Local Transport Note 1/98

The Installation of Traffic Signals and Associated Equipment

September 1998

Department of the Environment, Transport and the Regions
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The Scottish Office
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TITLE - THE INSTALLATION OF TRAFFIC SIGNALS AND ASSOCIATED EQUIPMENT

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ENQUIRIES

All enquiries on the general applicability of this Local Transport Note should be directed, in England to the appropriate Regional Government Office, in Wales to the Transport Policy Division, Welsh Office, Cathays Park, Cardiff CF1 3NQ, in Scotland to the Scottish Office, Development Department, National Roads Directorate, Network Management Division, Victoria Quay, Edinburgh, EH6 6QQ, or in Northern Ireland to The Department of the Environment for Northern Ireland, Roads Service Headquarters, Clarence Court, 10-18 Adelaide Street, Belfast, BT2 8GB. Enquiries about authorisation for non-prescribed signals and warning lights should be made to the above offices.

ABSTRACT

This note recommends the practices to follow when installing traffic signals, signal controlled crossings and associated equipment. It also describes the installation of temporary signals, school crossing patrol signs and warning lights.

This Local Transport Note has been notified to the European Commission pursuant to Directive 83/189/EEC of 28 March 1983 laying down a procedure for the provision of information in the field of technical standards and regulations (OJ 1983 L109, p.9) as amended by Council Directive 88/182/EEC of 22 March 1988 (OJ 1988 L81, p.75) and European Parliament and Council Directive 94/10/EEC of 23 March 1994 (OJ 1994 L100, P.30).

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CHAPTER 1
Introduction

1.01 This note recommends good practices to be followed for the installation of all permanent signal controlled and associated equipment. Guidance is also given for the installation of temporary traffic signals. Following these practices should result in a safe and readily maintainable installation.

1.02 Nothing in this note should be taken as implying any contractual liability. Any such matters are to be the subject of the contract between the Highway Authority or an agent of the Highway Authority and the Contractor.

1.03 The overall safety and convenience of the facility will be determined by the thoroughness of the design and the quality of the installation work.

1.04 Organisations involved in the installation should have an accredited registration for Quality Assurance to IS09000 with specific reference to the type of work involved. Specialist sub contractors engaged in slot cutting may be exempt from this requirement but should be adequately supervised by a Quality Assured organisation.

CHAPTER 2
Glossary of Terms

2.01 For the purposes of this Note the following meanings are intended:

HIGHWAY AUTHORITY means the body responsible for the maintenance and repair of the highway at the site. In nearly all cases this authority is also the traffic authority under the Road Traffic Regulation Act 1984[(4)].

AUTHORITY means the Highway Authority for the site, or an agent or consultant appointed by the Highway Authority.

MANAGING AUTHORITY means Highway Authority, Authority or contractor responsible for the works.

STATUTORY UNDERTAKER means the body or person in whom statutory power is vested to execute works on the public highways in the capacity in which the power is vested in them, for example Electricity, Gas, Water or Cable Service companies.

CONTRACTOR for the purposes of this Note includes anyone connected with carrying out the works, as a main contractor, sub-contractor, or a direct labour organisation.

(In Northern Ireland, Roads Service, an agency within the Department of Environment for Northern Ireland, is the sole authority in dealing with road matters.)

WORKS includes all work necessary on site to complete the signal installation including testing and certification.

INSTALLATION means construction of and implementation or modifications to traffic signal equipment.

SUPPLIER for the purpose of this Local Transport Note means anyone who supplies equipment.

OVERSEEING DEPARTMENT means the Department of the Environment, Transport and the Regions, Welsh Office, Scottish Office or the Department of the Environment for Northern Ireland as appropriate.

TEMPORARY TRAFFIC SIGNALS normally utilise signal controllers in accordance with Departmental Specification TR0141[(32)] and full size signal heads. Temporary traffic signals are capable of being used in any control configuration that can be implemented by permanent signals including pedestrian stages.

PORTABLE TRAFFIC SIGNALS means traffic signals, as prescribed in Regulation 32 of the Traffic Signs Regulations and General Directions 1994[(12)] and by Departmental Specification TRO111[(33)], normally mounted on tripods, which are intended for control of traffic for relatively short periods of time.

CHAPTER 3
Safety at Work during Installation

3.01 General

3.1.1 Installation work should be carried out with minimum disruption to pedestrian and vehicular traffic. Measures should be taken to ensure the safety of the contractor's staff and the public during the works. Adequate working space, warning signs, means of access and lighting must be provided. Precautions should be taken against the possible presence of gas in the controller cabinet, at the tops of signal poles, cable draw pits and ducts. If any gas is suspected anywhere in the ducting system, then the local gas board should be contacted immediately. (It should be noted that the Welsh Office trunk road specifications include a gas plinth at the controller to minimise the risk associated with gas.)

Inadequate provisions made for pedestrians during works

3.02 Regulations and general advice

3.2.1 The following paragraphs refer to the principal legislation and official guidance applying to the execution of works on the highway. The list is not exhaustive. Much of the legislation has been amended in various ways.

3.2.2 The Health and Safety at Work etc Act 1974[(1)] requires suitable steps to be taken to secure the health, safety and welfare of persons at work. It puts the onus on the contractor to ensure, so far as is reasonably practicable, the health, safety and welfare at work of all his employees and the safety of others who may be affected by his work, for example through provision of information, instructions, training and supervision.

3.2.3 Chapter 8 of the Traffic Signs Manual[2] details the requirements for placing signs and barriers during the period of the works and for the associated traffic management. (It should be noted that within Wales, the signing in accordance with Chapter 8 should be bilingual.).

3.2.4 The Electricity at Work Regulations 1989[3] require precautions to be taken against the risk of death or personal injury from electricity in work activities. They impose duties on persons involved in the design, installation and maintenance of equipment. Some of the hazards that can result from electrical causes in connection with work activities are: electric shock, electric burn, fires of electrical origin, electric arcing and explosion initiated or caused by electricity etc.

3.2.5 The Road Traffic Regulation Act 1984[4] defines the general duties of traffic authorities (Section 122) and contains provisions relating to traffic signs (Part V: Section 64 to 80).

3.2.6 The Highways Act 1980[5], including amendments by the Traffic Calming Act 1992, defines the powers vested in highway authorities for carrying out improvements, maintenance and constructional work on highways.

3.2.7 The Disabled Persons Act 1981[6] amended the Highways Act imposing a duty to have regard to needs of disabled and blind when executing works.

3.2.8 New Roads and Street Works Act 1991[7] defines the general duties of the Highways Authority (also statutory undertakers) to register, coordinate and monitor all work undertaken on the highway for which they are responsible. Part III (England and Wales) and IV (Scotland) of the act regulate the execution of street works of all kinds by statutory undertakers and others. Safety at Street Works and Road Works (A Code of Practice)[8] provides guidance on how to carry out road and street works safely. Contractors must always follow the principles outlined in the book.

3.2.9 HSE booklet Avoiding Danger from Underground Services[9] provides guidance for those who have duties under the Health and Safety at Work etc Act 1974 and other relevant legislation. This is a practical guide which applies to all situations where underground services may be found and where work is undertaken which involves penetrating the ground at or below the surface.

3.2.10 BS 7671[10] -Regulations for Electrical Installations (replacing the IEE Wiring regulations 16th edition) generally applies to the design, selection, erection, inspection and testing of electrical installations.

3.2.11 CDM Regulations 1994[11], the Construction (Design and Management) Regulations 1994 (CDM) place duties on clients, planning supervisors, designers and contractors to plan, coordinate and manage Health and Safety throughout all stages of a construction project. In particular, the client has to ensure that any designer or contractor appointed is fully competent to execute the works and will allocate sufficient resources for Health and Safety. Each of the foregoing designated persons have specific duties under the Regulations.

3.2.12 Prior to installation of new road crossings, local organisation of visually impaired people and the rehabilitation/mobility instructors should be informed of the proposed location and other features, such as tactile cones, so that they may inform local people.

CHAPTER 4
Planning the Work

4.01 Responsibilities

4.1.1 The Managing Authority is responsible for managing the activities involved in the execution of works. This will involve co-ordination with other bodies such as statutory undertakers, Police, other emergency services, the public transport authority and other relevant Highway Authorities. The Managing Authority should keep a register, showing with respect to each street for which they are responsible, such information as may be prescribed with respect to the street works, and such other descriptions of works as may be prescribed, executed or proposed to be executed in the street.

4.1.2 The Managing Authority will have responsibility for liaison with statutory undertakers and the Highway Authority to ascertain the positions of all underground services which may be affected by the proposed installation of traffic signals. The Managing Authority is also responsible for giving information to statutory undertakers that traffic signals are about to be installed.

4.1.3 The Managing Authority will be responsible for arranging a suitable (dedicated) electricity supply to the proposed installation and for indicating the exact location at which such a supply is required.

4.1.4 The Managing Authority will be responsible for arranging the communications interface for UTC (Urban Traffic Control) and remote monitoring connection, where specified.

4.1.5 The Managing Authority will have overall responsibility for ensuring that the proposed installation complies with all relevant statutory requirements, such as:

The Traffic Signs Regulations and General Directions 1994[12] (TSRGD);

The Zebra, Pelican and Puffin Pedestrian Crossings Regulations and General Directions 1997[13]

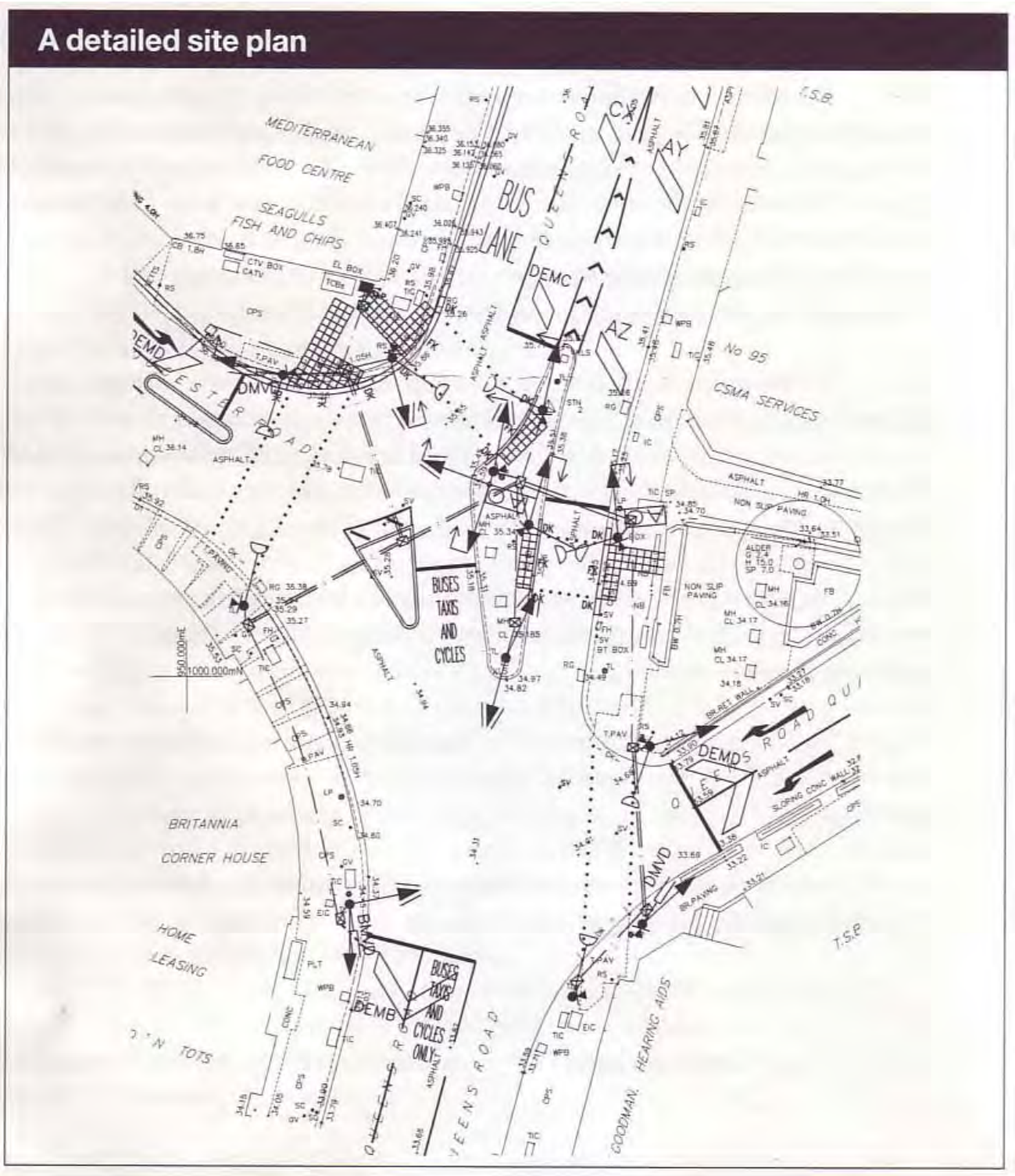
Note: Regulations covering Toucans have not yet been made but are expected to be contained in the amendments to TSRGD.

4.02 Preparation

4.2.1 A detailed plan (as built) of the layout of the site and signal installation should be produced prior to commencement of the works. The plan should include all cabling and ducting details, duct chambers, pole-pits, detector siting together with loop configurations and spacing details between the loops; overhead detectors where used should also be shown on the plan. The plan should show existing inspection covers, trees, lighting columns, signs and gantries. The local statutory undertakers (gas, electricity, telephone, water etc)

may be able to provide details of locations of their services but site investigation and survey may be necessary. The plan detailing the signal equipment should be at 1:200 scale. An additional 1:500 scale drawing is acceptable to show linking details and the positions of speed assessment, MOVA[14] (Microprocessor Optimised Vehicle Actuation), speed discrimination[15], SCOOT[16] (Split Cycle and Offset Optimisation Technique) or other loops where applicable. Conventional symbols should be used, refer to BS505[17] for guidance, and all schemes should be subjected to Safety Audit procedures.

A detailed site plan



CHAPTER 5
Civil Engineering Works

5.01 General

5.1.1 For the purposes of this note civil engineering works include the following:

a. all excavations and trenching both on and off the carriageway;

b. all duct laying, including bedding material, cable draw cords and draw pit construction:

c. all back filling and reinstatement of excavations and trenches;

d. removal of all surplus soil, stones, etc. from the site and making sure that the contractor has a valid licence for the disposal of spoil;

e. the setting out, provision and levelling of all foundations ready to receive the equipment when it is installed;

f. the provision of signs and barriers for both pedestrian and vehicular traffic.

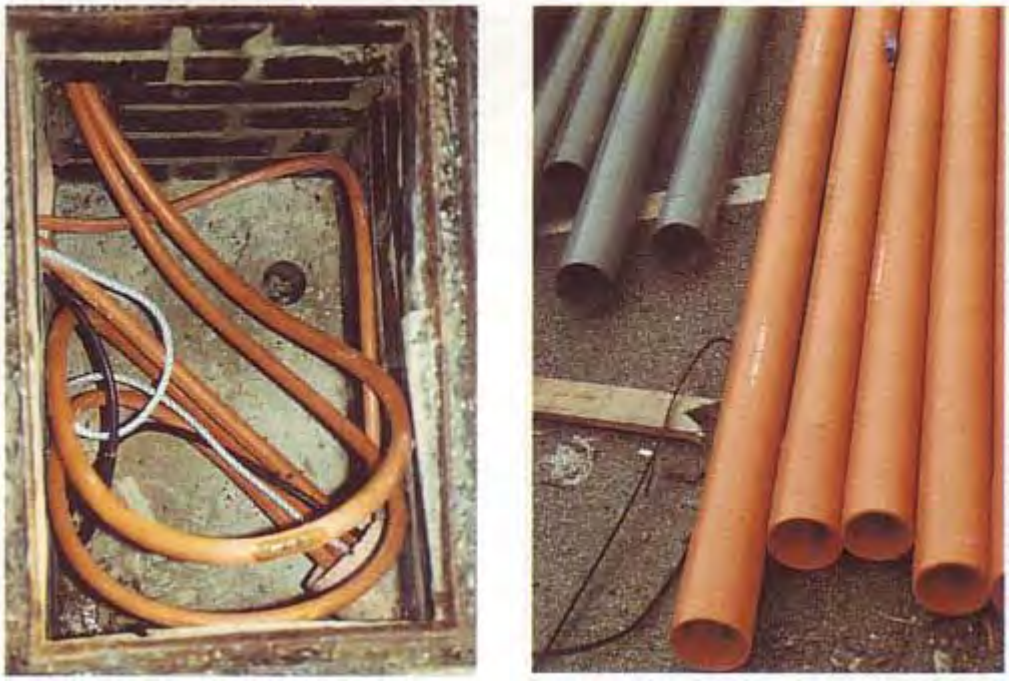
5.02 Ducting

5.2.1 Before the commencement of any excavation reference should be made to the advice given in section 18 of the booklet "Avoiding danger from underground services"[(9)].

5.2.2 It is recommended that the installation of electrical cabling is fully ducted and provided with drawpits and pole pits/adaptors so that any cable can be installed or removed with minimum civil engineering works. Drawpits should be provided at the end of each duct run and where the duct changes direction, drawn bends should not be incorporated in the duct runs except by the prior approval of the Managing Authority. The layout should be such that the tactile paving area is kept free of inspection chambers.

5.2.3 For duct laying and identification, reference should be made to the advice given in National Joint Utilities Group publication (NJUG) 4: The identification of Small and Buried Mains and Services[(18)]. For traffic signal equipment the ducts and cables should be coloured orange and marked 'Traffic Signals' along the length. Reference should also be made the NJUG publication No 7 for Recommended Positioning of Utilities Apparatus for New Works on New Developments and in Existing Streets[(19).]

5.2.4 The Managing Authority should ensure that all necessary measures are taken as required by any Statutory Undertaker and/or the Authority for the protection of its mains, pipes, cables or other apparatus during the progress of the works and also to construct and provide as required any auxiliary works necessary for the prevention of damage and interruption to Statutory Undertakers and/or Authority services to their satisfaction.



Drawpit showing traffic signal cables.

CHAPTER 6
Electrical Installation

6.01 Supply

6.1.1 The essential requirements for the supply of safe electrical equipment are contained in BS7671[10] and particular reference is drawn to Section 611, Highway Power Supplies and Street Furniture. The electricity company may provide a dedicated power supply for highway installations as a TN-S or TN-GS or TT system, BS 7671 Part 2 Definitions[10]

6.1.2 For a TN-S system the electricity supply company will provide a main earth terminal which is connected by a separate conductor to the means of earthing the supply system. The earth lead of the traffic signal installation shall be connected to the main earth terminal as detailed in 6.2.3.

6.1.3 TN-GS system. The electricity supply company will provide a main earth terminal connected by a combined neutral and earth connection to earth. This arrangement is also known as protective multiple earthing (PME). The earth lead of the traffic signal installation shall be connected to the main earth terminal as detailed in 6.2.3.

6.1.4 For TT Systems all exposed conductive parts of an installation are connected to an earth electrode which is electrically independent of the source earth.

6.1.5 In all cases the appropriate supply and earthing arrangements must be ascertained from the electricity supply company (who may impose their own requirements on circuits to be connected to their supply). The supply can be terminated within the controller or in a separate power supply termination pillar which avoids the electricity supplier from having to gain access to the controller (also provides the means of totally isolating the installation). It should be noted that for safety reasons, equipment at staggered crossings should not be mixed.

6.02 **Earthing**

6.2.1 All cabinets, poles and other metal hardware comprising the traffic signalling equipment installation should be connected to the installation earthing point by a protective conductor (PC). Extraneous conductive parts such as guardrails must not be connected. This is to reduce the risk, for example, of an extraneous conductive part becoming live due to a fault in the controller cabinet.

6.2.2 The connection to metalwork should be made internally to a secure standing terminal on a part of the enclosure which cannot be removed for routine maintenance. All ancillary connections (eg. doors, etc.) should be made to the secure terminal. All connections shall be both electrically and mechanically sound.

6.2.3 Wire terminations may be soldered, crimped or screwed. If the latter is used then a type where the screw does not make direct contact with the conductor is recommended, eg a spring leaf type.

6.2.4 Individual protective conductors should be insulated and colour-coded green with a yellow stripe. Sheathed and/or armoured cables within traffic signal poles and/or equipment should have the cable sheaths and/or armouring connected to earth using a method of earthing which provides sound mechanical and electrical integrity.

6.2.5 Where the sheathed and armoured cables are installed vertically in traffic signal poles, then support clips should be used where possible (see section 11).

6.2.6 The installation earthing point should be connected to the main earthing terminal(s) by a copper protective conductor, insulated and colour coded green/yellow stripe in accordance with Regulation 543-01-03 and 543-01-04 of BS7671[10]. For mechanical strength and resistance to damage, it is recommended that the conductor has a minimum cross sectional area of 6mm^2.

6.2.7 The electricity supply provided will be single phase and should be terminated in a cut-out of a type having incoming phase and neutral terminals. The electricity supply company or certified competent person will connect the controller conductors to the cutout. The conductor size will be specified at the design stage but in any case it is recommended that it is not less than 6mm^2. Although there is no obligation on the electricity supply company to provide an earth terminal, one is normally provided.

A typical traffic controller installation.

CHAPTER 7
Installation of Signal Equipment

7.01 General

7.1.1 All signal heads and pedestrian push-button units which are not in use should be bagged over or clearly marked as signals out of use when they are installed to avoid confusion to pedestrian and vehicular traffic. Tactile indicators should also be covered or removed when they are not in use so that visually impaired and deaf people are not misled, especially when tactile paving has been laid. Bags should be sufficiently opaque so that signal aspects do not show through when lit. The signs should be to Diagram 7016 (TSRGD) [12] for pedestrians at all pedestrian crossings and Diagram 7019 for vehicular traffic at signalled crossings or junctions.

Backing board fitted to increase conspicuity.

7.1.2 Photocells may be fitted to dim traffic signals at night. They should be sited in accordance with the manufacturer's recommendations. Care should be taken to ensure that the photocell is not overshadowed, causing the lamps to be permanently dimmed, or installed near street lighting, causing the lamps to operate on full brightness during the hours of darkness.

Signals bagged over when not in use.

7.1.3 Pedestrian push button boxes associated with pedestrian signals are normally installed so that the indicator panel is at 90° to the carriageway on the crossing side of the pole. Where nearside signals (used at Puffin crossings) are used, other mounting angles may be specified. The centre of the push button should be between 1.0m - 1.1m above the footway level. All fixings should be concealed so far as possible to minimise the risk of vandalism.

7.1.4 Reference should be made to any installation and alignment procedures provided by the equipment supplier when above ground detection systems are used.

7.1.5 Traffic signals should normally be fitted with black backing boards to enhance conspicuity against distracting backgrounds. The backing board may have a white border between 45mm and 55mm wide. With approval of the highway authorities, backing boards may be omitted in urban areas at sites where speeds are low and there are no distracting backgrounds or where there is restricted space to achieve the adequate clearance.

7.1.6 Equipment mounted on road lighting columns should be in accordance with BD 26/94[21].

7.02 **Signal Poles**

7.2.1 Signal poles should be erected in accordance with the Specification for Highway Works, clause 1203[22] . The signal heads should not be fitted until the concrete base has hardened sufficiently. Care should be taken to avoid damage to the pole during transportation and installation. Cable apertures for signal heads, push button wiring and cable entry should be correctly aligned. Where signal poles are erected on a verge of unmade ground, consideration should be given to providing a concrete pad or paving slab(s) around the poles to provide a suitable base for a ladder for maintenance purposes.

7.2.2 It is essential to ensure that the push button box is easily accessible by pedestrians and, where appropriate, cyclists waiting in the wait area. It is recommended that the pole should be sited approximately 0.5m from the crossing studs and 0.5m from the kerb edge. Tactile paving should be installed in accordance with the advice given in Disability Unit Circular 1/91[23] (this guidance will shortly be superseded by the forthcoming revised guidance to be issued by the Department of Environment, Transport and the Regions (Mobility Unit): "Guidance on the use of Tactile Surfaces").

7.2.3 Where signal head assemblies are to be pole or wall mounted there should be a horizontal clearance of not less than 450mm from vertically above the kerb edge to the nearest part of the assembly. This is to minimise the likelihood of damage to the signal heads from passing vehicles, especially vehicles with long overhanging mirrors or loads. Where the road has a steep camber, the clearance may be increased to 600mm. Offset traffic signal head mounting brackets (or cranked poles may be needed to ensure that the horizontal clearance is maintained.

7.2.4 The Traffic Signs Regulations 1994[12] and The Pedestrian Crossing Regulations[13] give the height to the centre of the amber optical assembly (between 2.4m min and 4.0m max for pole mounted and 6.1m to 9m for over carriageway). Consideration should always be given to the possibility of the later addition of regulatory signs, etc. below the existing traffic signal assembly. In this case, and within the limits of the amber signal height, a minimum clearance of 2.1m between the lower edge of the signal assembly (including any additional box sign or support brackets) and the footway should be maintained. It should be noted that increased clearance (2.3m) is needed for three aspect cycle signals and it is recommended wherever cyclists may be present. The pedestrian light signal should be erected with a clearance of 2.1 to 2.6 metres to the lower edge of the assembly.

7.03 **Signal controller**

7.3.1 The controller cabinet is to be installed at the place indicated on the site plan. It should be located such that when the access doors are in the open position they cause minimal obstruction of the footway. It should be possible to open the access doors fully and consideration must be given to the safety of operatives during maintenance operations. If it is necessary to site the controller adjacent to the kerb then it should not be possible for the access doors to be opened over the carriageway and the controller should be sited at least 0.5m from the kerb edge.

7.3.2 The controller cabinet should be positioned so that it does not obstruct the view of pedestrians waiting at the crossing or motorists on their approach. This will generally mean siting it at the leaving rather than the approaching side of the crossing. It is also good practice to site the controller cabinets so the traffic engineer can view the operation of the signals whilst standing at the front of the controller.

7.3.3 The controller may be installed on a cabinet type foundation as indicated in Departmental Specification TR 0102[17] as follows or as otherwise specified by the Highway Authority:

a. The cabinet should be mounted on a case root base, locating it on one or more paving slabs which are themselves securely bedded and properly levelled at the appropriate depth.

b. A bed of concrete is to be laid over the base of the root and paving slab(s). The top of the bed when finished should be 1/3 of the way up the legs of the stool and the site of the bed smoothed.

c. That part of the excavation within the controller case root should be back filled with compacted dry fine sand or pea gravel and topped with dry fine sand after the cables have been terminated. The remainder of the excavation around the controller is to be backfilled with cement bound material category 3 to specification for highways works clause 1038 to ground level and the surrounding area reinstated.

d. A layer of epoxy resin 6mm thick or as specified is to be laid on top of the sand to prevent ingress of gas and moisture into the controller through the root and to provide a seal with the controller case.

e. When a controller is mounted on a verge of unmade ground a concrete pad, which may consist of paving slabs, should be laid around the controller to a minimum width of not less than 1 metre on those sides to which access to the equipment is required.

f. Pole-mounted controllers are to be mounted on poles correctly aligned in vertical positions. The excavation is to be adequate to allow the pole to be planted to the depth recommended by the manufacturer. The bottom of the hole around the pole is to be filled with at least 300mm of concrete to the bottom of the cable entry slot. When cable laying and testing is complete the remainder of the backfilling should be completed, the cable entry to the controller should be effectively sealed against ingress of moisture into the unit.

h. Once the electronic modules are installed in the controller, the door seals and locks should be checked and the controller base sealed as soon as possible to stop any water ingress getting into the modules.

g. When all the cables have been installed all duct entries into the drawpits should be cleaned and then sealed using an approved foam sealer or mechanical duct/cable plug to stop the ingress of dirt and silt and to prevent gas filling the duct system.

7.04 **Signal head alignment and visibility**

7.4.1 The minimum requirement is two traffic signals, normally one primary and one secondary signal for each crossing.

7.4.2 It is important, however, that an approaching driver has a clear view of at least one signal head. As one signal may be masked by parked vehicles or other obstructions it is normal to align at least two signals to be seen on each approach, typically one primary and one secondary signal.

7.4.3 Drivers must also be able to see at least one signal when waiting at the stop line. This is normally achieved by a secondary signal mounted at either the centre or the off-side of the road.

7.4.4 At most pedestrian crossings or other stand-alone signals, one primary and one secondary signal will normally be sufficient to achieve the above objectives. The use of "primary" visors (which are cut away) on the secondary signal heads is normally recommended and improves the visibility both on approach and from the stop line. However, if the road is particularly wide or the approach alignment is poor it may be necessary to install additional signals.

7.4.5 There may be situations at some crossings where it will be necessary to restrict the view of the secondary signal in which case a "secondary" hood may be fitted. In these circumstances two primary signals are recommended.

7.4.6 On high speed roads the use of duplicate primary signal heads is recommended.

7.4.7 Where the 85th percentile approach speed is 35 mph or less, measured in accordance with TA 22/81[24], and unless otherwise specified by the Authority, it is recommended that the signals are directed at a point approximately 1.5 metres above the half of the carriageway involved at a distance of 50 metres from the stop line.

7.4.8 On roads with an 85th percentile approach speed greater than 35 mph, the aiming distance should be increased to 200 metres. If the visibility distance at a particular site is less than 200 metres then the signal aiming distance should be the actual maximum visibility distance.

7.4.9 Recommendations for the desirable and absolute minimum (or one step below the desirable minimum) visibility distances are given in LTN2/95 Table I[20] and DMRB TA 12/81[15].

7.05 Equipment and installation approval

7.5.1 All installations must be approved in accordance with the appropriate Standards and Specifications issued by the relevant Highway Authority.

7.5.2 All control equipment must comply with the relevant Overseeing Department specifications and be of type approved in accordance with TRG0500[25].

7.5.3 Toucan crossings currently require the Secretary of State's approval prior to installation.

Epoxy resin used to seal control base.

CHAPTER 8
Installation of Temporary Signals

8.01 The contractor should agree the positioning and arrangement of the temporary signal(s) with the Highway Authority, similar to the need for Highway Authorities to approve portable signals for configurations other than at shuttle working.

8.02 The existing pole(s) and any heads or other traffic management equipment not used during the temporary works should be either bagged over (or otherwise covered) or removed from site by the contractor and carefully stored, so that on completion they may, subject to the approval of the Managing Authority, be reinstated.

8.03 The contractor should provide the Highway Authority with a drawing showing the position of the temporary poles and signals for site approval.

8.04 Signals should always be installed on the pole so that no part of the signal overhangs the side of the drum (Appendix A) in which they are mounted. It is recommended that the horizontal clearance from vertically above the kerb edge (or the traffic barrier) to the nearest part of the assembly should not be less than 0.5m.

8.05 Wherever possible the drum position should be marked on the ground with paint so that it can always be replaced in the correct position if it is moved for any reason.

8.06 On lower speed roads the drum may be protected by baulk timber or temporary islands. It is recommended that the baulk timbers should be painted with red and white bands as shown in Diagram 7105 of The Traffic Signs Regulations and General Directions[12]. Reference should also be made to Chapter 8 of the Traffic Signs Manual[2].

8.07 The inter-connecting cable and cable joint box should be waterproof and protected against accidental damage, for example by burying. Precautions should be taken at all times to ensure that any cable left lying above ground is positioned so that it cannot be damaged by plant using the area or create a hazard for pedestrians, cyclists or other road users.

8.08 Where temporary signals use surface laid cables, it is recommended that extra low voltage is used, for example not exceeding 50V ac or 120V dc between conductors or to earth.

8.09 Care should be taken to safeguard pedestrian safety during road works within the area of the work site and particularly at or near pedestrian crossing facilities. Temporary pedestrian facilities may be provided on temporary signals as long as the area where pedestrians should cross is clearly marked.

8.10 If the temporary signal(s) is positioned such that the normal stop line cannot be used, a temporary stop line must be provided. The normal stop line should be erased or covered up with a suitable tape.

8.11 When the temporary installation has been completed, the contractor should ensure that all earthing conforms to the earthing requirements in BS 7671[10]. BS 7671 also requires an electrical installation completion certificate to be issued for temporary installations. This will require all aspects of the electrical installation to comply with the requirements of BS 7671.

8.12 An example of a typical design for a temporary signal mounting is given in appendix A.

A typical temporary traffic signal set-up.

CHAPTER 9

School Crossing Patrol Signs and Warning Lights

9.01 All signs and warning lights must comply with Regulation 39 and schedule 1,2 and 9 of The Traffic Signs Regulations and General Directions 1994[(12)].

9.02 The signs and the accompanying lamps should be sited in accordance with the details shown in Table A of the Traffic Signs Manual, Chapter 4[(26)], the minimum clear visibility distance shown in that table should be observed.

9.03 Where the existing signs are obscured or do not meet these recommendations they should be resited. All signs should conform with Diagram 545 in The Traffic Signs Regulations and General Directions 1994. The lamps and signs should not be obscured by other signs or street furniture and wherever necessary, arrangements should be made to cut back any foliage obstructing visibility.

9.04 The lamp unit (TSRGD diagram 4004) should be mounted below the "Children" sign (TSRGD Diagram 545 with appropriate accompanying plate diagram 546, 547.1 or 547.7) and separated from it by a minimum distance of 50mm.

9.05 It is recommended that the base of the lamp unit should not be less than 2.1 metres above the surrounding footway or verge in the vicinity of the post. This mounting height may be reduced to 1.8 metres or less at sites where the authority is satisfied that the lamp unit is unlikely to cause obstruction to pedestrians and that there is no risk of the indication to drivers being obstructed by pedestrians. The possibility of malicious damage should be considered wherever low mounting height is contemplated.

9.06 The lamp unit should be mounted upright and normally on the vertical axis of the sign. The lamp unit may be operated by a key switch or an automatic timer. If a key switch is required then it should be mounted within convenient reach.

9.07 When sited within 50 metres of a street lamp the sign must be illuminated throughout the hours of darkness. This requirement does not apply in Northern Ireland.

CHAPTER 10
Cables and the Installation of Cables

10.01 Multicore intersection and linking cables should be armoured or otherwise protected against accidental damage. They should be covered in an outer sheath of orange coloured PVC in accordance with NJUG Publication 4[(18)]. The latter need not apply to loop detector or loop feeder cables or data transmission cables. For PVC insulated cables for electricity supply refer to BS 6346[(27)].

10.02 A minimum of 4 spare cores should be provided on each cable run from the controller to the end of the run, wherever possible or as required by the appropriate managing authority.

10.03 Detector loop cables and tails should comply with Departmental Specification TR 2029[(28)]. For Welsh Office trunk road sites, loops should be in accordance with WOEM 1000.

10.04 Loop feeder cables should comply with Departmental Specification TR 2031[(29)].

10.05 Loop detector cables should be laid in accordance with the Specification for Highway Works clause 1218[(22)].

10.06 The Contractor should ensure before slot-cutting commences that the surface is suitable for the purpose of holding the detector cables. The Contractor should consult the Highway Authority Maintenance Engineer to ensure that the required slot patterns and depth of slot are not likely to cut or weaken steel reinforcement or to start cracking processes which could propagate.

10.07 All cables should be of adequate size and rating to meet the electrical current carrying requirements and electrical protection of the systems.

10.08 A mixture of extra low and low voltages should not be used in the same multicore cable and in the terminations at the tops of poles etc.

10.09 Cables should be laid in ducts in accordance with the Specification for Highway Works clause 1217[(22)] . Alternative practices are described in the Specification for Highway Works Notes for Guidance NG 1421.

CHAPTER 11
Cable Termination

11.01 Armoured multicore cables, where the armouring forms part of the earth continuity conductor, should be made off using terminations fit for the purpose. Where the armour or metal sheath of buried cables do not form part of the circuit protective conductor, BS 7671 requires that they are earthed in all cases. This provides some protection from danger should the cable be cut or damaged.

11.02 Sheathed and armoured cables in vertical runs which are inaccessible and unlikely to be disturbed should be supported at the top of the run.

11.03 All earthing and cable termination or gland plates should be constructed to resist vibration fatigue and must have a firm and shake proof electrical and mechanical connection between the plate and the metal work of the cabinet or pole. They must be made of material treated, if necessary, to give corrosion resisting properties in order to maintain electrical continuity.

11.04 Each cable should be identified at each end of the cable run and intermediate runs. Individual conductors should also be identified. All cable runs and connections should be fully documented.

11.05 All unused cores in cables should be identified and cut to a minimum length, long enough to connect to the furthest making-off point within the particular unit and cut so as to be of equal length, and should be connected to earth at both ends; care being taken that such spare cores are not connected prior to the earth-loop impedance test being completed.

11.06 Cable joints should not be used on new installations other than for joining inductive loop tails to loop feeder cables. The jointing methods and materials used should be as specified in the contract.

CHAPTER 12
Testing and Certification

12.01 On completion of or during the installation and before commissioning, the following tests should be carried out by the installer in accordance with BS7671[10] :

a. Insulation resistance tests as detailed in BS7671 Regulations 713-04-01 to 713-04-04 inclusive, Table 71A. (Note: this test should take place before connection of the supply to the equipment.)

b. Mains connection polarity check, Regulation 713-09-01.

c. Earth loop impedance test, Regulation 713-10-01. At Welsh Office installations, reference should be made to the Welsh Office for guidance on the testing required.

d. Where a residual current device (RCD) is installed, then tests in accordance with Regulation 713-12-01 should be complied with.

12.02 An electrical installation completion certificate in accordance with BS7671[10] should be provided by the contractor who is responsible for the tests. Note: these certificates have to be signed by a competent person.

12.03 Interconnecting cables should be tested in accordance with the Specification for Highway Works clause 1217[22].

12.04 Loops and loop feeder cables should be tested in accordance with the Specification for Highway Works clause 1218[22]; for Welsh Office installations, loops should be tested in accordance with WOEM 1000.

12.05 Other tests should include checking the physical conditions of cable terminations.

CHAPTER 13
Backfill and Reinstatement of Carriageways, Footways and Verges

13.01 The technical requirements will be specified in the contract documents.

13.02 Care should be taken to ensure that all installations are left suitable for use by all categories of users, particularly those with mobility or visibility impairments. Areas of pavement covered by tactile surfaces should be even and free of any unnecessary obstructions such as drawpits or other service covers and should be reinstated in accordance with the Safety at Street Works and Road Works Code of Practice issued under sections 65 and 124 of the New Roads and Street Works Act 1991[7]. The crossing should not be obstructed by guardrails protruding into the entrance and exit areas.

CHAPTER 14
Carriageway Road Markings & Road Surfacing

14.01 Road markings are required at all installations, as specified in the Traffic Signs Regulations and General Directions 1994[12] and in the Zebra, Pelican and Puffin Pedestrian Crossings Regulations and General Directions 1997[13]. Guidance on these is given in Chapter 5 of the Traffic Signs Manual[30], which also gives advice on laying the markings.

14.02 Care should be taken to maintain the integrity of any anti-skid surface treatment applied at crossing approaches[31] .

CHAPTER 15

Performance Tests

15.01 All signal functions including any UTC interface should be tested on completion of the installation to ensure that the system is working as specified in the contract. Where installed, vehicle detection and signal dimming systems are also to be checked. It may be necessary to carry out a factory acceptance test of junction controllers to ensure proper interpretation of the user specification.

15.02 Signal faces, including push buttons and tactile devices, which are installed and visible to road users and pedestrians prior to switch-on should be bagged off while such tests are in progress. Bags should be sufficiently opaque to ensure that the light signals are not visible to road users during tests. During flash test (to ensure correct relationship between controller phases and site phases) and red-lamp-monitoring test, it may be necessary to remove the bags. Care should be taken to ensure safety of all road user during these tests.

CHAPTER 16

Site Acceptance

16.01 On completion of the installation and prior to commissioning the Managing Authority may wish to test the system. If testing equipment held by the Contractor is required then it should be made available for use by them.

16.02 When the Authority is satisfied then a certificate should be signed. A suitable form of certificate is suggested in Appendix B.

16.03 Defects and/or ommissions which do not prevent the installation from functioning properly can be recorded on an agreed list and the certificate will then become an "interim acceptance certificate". When all listed faults have been rectified, the "final acceptance certificate" can be signed.

CHAPTER 17
Documentation

17.01 When the installation is complete the contractor should supply all the documentation associated with the scheme including at least the following:

a. Controller test schedule

b. Loop test schedule

c. Earth test certificate

d. Electrical completion certificate and test results

e. 'As installed' site layout drawing

f. Controller timings sheet

g. As built cable diagrams

Note: the electrical completion certificate should be provided before the installation is commissioned, Regulation 741-01-01(10)

CHAPTER 18
References

Note: *References for Northern Ireland;

**References for Scotland.

1. The Health and Safety at Work etc Act 1974.

* The Health and Safety at Work Order (Northern Ireland) 1978.

2. The Traffic Signs Manual - Chapter 8; 1991.

3. The Electricity at Work Regulations 1989.

* The Electricity at Work Regulations (Northern Ireland) 1991.

4. The Road Traffic Regulation Act 1984.

* The Road Traffic Regulation (Northern Ireland) Order 1991.

5. The Highways Act 1980 as amended by the Traffic Calming Act 1992.

** Roads (Scotland) Act 1984.

6. The Disabled Persons Act 1981.

* Article 127 of the Roads (Northern Ireland) Order 1993.

7. New Roads and Street Works Act 1991.

* The Street Works (Northern Ireland) Order 1995.

8. Safety at Street Works and Road Works - A Code of Practice issued by the Secretaries of State for Transport, Scotland and Wales under sections 65 and 124 of the New Roads and Street Works Act 1991.

9. Health and Safety Executive booklet - Avoiding danger from underground services.

10. Requirements for Electrical Installation BS 7671:1992 incorporating amendment number1 1994. (Formerly known as the Institution of Electrical Engineers Regulations for Electrical Installations, Sixteenth Edition 1991).

11. The Health and Safety CDM Regulations 1994.

* The Health and Safety CDM Regulations (Northern Ireland) 1995.

12. The Traffic Signs Regulations and General Directions 1994.

* The Traffic Signs Regulations (Northern Ireland) 1989.

13. The Zebra, Pelican and Puffin Pedestrian Crossings Regulations and General Directions 1997.

* The (Pelican) Pedestrian Crossing Regulations (Northern Ireland) 1989.

14. Design Manual for Roads and Bridges, Section 1,TD 35/91-All Purpose Trunk Roads MOVA System of Traffic Control at Signals.

15. Design Manual for Roads and Bridges, Section 1, TA 12/81-Traffic Signals on High Speed Roads.

16. Traffic Advisory Leaflet 4/95 - The SCOOT Urban Traffic Control System.

17. British Standards 505: Specification for Road Traffic Signals 1971 as amended by TR0102. This Standard specifies requirements for fixed and portable traffic signal installations.

18. National Joint Utilities Group Publication Number 4: The Identification of Small Buried Mains and Services.

19. Recommended Positioning of Utilities Apparatus for new Works on New Developments and in Existing Streets. NJUG Publication No 7, January 1997.

20. Local Transport Note 2/95- The Design of Pedestrian Crossings.

* TA 68/96- The Assessment and Design of Pedestrian Crossings.

21. Design Manual for Roads and Bridges, Section 2, BD 26/94- Design of Lighting Columns.

22. Department of Transport, Manual of Contract Document for Highways Works Volume 1: Specification for Highway Works.

23. Disability Unit Circular 1/91: The Use of Dropped Kerbs and Tactile Surfaces at Pedestrian Crossing Points.

24. Design Manual for Roads and Bridges, Section 1, TA 22/81-Vehicle Speed Measurement on All Purpose Roads.

25. TRG 0500 Issue A March 1991- Statutory Type Approval of Equipment and Systems for the Control of Vehicular and Pedestrian Traffic on Roads Other Than Motorways (Published by the Highways Agency).

26. Traffic Signs Manual- Chapter 4.

27. BS 6346: 1987 The British Standard Specification for PVC Insulated Cables for Electricity Supply.

28. Departmental Specification TR 2029B - Inductive loop cable for vehicular detection systems 7/94.

29. Departmental Specification TR 2031B -Armoured feeder cable for inductive loop systems 7/94.

30. Traffic Signs Manual - Chapter 5.

31. Design Manual for Roads and Bridges, HD 28/94- Pavement Design and Maintenance (Skidding Resistance)

32. TR 0141 Issue C, Specification for Microprocessor Based Traffic Signal Controller (Published by the Highways Agency).

33. TR 0111 Issue A, Traffic Signal Control Equipment for Use At Road Works (Published by the Highways Agency).

APPENDIX A

1. Materials

1.01 All baulk timbers, drums and fill should be supplied by the contractor for the site.

2. **Drums**

2.01 Drums should be the 45 gallon type with one end removed and any sharp edges bevelled over to ensure safety on site.

2.02 The drums should be provided with a 50mm diameter hole, 75mm from the base of drum as shown in fig 1. The edges of the hole should be bevelled so that the cable cannot be damaged.

2.03 The drums should be painted as shown in fig 1, i.e. the top third white, the middle third red and the bottom third white.

Figure 1. Drum and pole details

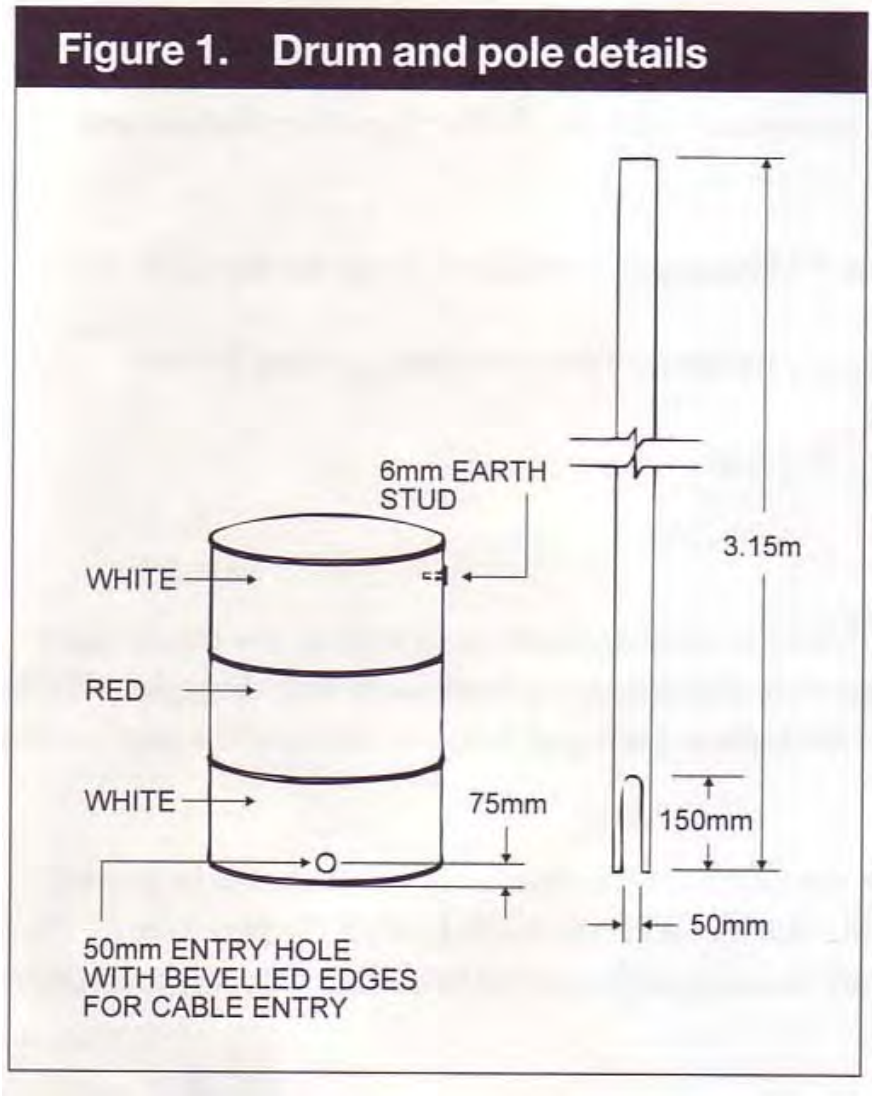
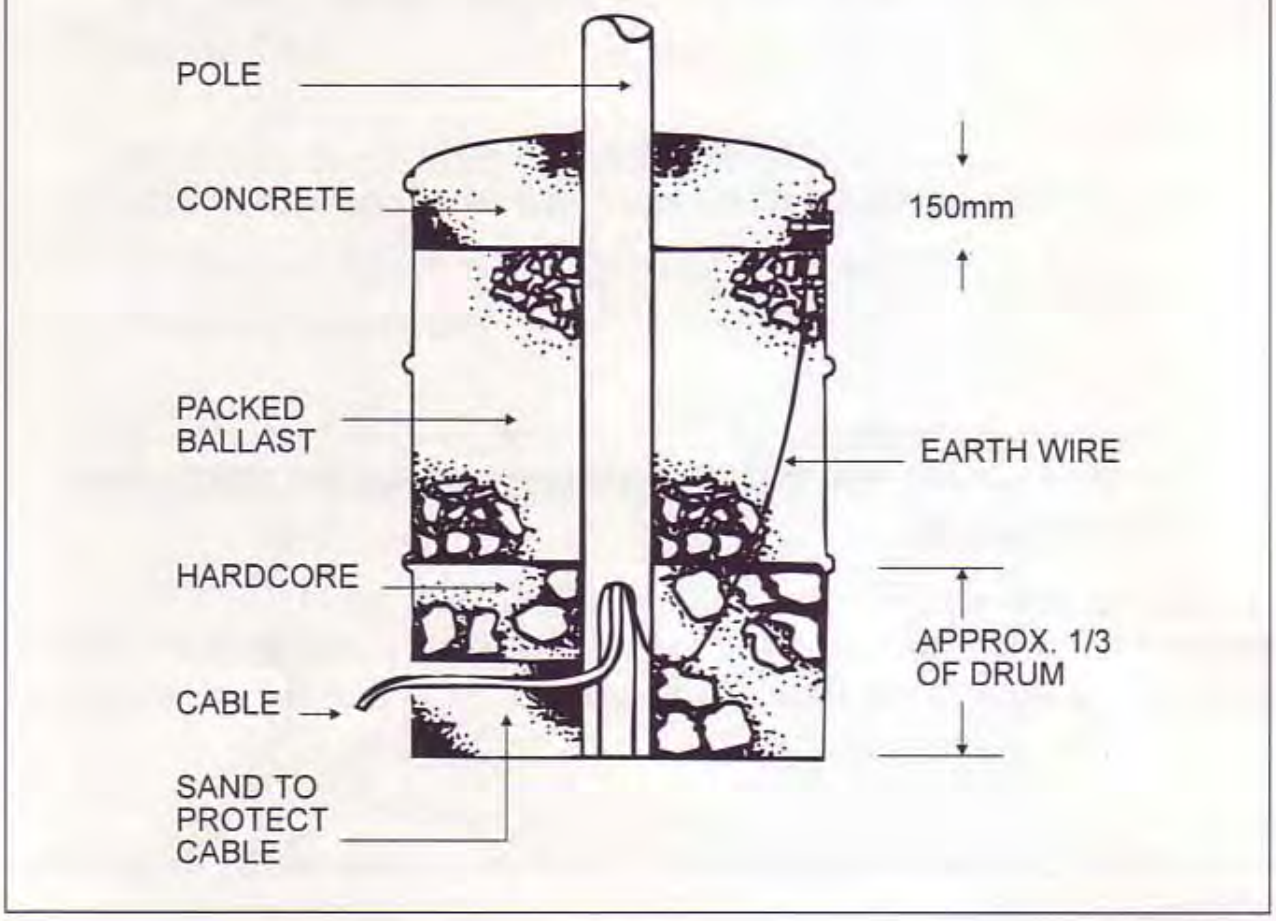


Figure 2. Section through drum with pole in position



3. **Poles**

3.01 Standard signal poles should be used, having been cut down so that the signal heads are installed at a height which is in accordance with the Traffic Signs Regulations and General Directions 1994[(12)].

3.02 The pole should have a 50mm * 150mm slot cut in the bottom for the cable entry.

3.03 The contractor should supply any necessary cable, brackets, jointing kits and miscellaneous items required.

4. **Installation**

4.01 The installation contractor should provide a 6mm earth stud on the inside of the drum near the top. He should also provide and connect a 6mm earth wire through a suitable ducting, fitted with crimped eyelet terminals at each end, between this and the earth stud at the top of the pole.

4.02 The pole should be placed in the centre of the drum. The cable should be passed through the hole in the drum into the slot and with the earth lead up the pole (see fig 2). Precautions should be taken to ensure that the cable cannot be damaged by any rough edges around the hole.

4.03 The drum should then be carefully backfilled with sand, hardcore and ballast as shown in figure 2. The top should be finished with concrete as shown on the drawing to avoid broken bottles and general rubbish being dumped on the top of the drum.

4.04 Only enough cable should be provided to allow the drum to be moved to its furthest proposed position. If during the progress of the works, there is an excess of the cable, this must be coiled up and taped to the side of the drum.

4.05 The cable should be terminated at the top of the pole. The other end should be jointed to the existing junction cabling using an approved sealed joint box ensuring that earth continuity is maintained.

Excess cable coiled and taped to the drum.

APPENDIX B

Example Traffic In-Service Report

TRAFFIC SIGNAL INSTALLATION COMPLETION CERTIFICATE

Customer's Name/Title: .....

DETAILS OF THE INSTALLATION

Site Address:	
Maintenance No:	Customer Drawing No: .....
New Installation ☐	Extent of installation covered by this certificate.
Modification to Installation ☐	

PARTICULARS OF THE INSTALLATION

Type of Earthing

TN-C-S ☐ TN-S ☐ TT ☐

Characteristics of the supply at the origin of the installation:

Nominal Voltage ..... V Frequency ..... Hz

		Specified	Measured
Maximum prospective fault current	(KA)		
Earth fault loop impedance or origin, Ze	Ω		

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 300mA ☐ N/A ☐

Maintenance socket only 30mA ☐

INSTALLATION TEST RESULTS

Test Equipment Used		Calibration Date
Multimeter:-		
Installation Tester:-		
Earth Loop Impedance Tester:-		
RCD Tester:-		
Inductance Tester:-		
Other:-		

Insulation Test of Complete Installation	RCD Test	Time
500V:—	30mA	
	150mA	
	300mA	

Cable Test Results

	Max. Allowable	Loop	Loop		
Cable Run:	Earth Loop	Resistance	Resistance	CPC	Earth Loop
From To	Impedance	Core to Core	Core to CPC	Resistance	Impedance

DETECTOR TEST RESULTS

Loop Designation	Series Resistance of Loop Max R = 2 Ω	Resistance to Earth of Loop Min R = 5 Ω	Series Resistance of Loop and Feeder Cable Max R = 5 Ω	Resistance to Earth of Loop and Feeder Min R = 2 Ω	

COMMENTS ON EXISTING INSTALLATION, IN THE CASE OF A MODIFICATION

CONSTRUCTION

I/We being the persons responsible (as indicated by my/our signatures below) for the construction of the electrical installation, particulars of which are described on page 1 of this form CERTIFY that the said work for which I/We have been responsible is to best of my/our knowledge and belief in accordance with BS7671:1992 — Requirements for Electrical Installations except for the department, if any, stated in this certificate.

Details of departures from BS7671

The extent of liability of the signature is limited to the work described on page 1 of this form.

For the CONSTRUCTION of the installation

Name (BLOCK LETTERS) ..... Position .....

Signature ..... Date .....

For and on behalf of:

INSPECTION AND TEST

I/We being the persons responsible (as indicated by my/our signatures below) for the construction of the electrical installation, particulars of which are described on page 1 of this form CERTIFY that the said work for which I/We have been responsible is to best of my/our knowledge and belief in accordance with BS7671:1992 — Requirements for Electrical Installations except for the department, if any, stated in this certificate.

The extent of liability of the signature is limited to the work described on page 1 of this form.

For the INSPECTION AND TEST of the installation

Name (BLOCK LETTERS) ..... Position .....

Signature ..... Date .....

For and on behalf of:

I/We recommend this installation be further inspected and tested after an inverval of not more than 1 year.

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