and shall include: -
- Earth continuity test.
 - Earth loop impedance test
 - Insulation resistance test of all cores.
 - Continuity of all cores to mass of cores
 - Polarity check
 - Residual Current Device test
- 3.21.3 A Completion Certificate shall be issued to the Overseeing Organisation at the time of signals commissioning or Site Acceptance Test (SAT). A copy of the certificates is contained in Appendix A. Commissioning shall not be completed until this certificate has been satisfactorily completed and accepted by the Overseeing Organisation.
- 3.21.4 The Contractor shall not give less than 7 days notice to the Overseeing Organisation of the intention to carry out any of the Electrical tests specified. The Overseeing Organisation and his representative shall be entitled to witness such tests. As many tests as in the opinion of the Overseeing Organisation are possible shall be arranged together.
- 3.21.5 In the event of any Electrical test indicating failure to comply, that test and those proceeding shall be repeated, in the correct sequence, after the fault has been rectified.
- 3.21.6 Until the site is commissioned and accepted by the Overseeing Organisation, the traffic signals are to remain switched off except for the purpose of electrical testing. Should the signals require to be switched on prior to commissioning, then Traffic Signal Inoperative boards are to be used in accordance to the Traffic Signs Regulations & General Directions 2002 Diagram No. 7019 at the responsibility of the Contractor.
- 3.21.7 The signals shall not be visible to motorists or pedestrians during installation and pre commissioning tests. All new signal heads shall be covered with a purpose made; opaque, orange tarpaulin/canvas cover (with no advertising on) and securely attached to the signal head. Push buttons including tactile devices shall also be covered. The coverings shall be fitted as soon as the new signal heads are positioned and **shall not** be removed until the Overseeing Organisation commissions the signals.
- 3.21.8 During the S.A.T, the Contractor is to carry enough spare equipment to ensure that any hardware/equipment failure does not delay switch-on or commissioning.

3.22 OMCU Commissioning.

- 3.22.1 Commissioning of the OMCU is to be carried out in the presence of the Overseeing Organisation. Interrogation of the OMCU shall be demonstrated by the Contractor to the Overseeing Organisations satisfaction by means of a suitable interrogation device.
- 3.22.2 The Contractor is to provide the Overseeing Organisation with an In-station configuration and live graphic diagrams, on disk or via e-mail at least one week prior to the SAT
- 3.22.3 The Contractor shall also complete and forward a copy of the completed "OMCU Installation Details Certificate" form to the Overseeing Organisation at least one week prior to the SAT
- 3.22.4 The Contractor shall test the OMCU in the presence of the Overseeing Organisation to demonstrate that the monitoring requirements of section 12 of this Appendix have been met, and that OMU current indication corresponds with the number of lamps being monitored per phase and detector input locations, etc.
- 3.22.5 The Contractor shall also override the dimming sensor in order to force the control equipment to change to the dim state. The OMCU shall be tested to confirm that the dim state has been recognised and that no lamp faults (as a result of the dim state) are reported by the OMCU to the in-station.
- 3.22.6 The Contractor shall remove one signal lamp per phase in turn at each signal installation being commissioned. Confirmation from the in-station operator shall be sought by the Overseeing Organisation that the lamp failure has been identified by the OMCU for the correct aspect and phase.
- 3.22.7 The Overseeing Organisation reserves the right to instruct the Contractor to carry out any other tests that they may consider necessary to prove the correct operation of the monitoring equipment.

3.23 Warranty and Maintenance.

- 3.23.1 The Contractor shall provide for warranty periods during which any defective equipment supplied shall be repaired or replaced. These warranty periods shall consist of 36 months for below ground vehicle detection and associated equipment (TOPAS 2505B), 5 years for LED signal heads Regulatory Signs and Push-Buttons and 12 months for the remainder of equipment. All returned parts shall be repaired / replaced and returned to the Overseeing Organisation free of any charge within 2 weeks from receipt of the faulty components.
- 3.23.2 The warranty periods listed above shall not commence until all works (including all Defects and Incomplete Works) have been completed, and a period of 28 fault free days has elapsed.
- 3.23.3 All outstanding defects and incomplete *works* (snags) are to be rectified within two weeks of switch on. In the event that outstanding works and defects are not completed within the timeframe, the Overseeing Organisation reserves the right to employ the services of another signal company to complete outstanding work and invoice the Contractor. Failure to resolve outstanding snags, to the Overseeing Organisations satisfaction, within the allocated timeframe may also result in the signal company being omitted from future tenders.

3.24 Documentation.

- 3.24.1 Traffic Signal Design Drawing and controller log book is to be provided in a waterproof wallet fixed inside the controller cabinet.
- 3.24.2 A hard copy of the instruction and maintenance manual for the controller shall be provided.
- 3.24.3 Instruction Manuals shall contain all information necessary to enable the equipment to be operated under normal working conditions and include brief details of simple checking procedures.
- 3.24.4 Electronic copies of the following documentation shall be supplied no later than 2 weeks subsequent to the handover into the maintenance of Hertfordshire County Council:-
- As Built Drawing of installation; scales to be 1:200 & 1:500 only in both AutoCAD and PDF format
 - Traffic Signal Controller Specification
 - Traffic Signal Controller Configuration files
 - MOVA dataset; MDS, MOVA and PDF copy
 - MOVA link / lane diagram detailing any special conditioning and outputs
 - MOVA / SCOOT validation report
 - Traffic Signal cable test certificates
 - Traffic Signal loop test certificates
 - Remote monitoring unit wiring details
 - Photos of site and internal wiring of controller and feeder pillar
 - Factory and Site Acceptance Test certificates and checklists

APPENDIX A – INSTALLATION DOCUMENTS

Title
Slot Cutting Measurement Certificate
Cable Schedule - Extra Low Voltage (ELV)
Equipment Power Consumption Certificate
OMCU Installation Details Certificate
Traffic Signal Installation Completion Certificate

SLOT-CUTTING MEASUREMENT CERTIFICATE

Junction Location

Site Reference No Sheet of Date of Measurement

Loop Identity	Slot-cutting (metres)		Under Kerbs (No.)	Notes
	Flexible Pavement	Rigid Pavement		
Totals				

Signedfor and on behalf of (Contractor)

Signed for and on behalf of the Overseeing Organisation

CABLE SCHEDULE - EXTRA LOW VOLTAGE (ELV)

Junction Location

Site Reference No Date Sheet..... of

Cable No.	No. of Cores	From	To
E1			
E2			
E3			
E4			
E5			
E6			
E7			
E8			
E9			
E10			
E11			
E12			
E13			
E14			
E15			
E16			
E17			
E18			
E19			
E20			

Signedfor and on behalf of (Contractor)

Signed for and on behalf of the Overseeing Organisation.

EQUIPMENT POWER CONSUMPTION CERTIFICATE

Power Supply Requirements of Equipment to be Supplied.

- a) Average power consumption of controller, detection and lamps
 (inc. wait lamps & internally illuminated Regulatory box sign lamps) Watts

- b) Peak Current Amps

- c) Electricity Supply Company Cut-out fuse rating Amps

OMCU INSTALLATION DETAILS CERTIFICATE

S.C.N./SITE Location:.....

Site telephone no:.....

Commissioned by.....(Signal Engineer)

Phase	Description	Type
1a		
2b		
3c		
4d		
5e		
6f		
7g		
8h		

Det	Description
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	

Det	Description
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
30	
31	
32	

Date:

Comments:

TRAFFIC SIGNAL INSTALLATION COMPLETION CERTIFICATE

Customer

DETAILS OF THE INSTALLATION

Site Address:		
Maintenance Site No:	Customers Drawing No:	
New Installation.	Extent of installation covered by this certificate	
Modification to Installation.		
Type of Earthing TN-C-S TN-S TT		
Characteristics of the Supply at the origin of the installation: Nominal Voltage Volts Frequency Hz		
	Specified	Measured
Maximum prospective fault current (KA)		
Earth fault loop impedance or origin, $Z_e \ \Omega$		
Mains supply protection device at origin: Type: BS Rating A		
Master switch fuse or circuit breaker: Type: BS Rating A		
Residual Current Device protecting:		
Whole installation	 mA	N/A
Maintenance socket only	 mA	

INSTALLATION TEST RESULTS

Test Equipment Used	Serial Number:	Calibration Date:
MultiMate: - Insulation Tester: - Earth Loop Impedance Tester: - RCD Tester: - Inductance Tester: - Other: -		
Insulation Test of Complete Installation 500V : -	RCD Test	Time
	30 mA	
	150 mA	
	300 mA	

Traffic Signal Cable Test Certificate

Site:

Cable (From-To)

Cable type (LV/ELV).....

Tested

By:

of:

Signature: Date:

Witnessed

By:

of:

Signature: Date:

Circuit Protective device	Type :	Standard :	Rating :	A
Sheath Insulation Test (min. 1 MΩ @ 500 V)	MΩ			
Supply Voltage	At Feeder Pillar :	V	At Signal Head :	V
Earth Loop Impedance (Ω) (max 20 Ω)	At Feeder Pillar:	Phase-Neutral : Ω	Phase-Earth :	Ω
	At Signal Head:	Phase-Neutral : Ω	Phase-Earth :	Ω

Core	Colour / Description	Insulation Resistance MΩ (min 6 MΩ @ 500 V)	Continuity Ω
Armour			
1	Brown		
2	Yellow		
3	Green		
4	Red		
5	White		
6	Blue		
7	Orange		
8	Black		
9	Red / White		
10	Red / Blue		
11	Grey		
12	Violet		
13	Red / Brown		
14	Red / Yellow		
15	Red / Black		
16	Red / Grey		
17	Red / Purple		
18	Red / Orange		
19	Red / Green		
20	Blue / White		

3.24.4.1.1.1 Inductive Loop Test Certificate

Site:.....

Weather Temperature : °C (min 2 °C)

Tested By:..... of : Signature : Date :

Witnessed By :of : Signature : Date :

	Loops						Feeder Cables			Loops and feeder cables				
	Loop before backfilling			Loop after backfilling				Loop Feeder before jointing		After jointing				
Loop Reference	Insulation Resistance MΩ (min. 10 MΩ @ 500 V)	Conductor Continuity Ω	Inductance μh	Insulation Resistance MΩ (min. 10 MΩ @ 500 V)	Conductor Continuity Ω	Inductance μh	Length m	Insulation Resistance MΩ	Conductor Continuity Ω	Insulation Resistance MΩ	Conductor Continuity Ω	Measured Inductance μh	Theoretical Inductance μh ($L=0.82.P.N(N+1)$)	Theoretical Continuity Ω (Max. 13.7 Ω/Km @ 20°C [±20%])

APPENDIX B – TR2500 CONTROLLER WORKS SPECIFICATION.

Separately provided. Refer to 871246526-YU-00-XX-SP-Y-0001

APPENDIX C – TRAFFIC SIGNAL DESIGN DRAWING.

Separately provided. Refer to 871246526-YU-00-XX-DR-Y-0001

APPENDIX D – MOVA DATASET.

Separately provided.

APPENDIX E – EQUIPMENT SCHEDULE

<u>Description</u>	<u>Quantity</u>
ELV Pedestrian Crossing Controller installed on NAL Controller Base (grey)	1
MOVA licence	1
Peek Chameleon OMU	1
Solar Cell	1
4.0m Straight Non-Passive Traffic Signal Pole + Pole Cap (grey)	2
ELV Primary RAG Signal Head + Side Hung Bracket	4
ELV Combined Puffin Nearside Signal and Pedestrian Demand Unit with Audio Unit	2
ELV Puffin Nearside High Level Repeater	2
Tactile Rotating Cone	2
On-Crossing Detector	2
Kerbside Detector	2
Electricity Feeder Pillar	1
Earth Rod	1
Signal Cable (armoured)	Item

All the above quantities are indicative and should be used in conjunction with the detailed site drawing, any anomalies in the quantities must be highlighted in the site specific quotation. All signal heads should have backing boards unless specified on the site drawing.

The above quantities are for traffic signal equipment only. No allowance has been made for any civils items (ie pole sockets, chambers, ducts etc)

APPENDIX 12/70 :CABLE AND CABLE CORE IDENTIFICATION

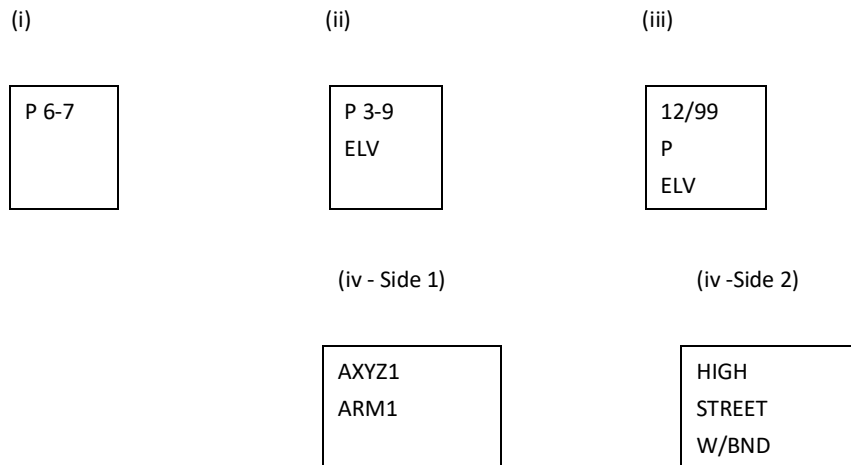
This Schedule is issued to ensure that all cable and cable cores in traffic signal installations are identified by the same method and code.

1 Traffic Signals Cable Identification

All cables entering any equipment housing shall be identified by a 'Pull-Tite' tag fixed around the inner sheath immediately above the Steel Wire Armouring (SWA) termination gland. The tag shall be marked, using an approved waterproof, indelible black marker pen, in the following manner:

- (i) Low Voltage Signal Cables - The tag shall be red and shall be marked with the numbers of the post, serviced by the cable.
- (ii) Extra Low Voltage Cables (Pedestrian Push Buttons, etc) - The tag shall be yellow and shall be clearly marked with the post number serviced by the cable, in addition the letters ELV shall be added.
- (iii) Extra Low Voltage Cables (Linking Cables) - The tag shall be yellow and shall be marked with the site reference number of the linked equipment and in addition the letters ELV shall be added.
- (iv) Loop Feeder Cables – One side of the yellow tag shall be marked with the detector and arm designation. The other side of the tag shall give the location of the loop.

Examples:



2 Identification of Cable Cores

All individual cable cores in cables used in a traffic signal installation shall be identified using coloured PVC grip type markers as shown below. The markers shall be positioned on the core adjacent to the termination point in such a way that they can be read easily. The markers shall be of a type that can not be removed without the removal of the core from its terminal.

The three identification markers used shall be:

- (i) First Marker – Numbered markers indicating posts numbers. These shall be colour coded in accordance with the international resistor colour code. The numbers shall indicate the post fed by that cable, i.e. the next post to which the cable runs.

- (ii) Second Marker – Legend markers indicating the function of the core as shown below. These shall be colour coded as follows:

-  LV Live conductor - Red with Black Text
-  LV Neutral conductor - Black with white text
-  LV Spare conductors - Brown with black text
-  ELV All conductors - Yellow with Black text

- (iii) Lettered markers indicating the phase of the core (White with black text)

Notes

- Where the address of the other end of a cable is the controller the first marker shall be omitted.
- Functions not covered by the above shall be written onto blank markers with an approved pen.

Example of standard pre-printed markers:

First marker

1	Brown	2	Red	3	Orange	4	Yellow	5	Green
6	Blue	7	Violet	8	Grey	9	White	0	Black

Second marker for LV cables

RED	Red	AMBER	Red	GREEN	Red
R/MAN	Red	G/MAN	Red	WAIT	Red
I.G/A	Red	F.G/A	Red	SIGN	Red
PE/L	Red	PE/N	Black	PE/SW	Red
SIG/N	Black	SIGN/N	Black	SPARE	Brown

Second marker for ELV cables

PUSH/B+	Yellow	BLEEP+	Yellow	TACT+	Yellow
PUSH/B-	Yellow	BLEEP-	Yellow	TACT-	Yellow
COMM	Yellow	INHIB	Yellow	LINK	Yellow
DET+	Yellow	SPARE	Yellow	T/O	Yellow
DET-	Yellow	MVD	Yellow	IRD	Yellow

Third marker

A	B	C	D	E	Etc. All White
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4 APPENDIX 5/2 : SPECIFICATION FOR SERVICE DUCT REQUIREMENTS

Location

1.1 The location for all service ducts are shown on drawing number:-

- 871246526-YU-00-XX-DR-Y-0001

Duct Requirements

- 1.2 Traffic signal ducts shall conform to BS EN 50086-2-4 and be MDPE 100 mm diameter, orange coloured and have 'Traffic Signals' embossed along its length. All ducts are to have smooth internal bore. Ducts from under kerbs/carriageway to nearest chamber shall be 50mm diameter and orange in colour.
- 1.3 Service ducts shall be arranged and laid in accordance with Hertfordshire County Council Standard Detail Drawing Number RING/1250/001.
- 1.4 The minimum cover below finished level shall be as follows:
 - 100 mm diameter ducts across carriageway 750 mm
 - 100 mm diameter ducts within footway/verges 450 mm
- 1.5 Ducts under carriageways shall extend at least 500 mm beyond the edge of the paved surface.
- 1.6 Ducts shall extend into access chambers by 25 mm +/- 2 mm
- 1.7 Where joints are required between duct sections the edges shall be chamfered and any burrs removed.
- 1.8 The Contractor shall ensure that all draw cords remain within the ducts, chambers and all other access points following the installation of cable to facilitate future maintenance or modification requirements.
- 1.9 Where ducting is to run through the concrete foundation of a pole retention socket, the size of the concrete foundation will need to be increased. The socket manufacturer shall be contacted to advise on the required adjustment.
- 1.10 The duct locations shall be checked against the Contract drawings. Any differences shall be recorded on the "As-Built" drawings.
- 1.11 All existing ducting shall require to be surveyed prior to works being undertaken on site to ascertain its condition (if applicable).
- 1.12 A NAL controller cabinet base will be utilised to safeguard against the ingress of moisture or gas, especially at cable entry point, as well, simplify installation, maintenance & future upgrading. The proposed orientation of the controller be agreed with the Engineer prior to installation of the base.
- 1.13 Signal posts shall be erected in pole retention sockets, ensuring vertical alignment. Posts shall not be cabled or fitted with equipment until such time as the foundation has achieved its design strength.

2.0 Chamber Requirements

- 2.1 Chambers shall be NAL Stakka box plastic twin walled type, installed as per manufacturer's specifications. Chambers shall be 450 x 450mm or 600 x 600mm in size as stated on drawing ref: 871246526-YU-00-XX-DR-Y-0001
- 2.2 All duct chambers shall be cleared of construction debris and detritus prior to the installation of any signal cable or other equipment. Any redundant cable should be removed from all duct and chambers prior to new cable installation.
- 2.3 All new covers to inspection chamber/draw pits in footway shall be composite Grade B 125 to BS EN124:1994 with minimum skidding resistance (SCRIM Value) of 40 and incorporate the words 'Traffic Signals'.
- 2.4 All new covers and frames to inspection chambers / draw pits in the verge are to have the frame securely fitted to the chamber using fixings as supplied by NAL. The legend 'Traffic Signals' is to be applied to each cover. A 100mm concrete surround shall be supplied around the chamber frame and cover to reduce overgrowth covering the chamber.
- 2.5 All traffic signal chambers shall be free draining. Traffic Signal cables shall not be permitted to be submerged in water irrespective of weather conditions.
- 2.6 Any existing chambers that are to be removed shall have the existing traffic signal ducting jointed and the redundant chamber backfilled with construction appropriate to the area the chamber is located.