SERIES 1500
MOTORWAY COMMUNICATIONS

Contents

NATIONAL ALTERATIONS OF THE OVERSEEING ORGANISATIONS OF SCOTLAND, WALES AND NORTHERN IRELAND

Wales

(02/03) The Series 1500 Motorway Communications may not be appropriate to Wales. Additional and substitute specifications requirements can be obtained from The Welsh Assembly Government, Transport Directorate, Cathays Park, Cardiff, CF10 3NQ.

MOTORWAY COMMUNICATIONS

1501 Introduction

1 Motorway communications installations shall comply with this Series.

2 Communications cabinet references may not be appropriate to all Overseeing Organisations.

1502 General Requirements

1 The Contractor shall:

(i) (02/03) unless otherwise described in Appendix 15/1, arrange to have delivered by the Overseeing Organisation, all cables, cabinets and ancillary items listed in Appendix 15/1 which the Contractor shall subsequently unload, store and install; and

(ii) unless otherwise described in Appendix 15/1, supply, deliver and install the cable ducts and chambers, in compliance with Clauses 1530 and 1533; and

(iii) unless otherwise described in Appendix 15/1, supply, deliver, store and install to the Motorwarn System, steel or timber posts, timber backing boards and paving slabs; and

(iv) (02/03) supply, deliver, store and install all associated cable fittings, as described in Appendix 15/1, terminate cables in compliance with Clauses 1515 and 1516 and test the installations in compliance with Clauses 1515 and 1518.

2 All operations shall be arranged so that the communications installation is completed, tested and the test results approved by the Overseeing Organisation at least 8 weeks before the date for completion of the Works and, where required in Appendix 15/1 any Section thereof, in order to allow time for the Overseeing Organisation to commission the system. The Contractor shall allow sufficient time in his programme for any repairs and retesting which may be required to be completed satisfactorily before the aforementioned 8 week commissioning periods.

3 (02/03) The Contractor shall provide facilities for the electricity supplier for service connections and for the Overseeing Organisation for commissioning of the system. Electrical supply points provided by the Contractor on behalf of the Overseeing Organisation shall be un-metered to accord with the Overseeing Organisation's existing requirements. The Contractor shall make all payments for electricity usage until such time as handover to the Overseeing Organisation.

4 The Contractor shall provide the Overseeing Organisation with full details of all personnel whom he proposes to employ on the testing and terminating of cables. Such details shall be provided in writing, 14 days prior to the commencement of cable termination. The written approval of the Overseeing Organisation shall be obtained prior to the commencement of such work.

5 The Contractor shall be prepared to demonstrate to the satisfaction of the Overseeing Organisation, in advance of commencing work, the competency of terminators and testers to carry out the cable testing and termination requirements detailed in the Specification. The Contractor shall allow adequate time in his programme for the approval procedure.

1503 Materials Equipment and Workmanship

1 (05/01) Materials and equipment supplied by the Contractor and his workmanship shall comply with BS 7671 Regulations for Electrical Installations (IEE Wiring Regulations) and the rules and regulations of the electricity supplier.

2 All such equipment shall be sufficiently compact for satisfactory installation and operation in the accommodation provided for it.

3 The Contractor shall ensure that enclosures, following the drilling, cutting or removal of cable entry knockouts, maintain the manufacturer's quoted IP Classification ratings and are cleaned of all waste and surplus material prior to any further work being undertaken.

1504 Site Records

1 (05/01) The Contractor shall keep a daily record in duplicate in a clear and legible form, on drawings, of all work carried out as it proceeds. One copy shall be kept available for the use of the Overseeing Organisation during the Contract and shall, at completion of the Works, be handed to the Overseeing Organisation for record purposes. The following information shall be recorded on the drawings:

(i) Duct locations including depth, number and size of ducts and duct material.

(ii) Cable chamber locations including type, depth, incoming and outgoing ducts, type of chamber cover and details of cable joints within.

(iii) Cabinet positions and type.

(iv) Cabinet and cable chamber references in accordance with HCD Drawing Number MCX 0145.

(v) Cable routes including cable lengths. Additionally, within a ducted network, the number and type of cable allocated to each duct and the length of each cable.

(vi) Cable size, type and drum number.

(vii) Power supply interfaces.

(viii) Private wire interfaces.

(ix) Transmission stations, including duct entry points.

(x) Signals.

(xi) Telephones.

(xii) Sheath repair and joint positions.

(xiii) Any additional requirements stated in Appendix 15/1.

The drawings shall be submitted for the approval of the Overseeing Organisation at weekly intervals during the Contract.

2 Locational measurements shall be taken of the underground equipment to the nearest 100 mm from the nearest edge of the carriageway or fence line. Offsets to the cables/ducts shall be recorded at 20 m intervals and at every change of direction along the line of the cable/ duct. Offsets shall be defined longitudinally by distance from a permanent highway feature, a marker post or other point and agreed with the Overseeing Organisation.

3 The Contractor shall keep a daily record of the work in sufficient detail including type and drum number of underground cables to enable site records to be completed. A copy of the daily record shall be provided by the Contractor on the next working day for retention and use by the Overseeing Organisation.

4 (11/04) The Contractor shall keep record sheets for ducts and chambers which shall indicate details of all cables, Cable Joint Enclosures (CJE), Above Ground Joints (AGJ), ironwork, and plugs installed and tests undertaken.

1505 Provision of Cabinets, Cables and Ancillary Items

1 (11/04) Cabinets, cables and ancillary items (which include cabinet bases, cabinet fittings, Cable Joint Enclosures (CJE), Above Ground Joints (AGJ), equipment mounting posts, and similar items purchased in bulk by the Overseeing Organisation) will, unless otherwise indicated in Appendix 15/1, be supplied by the Overseeing Organisation to the Contractor. The Contractor shall be responsible for organising with the Overseeing Organisation their delivery of bulk purchased equipment.

2 (02/03) The Contractor shall provide the Overseeing Organisation with a profile of his bulk purchased requirements by completing MCH 1286 which the Contractor shall keep up to date. The Contractor shall give the Overseeing Organisation at least 2 weeks' notice of his bulk purchase delivery requirement by completing MCH 1260.

3 (02/03) The Contractor shall provide the Overseeing Organisation with a schedule of exact cable lengths and their locations, after checking the lengths of the cable routes on site.

4 (02/03) The Contractor shall be responsible for all bulk purchased equipment and cable once received from the Overseeing Organisation's store, including its unloading and secure storage. The Contractor shall provide a dry and heated store for the equipment as described in Appendix 15/1. Any equipment or cable damaged or missing after receipt from the Overseeing Organisation's store shall be replaced by the Contractor at no cost to the Overseeing Organisation.

5 (02/03) The Contractor will be supplied with 2 master keys for the equipment, which shall be returned to the Overseeing Organisation on the completion of the works.

6 (02/03) The Contractor shall maintain an up to date record of all bulk purchased equipment, and cable, received from the Overseeing Organisation's store. The record shall include details of the number and type of equipment and serial numbers (drum numbers for cable).

7 (02/03) The Contractor shall be responsible for examining the equipment and cable upon receipt from Overseeing Organisation's store and shall be giving an immediate notice of any defects to the Overseeing Organisation or their haulage contractor.

8 (02/03) On completion of the Works all unused bulk purchased equipment and cables shall remain the property of the Overseeing Organisation; the Contractor shall be responsible for arranging with the Overseeing Organisation their collection of such equipment and cable.

9 (02/03) The Contractor shall take all precautions necessary to minimise the wastage of any bulk purchased cable used under the Contract. Where it can be shown that the Contractor has not exercised adequate care to reduce cable wastage to an absolute minimum, he shall provide replacement at his own cost.

1506 Cables

1 Communications cables shall consist of one or more of the following as detailed in Appendix 15/1:

(i) non-armoured copper communications cable to Specification TR 2150;

(ii) non-armoured optical fibre communications cable to Specification TR 2151;

(iii) non-armoured coaxial communications cable to Specification TR 2152;

(iv) armoured copper communications cable to Specification TR 2158;

(v) armoured composite copper/fibre optic cable to Specification TR 2017;

(vi) armoured coaxial communications cable to Specification TR 2160;

(vii) armoured feeder cable for inductive loop detectors to Specification TR 2031;

(viii) inductive loop detector cable to Specification TR 2029.

2 (05/01) Power cables for communications systems shall be to the following as detailed in Appendix 15/1:

(i) non armoured energy cable to Specification TR 2153;

(ii) armoured energy cable to Specification TR 2161.

Where installations require power cable with conductor sizes outside the stock sizes available from the Overseeing Organisation's store the cables shall be supplied by the Contractor to the above Specifications as appropriate. These sizes are detailed in Appendix 15/1.

3 Each drum of cable delivered to the Site shall have Quality Inspection Certificates attached to each flange in accordance with the relevant cable specification. The Contractor shall ensure that the certificate relates to the cable to which it is attached. The certificate shall be given to the Overseeing Organisation prior to the installation of cable. Before laying armoured cables the Contractor shall test and accept the integrity of the sheath in accordance with cable test specification MCG1022 (for copper cables) or MCG1055 (for fibre cables). The results of the Contractor's tests shall be notified to the Overseeing Organisation. The Contractor is not required to test non-armoured cable prior to installation. Should the Contractor wish to test the integrity of any lengths of non-armoured cable he shall be free to do so at his own expense. Should any non-armoured cable fail such a test the Contractor shall bring it to the attention of the Overseeing Organisation. The location in the ground of cable lengths by reference to their drum numbers shall be kept with the daily records.

4 The location of buried cables shall be detected, confirmed and protected in accordance with the "Special Requirements in Relation to Motorway Communications Systems" and any additional requirements determined by the design.

5 The Contractor shall return part used drums of cable to the site compound area for subsequent use. Part used drums shall be clearly marked and kept separate from unused drums. The Contractor shall keep and maintain a register of all cable drums; the register shall, for each cable drum, include the cable drum number, cable size and the length(s) of cable removed. Surplus cable lengths shall be neatly coiled or drummed as appropriate and the Contractor shall record the length and other details as for drummed cable specified above.

6 (02/03) The Contractor is responsible for arranging the collection of empty cable drums from the site compound area. The Contractor shall supply a record to the Overseeing Organisation of all drums collected.

1507 Cable Installation

General

1 (11/04) The approximate location of cables, Cable Joint Enclosures (CJE), Above Ground Joints (AGJ), chambers and cabinets are described in Appendix 15/1. The exact locations shall be agreed with the Overseeing Organisation before the commencement of any associated groundwork.

2 Cables shall be laid in accordance with any particular requirements in Appendix 15/1, including, if required, additional protection and support.

3 Cables shall only be laid when the ambient temperature is above 0°C, and the cable has been stored at a temperature greater than 0°C for the previous 24 hours.

4 (05/01) Sufficient length of cable shall be allowed for its correct termination. When termination does not proceed immediately following the installation of the cable, the cable ends shall be sealed against the ingress of moisture in accordance with HCD Drawing Number MCX 0137.

5 The Contractor shall satisfy himself that ducts are suitable for cable installation prior to the drawing in of cable. The Contractor shall ensure that on completion of the cable installation works a draw cord is secured in each duct.

6 No cable shall be left exposed at the end of any work period. Any cable stolen and/or vandalised as a result of the Contractor's non-compliance with this requirement shall be replaced by a length equal to the original unbroken total length of cable involved, at the Contractor's own cost which also includes the cost of the replacement cable and any necessary jointing/ termination.

7 Excavations to parts of the highway that will be open to traffic between the end of one work period and the start of the next work period shall be covered by steel plates. The steel plates shall be strong enough to withstand the passage of any vehicles permitted to drive on the highway, without the possibility of collapse or dislodgement.

8 In the event of any damage whilst cables are being installed, the whole of the particular length of cable concerned shall be removed, replaced, re-connected and, if necessary, re-tested at the Contractor's expense prior to the handover date.

9 Every cable shall be permanently labelled in accordance with the drawings to ensure its unambiguous identification immediately following its installation.

Non-Armoured Cables

10 The Overseeing Organisation shall witness the installation of all cables; any cables installed which have not been witnessed by the Overseeing Organisation shall be removed at the Contractor's expense.

11 Cables shall be drawn into cable ducts and chambers that have been installed in compliance with Clauses 1530, 1531 and 1532.

12 Power cables shall not share the same duct as longitudinal communications cables.

13 Cables shall be installed using a static mechanical winch fitted with a clutch.

14 Cables shall be lubricated during installation using a suitable water based, biodegradable lubricant.

15 The draw cord shall not be used for cable installation. The Contractor shall use the draw cord to pull through a purpose made cable pulling rope which shall then be used for cable installation. The cable pulling rope shall be attached to the cable by means of a pulling eye fitted to a stocking (copper and power cable) or a pulling eye attached to the central strength member (fibre cable). In all cases the Contractor shall attach a swivel between the cable pulling rope and the pulling eye.

16 Purpose made bellmouths shall be fitted to the exit and entry of every duct, including all intermediate points, prior to the commencement of cable installation. A purpose made cable chute shall be used at the cable entry point to the network. Cable guides shall be used to support the cable in all intermediate chambers.

17 (05/01) Where intermediate chambers exist on a cable route the cables shall, where practical, be installed through these chambers in one operation; the Contractor shall ensure that an operative is present at every such chamber to ensure the safe installation without damage to the cable. Where cables pass through intermediate chambers, the Contractor shall, immediately after installation, label each cable with the destination of the cable (joint chamber or equipment reference as appropriate) 150 mm from the entry and exit points of the chamber. The type of labelling to be used shall comply with HCD Drawing Number MCX 0872.

18 Where 40 pair and optical fibre cables are to be installed into the same duct, the 40 pair cable(s) shall be installed first.

19 Optical fibre cables shall additionally be marked at intervals of 500 mm along their length inside chambers; the marking shall be 25 mm wide, yellow PVC adhesive tape or alternative fit for the purpose.

20 Cables shall not be bent to an internal radius of less than 6 times the external diameter of the cable (for copper cable) or 12 times the external diameter of the cable (for fibre cable and power cable) or the radius recommended by the manufacturer, whichever is greater.

21 (05/01) Cable management in chambers shall be as shown on HCD Drawing Number MCX 0873. The cabling Contractor shall secure the cables to the chamber walls using appropriate fixings.

22 (11/06) On completion of cabling, the ducts shall be re-sealed with purpose made mechanical duct plugs installed in compliance with sub-Clause 1530.8. The cables shall be looped around the cable support ironwork as detailed on HCD Drawing Number MCX 0873 and secured to the ironwork.

23 All non armoured cables installed on gantries shall be protected from mechanical damage by being installed within a covered cable tray.

Armoured Cables

24 (05/01) Cable trenches shall be excavated to the lines described in Appendix 15/1 and in accordance

with Clause 602 and HCD Drawing Number MCX 0141. The depth of excavation shall be such that cables laid under verges, footways or open ground shall have a minimum cover of 500 mm and under carriageways of 750 mm, or 300 mm below formation, whichever is the greater depth.

25 Cables laid in trenches shall be both bedded on and covered by a 75 mm thickness of sand complying with sub-Clause 503.3 (ii). Class 1C material complying with Table 6/1 and compacted to the requirements therein shall be deposited to a thickness of 175 mm prior to further backfilling to comply with sub-Clause 26 of this Clause.

26 Backfilling shall be in accordance with Clause 602 with material Class 8 complying with Table 6/1 and compacted to the requirements therein. The material shall be spread and compacted evenly without dislodging, disturbing or damaging cables, ducts or troughs. Power hammers shall not be used within 300 mm of cables, ducts or troughs. The surface shall be reinstated as described in Appendix 15/1.

27 Cable marker tape complying with Clause 1511 shall be laid approximately 250 mm above all communications and power cables. Where several cables are laid in one trench one line of marker tape shall be installed for each 600 mm of trench width.

28 Cable covers for protection of underground cables shall comply with BS 2484 and shall be installed as described in Appendix 15/1.

29 Where permitted in Appendix 15/1 cable may be installed using a purpose built cable laying machine.

30 When cables are required to be laid in ducts the Contractor shall swab through the duct prior to drawing in the cables and a further draw cord. On completion of cabling and prior to backfilling, ducts shall be left with a draw cord in place and then resealed with split plugs, or suitable alternative material, to adequately seal the ducts against the ingress of foreign matter.

31 (05/04) Where cables are laid in troughs they shall be covered with sand up to the level of the cover. The sand shall or all pass as 2 mm size test sieve as specified in BS EN 933-2.

32 Between adjacent, longitudinal cabinets a drum length shall be laid in one operation, unless otherwise stated in Appendix 15/1. Longitudinal cables shall generally be run parallel to the fence line or edge of the hardshoulder. Transverse cables shall run at right angles to the carriageway. Transverse cables installed diagonally with respect to the carriageway shall not be accepted unless being laid in existing ducts.

33 (05/01) All fibre optic, 30 pair, 20 pair and 2 pair cables exceeding 50 metres in length shall be provided with buried loops. These loops shall be installed at each end of the cable immediately adjacent to the entry and exit ducts at cabinet locations. The loop shall be made of a minimum of 3 metres of cable and comply with HCD Drawing Numbers MCX 0149 and MCX 0150.

34 Cables shall not be bent to an internal radius of less than 12 times the external diameter of the cable or the radius recommended by the manufacturer, whichever is greater.

35 When duct or trough alignments differ from those of the trench the transition from one to the other shall not exceed 1:30 horizontally or vertically.

36 (05/01) Cables occupying the same trench shall be separated by the distances shown on HCD Drawing Number MCX 0141.

1508 Installation of Cabinets and Signal Posts

1 (05/01) The Contractor shall construct paved areas and foundations incorporating plinths 610 for cabinets and signal posts as described in Appendix 15/1. The cabinets and signal posts shall be mounted on the plinths using the holding down bolts provided. (Reference HCD Drawing Numbers MCX 0140 and MCX 0144.) Paved areas shall be constructed with a gentle fall away from cabinets. Cabinet doors shall be capable of opening and closing without being fouled by the paved area.

2 (05/01) After the completion of terminations and testing, the plinths shall be filled with 6 mm pea gravel and the bases of Cabinets 600 and 617 shall be sealed in accordance with HCD Drawing Number MCX 0156 sheet 1.

3 The Contractor shall keep the interior of cabinets free from moisture and dirt. The Contractor shall ensure that the doors of each cabinet are closed and properly secured after the installation of equipment in the cabinet and after the completion of any other work.

4 (11/06) Entry/exit ducts to cabinets on a ducted network shall be sealed using purpose made mechanical plugs in compliance with sub-Clause 1530.8 to prevent the ingress of soil, gravel etc. On a direct buried network entry/exit ducts shall be sealed using suitable plugs or expanding foam.

5 Where cabinets are situated in groups they shall be located in a consistent sequence as described in Appendix 15/1.

1509 Gantries for Motorway Signals

1 Sign/signal gantries shall comply with sub-Clause 1220.2. Details of traffic signs including variable message signs and matrix signals on gantries are given in Appendix 12/1. Details of electrical equipment are given in Appendix 14/5.

1510 Installation of Telephone Posts and Housings

1 The Contractor shall construct paved areas and set the telephone post vertically in concrete foundations all as described in Appendix 15/1.

2 Telephone housings and instruments shall be mounted on the posts and orientated so that the back of the housing faces oncoming traffic unless otherwise described in Appendix 15/1.

3 Where telephones are installed on existing motorways they shall be covered with "Not in Use" bags until they have been commissioned and are available for use by the public.

4 (05/01) The Contractor shall provide and install a jointing box complete with Cable Joint Enclosure (CJE Type 15T) adjacent to each telephone post as detailed on HCD Drawing Number MCX 0811 sheet 3. A short section of duct, either 50 mm or 75 mm in diameter shall be installed from the joint box to the telephone post. The joint between the duct and post shall provide a water tight seal and shall be flexible so that in the event of the telephone being knocked down, the joint will break and leave the joint box undamaged.

1511 Marker Tape

1 All cables and ducts installed underground shall have their position indicated by the use of detectable marker tape. Marker tape, as described below, shall be buried in the trench above the cable/duct.

2 Marker tape shall be manufactured from self coloured thermoplastic material not less than 150 mm wide; it shall have a metallic insert or backing which will allow detection by electronic route tracing equipment. The detectable metallic component and the form of tape construction shall be either:

(a) Stainless steel wire or wires with a minimum total cross sectional area of 0.30 mm^2 laid in a sinusoidal wave form or stainless steel strip with minimum dimensions of 10 mm wide and 100 micron thick. The stainless steel wire or strip shall be sandwiched in between two layers of thermoplastic tape with a combined minimum tape thickness of 150 micron or bonded to one layer of thermoplastic tape with a minimum thickness of 150 micron.

(b) Aluminium foil with minimum dimensions of 50 mm wide and 9 micron thick totally enclosed in between two layers of thermoplastic tape. The combined thickness of the two tape layers shall be a minimum of 400 micron.

3 Joints between successive lengths of tape shall be made using crimps or clamps such that the electrical continuity and tensile strength of the tape is maintained. The joint shall be protected from corrosion and attack from ground chemicals.

4 The wording on the marker tape shall read "CAUTION COMMUNICATIONS/ POWER CABLES BELOW". The wording shall occur at intervals up to a maximum of 1 m apart. The letters of the wording shall be a minimum of 30 mm high with a minimum of 5 mm line thickness

5 Marker tape shall be yellow in colour, with wording in black.

1512 Installation of Ancillary Items

1 Boxes 615 shall be mounted on to the baseboards of Cabinets 609, the knockouts for cable access removed as necessary and holes bushed, all as described in Appendix 15/1. Terminators 13 and 14 shall be fitted within the Boxes 615 where appropriate.

2 Distributors 902/9902 shall be mounted on to the baseboards of Posts 75 and Distributors 901 and 9903 shall be mounted on gantries as described in Appendix 15/1.

3 Distributive and protective devices shall be installed in power supply cabinets as described in Appendix 15/1.

4 The Contractor shall supply and install enclosures, termination equipment and all fixings in optical fibre cabinets as described in Appendix 15/1.

5 (05/01) Cabinets type 600 shall be installed as shown on HCD Drawing Number MCX 0830. The Contractor shall install termination frames, and install wiring as shown. The complete frame shall be wired off site using 0.5 mm single stranded copper twisted jumper wire for the links.

6 (05/01) Marshalling cabinets shall be installed in accordance with HCD Drawing Number MCX 0853 (Transmission Station Site) or 0854 (617 Cabinet Site), as appropriate.

1513 Jointing and Termination of Multi-pair Communications Cables

1 (11/04) Cable joints (except in detector loop systems) will only be permitted within Cable Joint Enclosures (CJE) or an Above Ground Joint (AGJ).

2 Cable joints in detector loop systems shall comply with Clause 1218.

3 During jointing and termination, the sheaths shall be removed from the cable ends to reveal the pairs of insulated conductors. All surplus jelly shall be removed by the use of a clean dry cloth taking care not to stretch the insulation, and any fluid substance to aid the cleaning process shall have had the prior approval of the cable manufacturer and be shown to have no detrimental effect on the cable or, if applicable, the jointing system.

4 Cables shall be dressed neatly.

5 The Contractor shall ensure that the lay of the cable is maintained up to the termination position. All conductor pairs shall be identified by means of a numbered plastic sleeve or collar.

6 Termination of cable using Insulation Displacement Connectors shall be undertaken in accordance with the manufacturer's instructions using any specialist tools necessary. The Contractor shall provide the requisite tools.

7 Within cabinets Type 600 links shall be terminated in terminal blocks complying with sub-Clause 2 of Clause 1514. The conductors shall be secured by tightening the screws with a torque screwdriver to within the range 0.4 to 0.6 Nm. They shall be of sufficient length to facilitate routine maintenance and allow for several subsequent re-terminations. Care shall be taken at all times to maintain correct pairing. The Contractor shall clearly identify links by using collets at either end.

8 Where the Contractor is required to terminate cables into cabinets containing operational circuitry, the Contractor shall, through the Overseeing Organisation, arrange for the Overseeing Organisation's Specialist Maintenance Contractor to attend each site to supervise or undertake all work within the cabinet for which the Contractor is responsible. This must not compromise the operational system(s).

9 Terminations and jointing shall be carried out under cover, either using a purpose made tent or a vehicle.

10 (11/04) Cable Joint Enclosures (CJE) shall be installed in chambers and Above Ground Joints (AGJ) in cabinets, as described in Appendix 15/1 and as follows:

(i) (11/04) Longitudinal CJE (Types 15-1, 15-2, 15-3 and 15-4) and AGJ (Types 16-1, 16-2, 16-3, 16-4 and 16-5) shall be installed on the longitudinal 40 pair cable in accordance with HCD Drawing Numbers MCX 0820 and MCX 1030 respectively and as appropriate. Cables shall be installed in accordance with HCD Drawing Numbers MCX 0823 and MCX 1030 as appropriate.

(ii) (11/04) A CJE Type 15L or AGJ Type 16L shall be installed at each Longitudinal CJE/AGJ location. Each 15L shall be linked to the relevant main CJE using a length of 40 pair cable to TR 2150. Cables shall be installed in accordance with HCD Drawing Numbers MCX 0823 or MCX 1030 as appropriate.

(iii) Where high frequency carrier circuits are required, the cable shall be terminated within CJE Type 15HFC. Cables shall be installed in accordance with HCD Drawing Number MCX 0823.

(iv) At rural post mounted signal sites a CJE Type 15 RSI shall be installed in a cabinet Type 609 as shown on HCD Drawing Number MCX 0165 to facilitate the isolation of RS485 circuits.

(v) At emergency telephone sites where post 71 is used, a CJE Type 15T shall be installed in a joint box as shown on HCD Drawing Number MCX 0811.

11 (05/01) Cable continuity kits as detailed on HCD Drawing Number MCX 0871 shall be installed on every cable.

12 (05/01) Following the completion of jointing and termination in a CJE, the Contractor shall prove the integrity of the CJE by performing an air pressure test. Unless otherwise indicated in Appendix 15/1 a modified CJE dome for use in air pressure tests will be supplied by the Overseeing Organisation to the Contractor. The modified CJE dome shall be fitted with an air valve and a pressure gauge accurate to ± 5 kPa. The test procedure shall be as follows:

(i) secure the modified dome to the base of the completed CJE;

(ii) pump air into the modified dome, to a pressure of 100 kPa;

(iii) immediately continuously immerse the CJE including heat shrink seals under water for 10 minutes.

If the pressure in the modified dome falls and bubbles emerge from the CJE or the heat shrinks then the test

has failed and the Contractor shall remake the relevant heatshrink seal or dome to base joint and retest. If bubbles emerge from the CJE bosses the CJE shall be replaced and the whole CJE joint be remade and retested. The Contractor shall test every CJE in this manner and provide the Overseeing Organisation with a schedule detailing the reference number of the CJEs tested, date and time of test and the test results. The Contractor shall give the Overseeing Organisation 24 hours' notice of any test to allow the tests to be witnessed.

13 (05/01) Links shall be installed and connected within Cabinets 600 and Boxes 615 and jumper leads installed between Boxes 615 wherever two are installed within one Cabinet 609; using as appropriate the insulated conductors of multi-pair/0.9 mm cable with its outer sheath, armour and inner sheath removed. The leads shall be of sufficient length to facilitate routine maintenance and allow for several subsequent re-terminations as shown on HCD Drawing Number MCX 0132 and shall not obstruct any accessory in the Box 615. The Contractor shall maintain multipair colour coding so that colour code duplication does not occur. Care shall be taken at all times to maintain correct pairing. In the 'mainside' Box 615 the links shall be tied back and left unconnected.

1514 Cable Connectors

1 Where shown on the drawings cables shall be terminated using Insulation Displacement Connectors which conform to Specification MCE 2183.

2 Where shown on the drawings the Contractor shall use terminal blocks which shall be as described on the drawings.

1515 Termination of Fibre Optic Communication Cables

General

1 The Contractor shall be responsible for the safe disposal of any fibre waste.

Non-Armoured Cables

2 (11/04) Unless otherwise stated in Appendix 15/1, cables shall be terminated in CJE Type 15F or AGJ Type 16F. The manufacturer's instructions shall be followed. The fibres shall be fusion spliced and protected from mechanical strain. (Reference HCD Drawing Numbers MCX 0823 and MCX 1030).

Armoured Cables

3 (05/01) Cables shall be terminated in an approved hermetically sealed box containing silica gel to prevent damage due to the occurrence of moisture. The fibres shall be fusion spliced and protected from mechanical strain. (Reference HCD Drawing Numbers MCX 0489 and MCX 0490.)

4 Copper conductors shall be secured by tightening the screws with a torque screwdriver to within the range 0.4 to 0.6 Nm.

1516 Termination and Jointing of Power Supply Cables for Communications

1 Power supply cables for communications shall be terminated as described in Appendix 15/1.

2 Cable joints in power cables shall be made where described in Appendix 15/1. Additional joints shall not be permitted to overcome inaccuracies in measurement, or cable damage. Cable joints shall not be situated in a duct or trough. Heat-shrink type joints shall not be used.

3 Cables greater in size than 25 mm^2 shall not be terminated within cabinets. The cable shall be jointed to a length of 10 mm^2 or 25 mm^2 cable manufactured to Specification TR 2153 or TR 2161 which shall be terminated within the cabinet. An underground cable reduction joint shall be provided to facilitate the joint. Where such a joint is required it shall be made in the adjacent Type C chamber (non-armoured cable) or near to the cabinet cable entry duct (armoured cable). Details of the reduction joint shall be displayed within the cabinet.

4 Joints shall be made using a suitable jointing system in which all components are mutually compatible and adequate for the type of cables to be jointed. Joints shall be installed in accordance with the manufacturer's instructions. Prior to cable laying the Contractor shall provide the Overseeing Organisation with the names of the jointers proposed and evidence of the proposed jointers' competence in the use of the cable joint kit to be used. Jointers shall not commence any jointing until the written approval of the Overseeing Organisation has been received. A record shall be kept to enable cable joints to be identified with the jointer responsible for the work.

5 Jointing shall only be carried out when all the materials used in the joint are free from visible signs of moisture. Joints must be left protected from water, frost, direct sunlight and extremes of temperature during the curing period. Joints shall be adequately supported at all times. Backfilling shall not take place until the joint

is completely cured and able to withstand any stresses which may be imposed on it.

6 Where a new power supply is being provided to existing equipment which will result in a disruption to or the loss of existing facilities (signals, CCTV etc) the Contractor shall obtain written authority from the Overseeing Organisation who will advise the Motorway Police and Overseeing Organisation's Maintenance Contractor of the anticipated duration, so that the effects of the power supply disruption can be assessed. The Contractor shall provide at least two weeks' notice in writing to the Overseeing Organisation of all planned disruptions. The Contractor shall undertake all necessary preparatory work to ensure that the period of disruption is minimised.

7 Where power supply cables are to be terminated into existing cabinets which contain operational equipment, the Contractor shall, through the Overseeing Organisation, arrange for the Overseeing Organisation's Maintenance Contractor to attend each site to witness cable termination work undertaken by the Contractor. The Contractor shall give at least two weeks' written notice.

8 At each existing gantry the Contractor shall carry out suitable tests to confirm that the lighting supply and the communications power supply are fed from the same phase. Where tests show the two supplies are not in phase the Contractor shall isolate the communications energy supply, at the energy isolation cabinet, from the mains supply and carry out the necessary remedial works.

9 Where described in Appendix 15/1, a cable joint marker block, consisting of a 300 mm square and 225 mm deep precast concrete block or buried active joint marker shall be placed over the cable joint. The block shall have a mark indented into its top surface as described in Appendix 15/1, and its position shall be recorded on the site records.

1517 Earthing and Bonding

1 The earthing and bonding of the whole installation shall comply with the recommendations contained in BS 7671 and BS 7430. Details of the earthing and bonding requirements are given in Appendix 15/1.

2 The area of gland plates or boxes which will come in contact with a cable gland shall be cleaned of all paint and corrosion before a cable gland is fitted. Once the gland is fitted, exposed metalwork of gland plates or boxes shall be suitably treated to protect against corrosion.

3 All connections to bolted fixtures shall be made through crimped type lugs.

4 Adjacent cabinets less than 2 metres distant shall be effectively earth bonded together.

1518 Cable Testing

1 The Contractor shall undertake tests on cables as detailed in Appendix 1/5.

2 Where cables are supplied by the Contractor to Specifications TR 2150-2153 (non- armoured cable) or TR 2158-2161 (armoured cable) they shall be tested at the manufacturer's works to ensure compliance with those specifications and the tests shall be witnessed by a specialist consultant appointed by the Overseeing Organisation.

3 Cables shall be tested by the Contractor in accordance with Specification MCG 1022 (for armoured copper cables), MCG 1055 (for armoured fibre cables), or MCG 1099 (for non-armoured cables), as appropriate. Tests shall be witnessed by a specialist consultant appointed by the Overseeing Organisation. The cable sections for tests shall be as described in Appendix 15/1.

4 Three copies of all cable test results shall be supplied to the Overseeing Organisation on the completion of each test.

5 The Contractor shall provide and display warning notices, barriers etc when testing cables.

6 All test instruments requiring calibration shall have a current calibration certificate, copies of which shall be available at the time of testing.

7 The Contractor shall give at least two weeks' notice, in writing, to the Overseeing Organisation of his intention to test any cable.

8 In the event of the Contractor opening up a trench or drawing further cables through a duct after cables have been Stage 1 tested, then all cables in the trench or duct shall be retested. Any damage identified by this test shall be rectified by the Contractor and the cables then re-tested.

Non-Armoured Cable

9 (11/04) Testing shall not be undertaken within 7 days of any CJE/AGJ being opened.

10 (11/04) All local breakjacks shall be fitted in every longitudinal Cable Joint Enclosure (CJE Types 15-1, 15-2, 15-3 and 15-4) or switches opened in Above Ground Joints (AGJ Types 16-1, 16-2, 16-3, 16-4 and 16-5) prior to the commencement of testing. These breakjacks/switches shall be left in place after testing.

11 Build out capacitors shall be fitted prior to the testing of the longitudinal 40 pair cable in accordance with Specification MCG 1099.

Armoured Cable

12 (05/01) The Contractor shall, after testing, locate and expose any damaged outer sheath whether caused by himself or not and shall report all such damage to the Overseeing Organisation. The Overseeing Organisation shall be informed prior to the commencement of any operation to expose damaged cable and shall be allowed to be in attendance during the operation. The Contractor will be informed whether a sheath repair will be permitted.

Should sheath repairs be permitted the Contractor shall provide and install cable joint markers complying with the requirements of duct end markers (sub-Clause 501.8), but the letters 'CJ' replacing the letter 'D'. Temporary markers shall be provided if necessary to ensure the accurate positioning of permanent markers, alternatively an active marker may be provided.

13 No tests shall be carried out until the cable trench has been backfilled and the ground above the cable reinstated and the cable ends have been installed (unterminated) in the respective termination cabinets.

1519 Labelling and Numbering

1 (11/04) Gantries, Cable Joint Enclosures (CJE), Above Ground Joints (AGJ), cable chambers, cabinets, signal posts and telephones shall be numbered and cables shall be labelled, in accordance with the MCX Series of standard drawings and the details described in Appendix 15/1.

2 With the exception of cable labels and any earthing labels required by Appendix 15/1 all labels shall be of the engraved colour laminated type. In addition all engraved labels shall be secured into position using stainless steel nuts, bolts and washers or stainless steel screws as appropriate.

3 The Contractor shall not leave cables unlabelled at any time and shall provide temporary labelling accordingly to facilitate testing and termination prior to the implementation of permanent labelling.

4 All Cabinets type 609 containing power distribution and control equipment shall be labelled to indicate the source of supply, destination, circuit arrangements and test details in accordance with regulations. Refer to Appendix 15/1 for examples of such labels.

5 Where the Contractor carries out modification work to existing cabinets, new labels shall be fitted where appropriate and in accordance with Appendix 15/1.

6 The Contractor shall submit to the Overseeing Organisation for approval his proposals for cabinet labels. The Contractor shall allow seven days for approval of the proposals.

7 Motorway designations for longitudinal cables are detailed in Appendix 15/1.

1520 Loading

1 The longitudinal communications cable shall be loaded in accordance with Appendix 15/1. The Overseeing Organisation will arrange for the supply and delivery of the necessary capacitors and associated mounting assemblies.

1521 Removal and Resiting of Existing Equipment

1 Existing communications equipment shall be removed or resited where required in the Works, as detailed in Appendix 15/1. No equipment shall be removed or cables disconnected or cut until approved by the Overseeing Organisation.

2 Existing redundant cabinets, telephone posts, housing and handsets, signal equipment, etc, as detailed in Appendix 15/1 shall be carefully removed to store. The location of the store shall be notified by the Overseeing Organisation at the commencement of the Works.

3 Where required in Appendix 15/1 redundant electronic or signalling equipment shall be removed by the Contractor under the supervision of the Overseeing Organisation's Specialist Maintenance Contractor. At least one week's notice shall be given by the Contractor of his intention to remove such equipment.

4 Conductors shall be disconnected from the equipment in which they are terminated, the terminal screws and glands re-tightened and the cable withdrawn clear of the equipment.

5 Items of equipment to be resited shall be unbolted from their plinths or supports together with their holding down bolts, stored, and resited as described in Appendix 15/1. Plinths and concrete foundations shall be broken out and disposed of in compliance with Clause 201.

6 Buried cables to be removed shall be located and pegged throughout their routes, the Contractor shall also excavate trial holes to expose these cables at the pre-determined locations detailed in Appendix 15/1. Where described in Appendix 15/1 the Contractor shall

excavate that part of the cable route carefully by hand. Where the cable to be removed is sharing a trench with other existing cables, on completion of removal, all stones and contaminated material shall be removed from the cable trench, clean sand and warning tape shall be provided and installed and the cable trench shall then be reinstated in compliance with Clause 1507; the Contractor shall then remove and dispose of all unsuitable and surplus material in compliance with Clause 201. Cable in ducts shall be carefully withdrawn, the Contractor must also fulfil the requirements for removal of duct seal, re-sealing and re-roping. Cables in troughs shall be carefully segregated and lifted out, the Contractor shall also remove all trough lids, all debris from troughs and all sand from troughs. On completion the Contractor shall provide and install clean sand, reinstate all trough lids, and provide and install new trough lids to replace any breakages caused during the preceding operation. Redundant cables are to be coiled onto drums at the time of removal and transferred to the site storage area for subsequent disposal by the Contractor.

Cables on signal gantries shall be unclipped and taken down, the Contractor shall also transport these to the site storage area and subsequently dispose of them. The Contractor shall provide and install new cable clips, where required, for retaining existing cables on the gantry structure and cable tray.

7 The sites of cabinets, plinths and cable trenches shall be reinstated to the level of the surrounding ground unless otherwise described in Appendix 15/1.

1522 Motorwarn System

1 The approximate position of the Motorwarn Units, where required, are described in Appendix 15/1. The exact locations shall be determined on site before the commencement of any associated groundwork.

2 (05/06) Steel tube for posts shall comply with any part of BS 6323 and shall be galvanized in compliance with Clause 1909. Timber shall comply with Clause 304. The backboard shall be painted in accordance with Clause 312. Posts shall be placed in ST2 concrete complying with Clause 2602. Paving slabs shall comply with BS EN 1339 and shall be laid directly on the topsoil. Where installation of the electrical equipment is required in Appendix 15/1 it shall be carried out in accordance with the HCD MCX series drawings.

1523 (11/06) Detector Loops

1 Detector loop installation and testing shall comply with Clause 1218.

2 (11/06) The Cabinet 600 equipped for detector loop use shall be installed in accordance with Clause 1508.

3 The power supply cable shall be terminated as described in Appendix 15/1. The loop feeders shall be terminated in terminal blocks complying with Clause 1514, secured to the equipment frame. Terminal screw tightness shall be within the range 0.4 to 0.6 Nm. Each feeder shall have 500 mm of cable coiled in the bottom of the cabinet to allow subsequent re-terminations. Each feeder shall be individually identified by means of a label.

4 Where loops are to be installed on existing motorways it is the responsibility of the Contractor to devise, obtain approval for and provide the traffic management systems necessary for the safe installation of the loops. Traffic management shall comply with the requirements of Clause 117.

1524 Trial Pits

1 Trial pits shall be excavated as described in Appendix 15/1.

1525 Maintaining the Existing Motorway Communications Network

1 The motorway communications network forms part of the National Communications System and consequently any damage to equipment/infrastructure within the works area can have severe consequences to the system as a whole. The Contractor shall maintain the integrity of the existing motorway communications system by one or any combination of the following methods:

(a) Protection and use of existing network and equipment.

(b) Provision of a temporary network.

(c) Use of the new network.

The method(s) shall be identified in the Contractor's programme and agreed with the Overseeing Organisation.

2 The Contractor shall give at least three weeks' written notice of the proposed change to the network, which must have been identified in advance in the Contractor's programme. Any such proposal shall be subject to the agreement of the Overseeing Organisation. The alternative network shall be installed, tested and accepted by the Overseeing Organisation at least 5 days before the proposed date of change of network. The Contractor shall allow adequate time in his programme to ensure that the revised network is accepted.

3 The Contractor must allow the Overseeing Organisation's Specialist Maintenance Contractor access to all equipment within the Works which has been identified as operational.

1526 The Inspection and Testing of Electrical Installations

1 The Contractor shall carry out the Inspection and Testing of Electrical Installations in accordance with BS 7671. The Contractor shall provide Inspection and Completion Certificates to the Overseeing Organisation in accordance with BS 7671.

2 Where the Inspection/Tests show that existing cabinets, or the earthing arrangements within existing cabinets do not meet with the requirements of BS 7671, the Contractor shall immediately notify the Overseeing Organisation giving full details of non-compliance. The Contractor shall not undertake any work on such a cabinet until written instructions have been issued by the Overseeing Organisation.

3 For the purposes of carrying out the Tests the Contractor shall use instruments which shall be tested and calibrated at six monthly intervals. Copies of the test/calibration certificates shall be forwarded to the Overseeing Organisation with the first certificate dated within three months of the Contract start date. The Line to Earth Loop Impedance testing instrument shall be of the digital display type and shall operate from zero to 19.99 Ohms (Accuracy ± 1% F.S. ± 1.5% Reading) with 0.01 Ohm Resolution. Where Alternating Current measurements are required, Ammeter testing instruments shall be of the digital display type and shall be capable of operation from 0-200 mA in 2 mA, 20 mA and 200 mA ranges with accuracy of ± 1%.

1527 Cable Installation at Transmission Stations

1 Cables shall be installed into and terminated within Transmission Station Buildings as described in Appendix 15/1.

2 (11/03) Work shall not be undertaken in Transmission Station Buildings by the Contractor unless the Overseeing Organisation's Specialist Transmission Maintenance Contractor is in attendance. The work shall be identified in the Contractor's programme and agreed with the Overseeing Organisation. The Contractor shall provide at least two weeks' notice in writing to obtain authority to undertake the work. The Contractor shall request the attendance of the Overseeing Organisation's Specialist Maintenance Contractor, who will witness the Contractor's work. The Contractor must ensure that he does not disrupt any live systems.

1528 Modifications to Existing Cabinets

1 The Contractor shall carry out modifications to existing cabinets as described in Appendix 15/1.

2 The Contractor shall, prior to laying any cable to the cabinets, locate, by electronic means, the position of all cabling; expose all cables by careful hand excavation and identify the type, size and designation of each cable.

3 Where necessary the Contractor shall remove, retain for re-use, and replace the cabinet base pea gravel; remove and relay any hardstanding; excavate to expose cable remake loop, excavate cable routes; re-route cable to gain sufficient lengths for the proposed modification; reinstate cable trenches; break open and re-seal resin filled base; disconnect and reconnect, undo existing gland and regland, including the provision of new gland assemblies and cable termination ancillaries where required; withdraw and reinstall cables at cabinet base.

4 Any work required to operational circuitry shall be undertaken by the Overseeing Organisation's Maintenance Contractor. The Contractor shall give at least one week's written notice of the need for such work.

1529 Temporary Emergency Telephones

1 Temporary Emergency Telephones shall be installed for use by the public when it would be necessary to cross either a live traffic lane or the Works to use the nearest working Emergency Telephone. When not in use Temporary Emergency Telephones shall either be removed or covered up. The direction of Temporary Emergency Telephones shall be indicated in a manner approved by the Overseeing Organisation at 100 metre intervals. The location and orientation of Temporary Emergency Telephones shall be agreed with the Overseeing Organisation.

2 Telephone Instruments and Posts shall be supplied by the Overseeing Organisation in compliance with Clause 1505. The Contractor shall give at least two weeks' written notice of the need for telephones.

3 Cable for Temporary Emergency Telephones shall be identified at 20 metre intervals in a suitable manner. Cables shall be laid in existing ducts to cross the carriageway and on the surface elsewhere with suitable protection from damage by the Works.

4 Cable for Temporary Emergency Telephones shall be connected to the nearest 609C or 600C cabinet or Box 615 or equivalent on the live communications network. A loop of cable of 3 metres length shall be coiled on the ground adjacent to the cabinet or box.

5 Connections and disconnections from the live communications network shall be carried out by the Overseeing Organisation's Specialist Maintenance Contractor(s). The Contractor shall give at least one week's written notice of the need for such work. The need for this work shall be identified in advance in the Contractor's programme and agreed with the Overseeing Organisation.

6 The Contractor shall install, place in position, maintain, cover up, uncover, reposition, recable and remove Temporary Emergency Telephones and associated work as necessitated by the progress of the Works, and upon completion of the Works return them to the Overseeing Organisation.

7 Maintenance of Temporary Emergency Telephones connected onto the network shall only be undertaken by the Overseeing Organisation's Specialist Maintenance Contractor. The Contractor must allow full access arrangements to the Specialist Maintenance Contractor.

1530 Cable Ducts

1 The term cable duct is used in this Series to describe the ducts or conduits used for installing the motorway communications cable network. The ducts shall comply with this Series and any other requirements described in Appendix 15/2. The Contractor shall be responsible for ensuring that all components used within the duct are compatible with each other and with existing ducts.

2 (11/06) With the exception of ducts in transverse crossings installed using trenchless installation techniques, cable ducts shall comply with the general requirements of BS EN 50086-1 and the particular requirements of BS EN 50086-2-4. The ducts shall have a current British Board of Agrément Roads and Bridges Certificate or equivalent in accordance with Clause 104.

With the exception of ducts in transverse crossings installed using trenchless installation techniques, ducts shall be manufactured from thermoplastic material. The bore shall be smooth and even. The external surface shall be even or corrugated in the longitudinal section.

With the exception of ducts in transverse crossings installed using trenchless installation techniques, ducts shall be solid, twin or multi-walled. Non homogeneous ducts with honeycomb or foam filled construction between the inner and outer surfaces will not be permitted.

The BS EN 50086-2-4 classifications shall be "Normal duty". Ducts shall have a BS EN 60529 IP Code of IP47.

With the exception of ducts in transverse crossings installed using trenchless installation techniques and unless otherwise described in Appendix 15/2 the sizes of the ducts shall be as shown on the Drawings. These sizes are 150 mm, 100 mm and 50 mm and correspond to BS EN 50086-2-4 nominal sizes 200 mm, 125 mm and 63 mm respectively. The corresponding minimum internal diameters shall not be less than the preferred minimum inside diameters of 150 mm, 94 mm and 47 mm respectively contained in BS EN 50086-2-4, Table 101.

Ducts of 200 mm and 125 mm nominal size shall be non-coilable and supplied in straight lengths. Ducts of 63 mm nominal size may be supplied in straight lengths, on reels or coiled.

Ducts shall meet the requirements of Table 5/9 for Static friction coefficient and Resistance to point loads.

With the exception of ducts in transverse crossings installed using trenchless installation techniques, the external wall of the ducts shall be self coloured purple (black in Scotland) in accordance with National Joint Utilities Group publication "Guidelines on the positioning and colour coding of utilities' apparatus".

The ducts shall comply with any additional requirements described in Appendix 15/2.

3 (05/01) The materials from which the duct and fittings are made shall be treated so that they are protected from the deleterious effects of short term exposure to ultra violet light and shall be resistant to degradation by acids, alkalis, common chemicals, bacteria, fungi and moulds occurring in soils. The Contractor shall protect the duct and fittings on site in accordance with the suppliers' recommendations.

4 Each duct shall be fitted with a pigmented, stranded polypropylene or equivalent rot-proof material draw cord of 5kN breaking load and having a design life of not less than 20 years, the ends of which shall be made fast within the chambers to which the duct is terminated. Draw cords shall be secured to the duct plugs. Draw cords shall not be knotted within ducts; where a joint is required it shall be a spliced joint.

Ducts in Transverse Crossings

5 (11/06) Ducts in transverse crossings installed without a sleeve using directional drilling techniques conforming to the requirements of Series 8000 (MCHW 5.8.2) shall consist of four 110 mm nominal size Medium Density Polyethylene (PE 80) pipes conforming to the relevant provisions of either

BS EN 12201-2 or BS EN 13244-2 and any other requirements described in Appendix 15/2. The pipe bores shall be smooth and even.

The pipes shall be securely bundled together and installed under the crossing with a minimum cover above the duct of eight times the reamed diameter of the bored hole. Each pipe shall be tested after installation in accordance with the requirements of Clause 1533.

Lengths of pipe not installed in the bored hole shall be self coloured purple on the external wall or sleeved with a duct that is self coloured purple (black in Scotland).

The ducts shall have a current British Board of Agrément Roads and Bridges Certificate or equivalent in accordance with Clause 104.

Non-Armoured Cable Network

6 (11/06) The duct network shall be protected against the ingress of water, gas and air. This shall be achieved by the ducts having suitable joints and also plugs at the entry to all chambers. The degree of protection shall be IP47.

7 (11/06) Ducts containing motorway communications cables or power cables for motorway communications systems installed on roads other than motorways shall be clearly and permanently marked with the legend "MOTORWAY COMMUNICATIONS/POWER" in two, diametrically opposite, planes. The ducts shall be installed such that the legend is uppermost. The method of marking shall not affect the integrity of the duct. This marking is in addition to the markings required in the BS EN 50086 series. The method of marking and the durability test shall comply with the BS EN 50086 series.

8 (11/06) The Contractor shall provide and install in the end of every duct at every point of entry to chambers purpose made mechanical duct plugs in accordance with HCD Drawing Number MCX 0814.The Contractor shall provide inserts which fit into the cable ports to allow combination of cables to be installed as detailed in Appendix 15/2. Duct ends at cabinets shall be fitted with open grommets to prevent cable chaffing.

9 (11/06) Ducts shall be supplied with purpose made spacers and strapping as indicated on HCD Drawing Number MCX 0814. The strapping shall bind the ducts tightly in the specified formation during installation, backfilling and for the whole life of the duct. The spacing of the strapping shall be such that the ducts shall not separate by more than 50 mm, this spacing would typically be 1 m. The contact area between spacer and duct shall be large enough to ensure that the spacer cannot pierce the walls of the duct. The Contractor shall provide the Overseeing Organisation with details of the proposed strapping and spacer arrangement for approval at least 2 weeks prior to the installation of any ducts.

1531 Installation of Ducts

General

1 Ducts shall be laid at the level and offset shown on the Drawings and schedules. Longitudinal ducts shall generally be run parallel to the edge of the hardshoulder. Transverse ducts shall run at right angles to the carriageway. The exact location of the ducts shall be agreed on site before the commencement of any associated groundworks. Excavations shall comply with Clauses 502 and 602. Immediately following the excavation of the trench, the ducts shall be jointed and laid on the bedding material. The deviation in level from that specified at any point shall not exceed 50 mm.

2 Ducts and fittings shall be examined for damage and the joint surfaces and components shall be cleaned immediately before laying. Measures shall be taken to prevent soil or other material from entering ducts, and to anchor each duct to prevent movement before the work is complete.

Non-Armoured Cable Network

3 (05/01) Duct joints shall have the following characteristics:

(i) The joint and duct shall be free from burrs and other irregularities that may cause damage to cables when they are drawn through the duct.

(ii) The joint shall hold and maintain the ducts in axial alignment during installation and afterwards when subjected to reasonably foreseeable ground movement.

(iii) The joint shall not compromise the duct network protection of IP47.

4 (05/01) Cable duct configurations, bedding, haunching and surround shall be as shown on HCD Drawing Number MCX 0814.

5 Backfilling shall be undertaken immediately after the required operations preceding it have been completed.

6 (05/01) Trenches for the cable ducts shown on HCD Drawing Number MCX 0814 (sheets 1 and 2) shall be backfilled with Class 8 lower trench fill material, as described in Table 6/1 and in compliance with the 600 Series, which shall be placed above the surround

material. The Class 8 material shall extend to within 150 mm of ground level. The material shall be spread and compacted evenly without dislodging, disturbing or damaging the ducts. Power hammers shall not be used within 300 mm of the ducts.

7 (05/01) For ducts shown on HCD Drawing Number MCX 0814 Sheets 1 and 2 topsoiling, grass seeding and/or turfing, as described in Clauses 618 & 3005, shall be placed in the top 150 mm of the cable duct trench unless otherwise specified in Appendix 15/2.

8 (05/01) For ducts shown on HCD Drawing Number MCX 0814 Sheets 1 and 2 marker tape shall be laid within the trench excavation at a depth of 150 mm or at the Class A/topsoil interface whichever is the greater. The marker tape shall comply with Clause 1511.

Armoured Cable Network

9 (11/03) Ducts shall be provided for cables that are laid across or within 500 mm of filter drains. The ducts shall be surrounded with 150 mm of ST2 concrete in compliance with Clause 2602. In the event that a cable route coincides with the line of a filter drain an alternative trench line shall be determined. Any damage caused by the Contractor to any drain shall be satisfactorily repaired and reinstated at no cost to the Employer.

1532 Chambers for Motorway Communications Cables

1 (05/01) Chambers shall be either Type A, B or C as shown on HCD Drawing Number MCX 0815. These chambers are rectangular in plan and have a standard plan size. Where designated as Joint Chambers, chambers Type A shall be fitted out with cable supports as detailed on HCD Drawing Number MCX 0815. Chambers shall be as detailed in the schedule in Appendix 15/2. Chambers shall be constructed so that their covers are raised 50 mm above the level of the adjacent ground.

2 Chambers shall be used solely for motorway communications cables.

3 The exact location of these chambers shall be agreed with the Overseeing Organisation on site prior to the commencement of any excavation works. Failure to do so may result in abortive work.

4 (11/03) Foundations to chambers shall be of ST4 concrete in accordance with Clause 2602.

5 Brickwork shall comply with the 2400 Series and be built with mortar designation (i) in English bond. The joints of brickwork where exposed shall be finished as specified for unpointed joints in Clause 2412. The ends of all ducts shall be neatly built into the brickwork and finished flush with mortar designation (i).

6 (11/04) Precast concrete chambers shall comply with BS 5911-3 and BS EN 1917. Cast in situ chambers shall be constructed of ST4 concrete complying with Clause 2602 unless otherwise described in Appendix 15/2.

7 (11/04) Chambers not exceeding 1.3 metres in depth to invert, may be constructed from complete plastic units or other units in equivalent material. Where the units do not meet the loading requirements of BS 5911-3 and BS EN 1917, they shall be surrounded by 150 mm of ST4 concrete.

8 (11/04) Where the depth of invert of chambers exceeds 900 mm below the finished surface of the carriageway or the adjacent ground, manhole steps complying with BS EN 13101 shall be built in as specified in BS EN 1917. Steelwork fittings shall comply with BS 970 : Part 1 and be galvanised in compliance with Clause 1909 after fabrication. Threaded components shall be galvanised in compliance with Clause 1909.

9 (11/03) Excavation around chambers, shall be backfilled with general fill materials as described in Table 6/1 and compacted in compliance with Clause 612. Where mechanical compaction is impracticable, the excavation shall be backfilled with ST2 concrete complying with Clause 2602. Where there are precast concrete access shafts to precast concrete chambers, the shafts shall be surrounded by a minimum thickness of 150 mm of ST4 concrete, and the remaining excavation backfilled with general fill material as described in Table 6/1 compacted in compliance with Clause 612.

10 (05/01) Chamber covers, gratings and frames shall be as described in Appendix 15/2 and shall comply with BS EN 124. Triangular covers shall be hinged. Chamber cover bolts shall comply with BS 4190 : 1967 and be galvanised in compliance with Clause 1909. Requirements for special duty covers for use in carriageways shall be as described in Appendix 15/2.

11 Four sets of lifting keys as described in Appendix 15/2 shall be delivered to the Overseeing Organisation for each type of cover supplied. Additionally, a suitable cover lifter shall be delivered to the Overseeing Organisation where the mass of an individual cover exceeds the value in Appendix 15/2.

12 Frames for chamber covers gratings shall be set in cement mortar designation (i) complying with Clause 2404 or a suitable proprietary quick setting mortar of equivalent strength.

13 (05/01) Chambers shall be constructed with a sump as shown on HCD Drawing Number MCX 0815. Chambers shall be constructed with a soakaway or connected to the highway drainage network where detailed in Appendix 15/2.

14 (05/01) Chambers shall be clearly identified by the legend "MOTORWAY COMMUNICATIONS", the lettering shall be 25 mm high and shall be embossed into each cover. Where covers have a concrete infill a plate manufactured from a non-corrodible metal or steel, galvanised in accordance with Clause 1909, shall be cast into the concrete flush with the concrete surface.

15 (11/06) The marker post reference of the chamber (eg 1234A) and the chamber reference number shall be stamped, in letters 50 mm high, in a concrete block cast immediately adjacent to the cover or cast and raised in aluminium riveted to the chamber cover. The concrete shall have a steel float finish applied prior to the stamping. Except for communication jointing chambers, chambers that are within 5 metres of cabinets do not require this referencing. This dimension shall be measured from the chamber cover frame to the nearest cabinet. Communication jointing chambers shall always be referenced.

1533 Proving and Testing of Ducts

1 (11/06) Longitudinal and cross carriageway cable ducts shall be proved by drawing a wooden or plastic mandrel, as shown on HCD Drawing I2, through as the ducts are laid. Local ducts from chambers to cabinets shall be proved by drawing through each completed length of duct a spherical mandrel of a diameter 10% less than the nominal bore of the duct. On the successful completion of each pull the Contractor shall certify compliance of the duct and immediately plug the duct in accordance with sub-Clause 1530.8.

2 (11/06) Longitudinal and cross carriageway cable ducts shall be tested in chamber-to-chamber sections by means of the air test described in sub-Clause 3 of this Clause. On the successful completion of each test the Contractor shall certify compliance of the duct and immediately plug the duct in accordance with sub-Clause 1530.8.

3 To undertake the test, air shall be pumped in by suitable means until a stable pressure of 100 mm head of water is indicated in a U-tube connected to the system. The air pressure shall not fall to less than 75 mm head of water during a period of 5 minutes without further pumping, after an initial period to allow for stabilization.

4 A register of mandrel and air test certificates shall be maintained by the Contractor and handed to the Overseeing Organisation on the successful completion of the ducting work.

1534 Closed Circuit Television

1 Closed circuit television (CCTV) shall be as described in Appendix 15/1.