SERIES 1100

CABLING AND NETWORK ACTIVATION

Contents

1101 General Requirements

1 The Employer shall supply the following materials through central stores, operated by the Engineer:

Cable Installation

(i) Fibre Optic Cables - internal and external;
(ii) Coaxial Cables - internal and external;
(iii) Telephony Cables - internal and external;
(iv) Fibre Optic Cables - Blown

Joints, Splices and Terminations

(v) Fusion Splice Protectors;
(vi) Fibre Closure;
(vii) Coaxial Connector;
(viii) Coaxial Joint Housing;
(ix) Distribution taps, termination strips;
(x) All backboard materials;
(xi) Copper Connectors;
(xii) Micro-bore Sub-duct and associated connectors (All types)

2 The Contractor shall supply all other materials, including those listed below.

Cable Installation

(i) Sub Duct (Standard);
(ii) Proprietary Gas and Water Duct Seals (Standard Sub-duct).

3 The Employer reserves the right to specify the manufacturer of, and inspect, any materials used during the execution of works. Any materials found to be damaged or not in accordance with the Specification shall be rejected at no cost to the Employer. Any free issued materials found to be damaged will be re-charged to the Contractor.

4 All Works shall be carried out in accordance with the drawings and method statement issued for the installation. No deviation from this will be allowed unless confirmed in writing by the Engineer.

5 It is the Contractor's responsibility to detect and avoid all existing services and plant. This is to be carried out prior to any work taking place. The Contractor shall be held liable for any damage, and costs incurred therein, to existing services, utilities and plant.

1102 Installation of Fibre, Copper and Coaxial Cables and Sub-Duct - General

Duct Allocation

1 The allocation of cable types, Sub-duct (standard) or micro-bore sub-duct to ducts shall have been determined prior to cabling works commencing, and shall depend on whether a fibre route is involved. In a standard footway, the preferred layouts are illustrated in Figures 0-1, 0-2 and 0-3.

2 When changing direction at a road crossing or street corner, the same relation should be maintained particularly in regard to duct levels. However, a change from left to right bore may be beneficial to bend radii. The Contractor shall confirm with the Engineer whether any on-site changes are allowable.

3 Drop cable needs to enter and leave a chamber by the same duct.

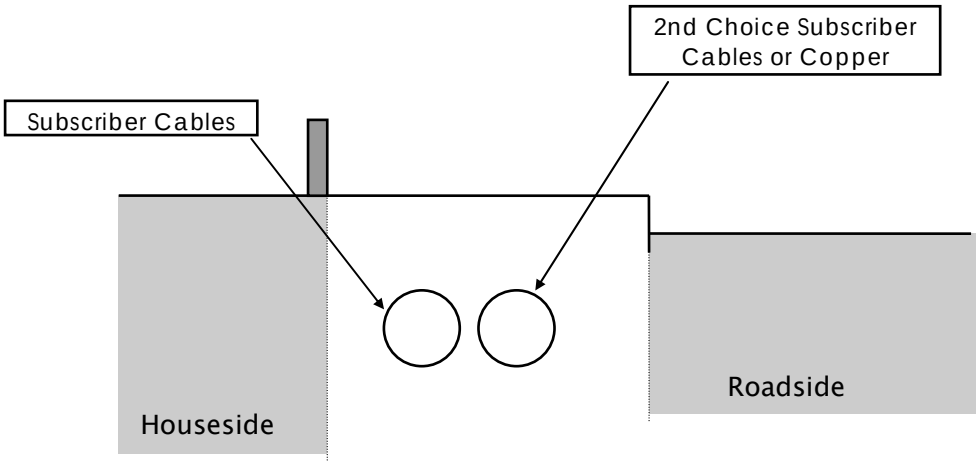

Figure 0 - 1: Two Way Duct

1102 Installation Of Fibre, Copper And Coaxial Cables And Sub-Duct - General (.... contd.)

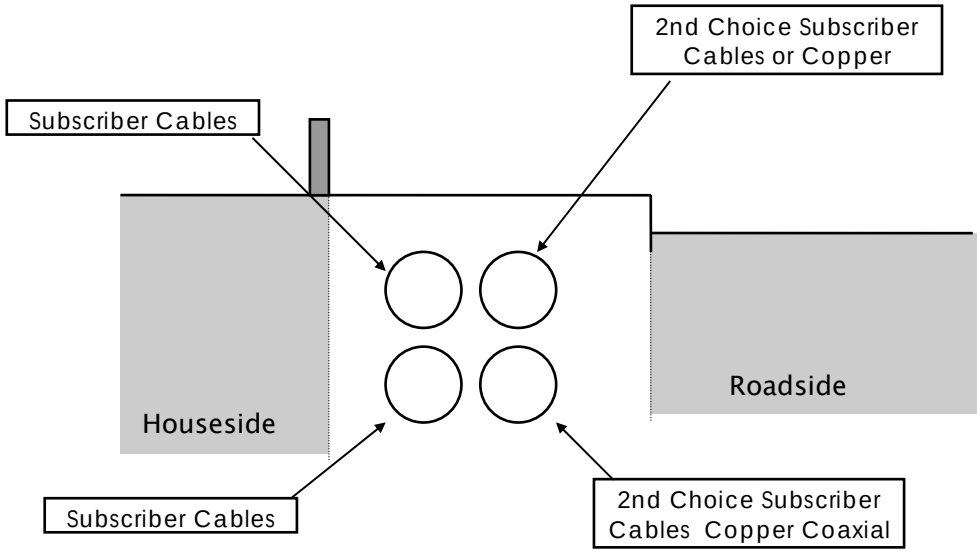

Figure 0 - 2: Four Way Duct

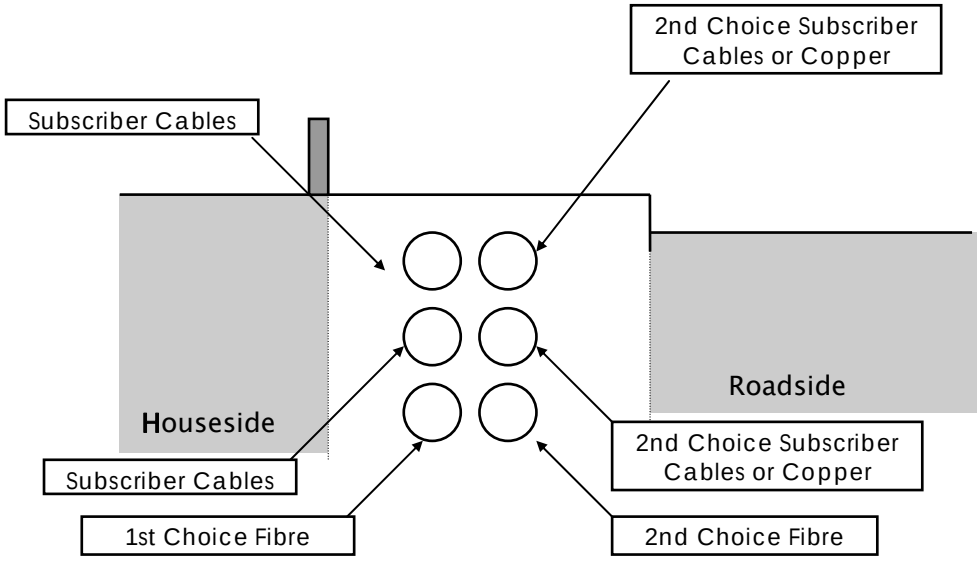

Figure 0 - 3: Six (or more) Way Duct

1103 General Preparatory Works for Cable Pulling

General

1 Clauses 1104 to 1108 (inclusive) of the Specification give detailed guidance as to the pulling-in of cables (excluding Blown Fibre Cable). As preparatory guidance, the following procedure should be noted:

(i) The Contractor shall, at a reasonable time before commencement of any part of the works, carry out a survey of the proposed route in order to ensure that the route is accessible and available, in line with the proposed Works programme. The survey should also note the position of all cabinets and chambers in order to ensure their compliance with the information provided in the Works Package issued by the Engineer.

(ii) The Contractor shall measure, using a calibrated measuring wheel, all lengths of track within a given area to compare as built lengths with planned lengths. Any discrepancies greater than 10% will be reported to the Engineer. The Contractor shall then liaise with the Engineer to ensure any problems are solved in accordance with this specification and current procedures.

(iii) Drum positions for cable laying shall be determined during the route survey. During the survey the Contractor should establish the accessibility and availability of the proposed drum locations in accordance with the proposed Works programme. The cable drum shall be transported as near to the setting-up point as possible without rolling. If rolling is necessary the drum shall be rolled only to tighten the cable onto the drum.

(iv) Where cables are to be installed in shared routes, all reasonable precautions must be taken to prevent damage to existing cables or fragile structures within those routes.

(v) The Contractor shall complete a visual check of all cables delivered to site prior to their utilisation in cabling operations. Any defects discovered following Contractor inspection shall immediately be reported to the Engineer. All visually defective cable will remain unused, and will be dealt with as directed by the Engineer.

(vi) All cable must be placed in a suitable store prior to use. Consideration should be given to both security and environmental conditions. Suitable protective caps must be fitted to the exposed ends of each cable. These must not be removed until the cable is required.

(vii) The cable drum shall be positioned in such a way that the cable leaves the drum and enters the duct line in a smooth, continuous curve and that minimum bending or flexing to the cable occurs. The Contractor should ensure that an operative remains with the drum at all times during installation. The cable drum operative shall be in constant communication with all operatives engaged in the Works at all times.

(viii) Cables are to be kept as straight as possible, with bending kept to a minimum. Under no circumstances must the cable be curved tighter than the cable manufacturers stated minimum bend radius.

(ix) Cable guides are to be used at all suitable positions. The pulling of cables shall ensure movement is smooth and continuous, with all cables lubricated to reduce pulling tensions.

(x) Cables must be laid on ground sheets when fleeting them, grit and other substances must not be allowed to attach to the cable which will result in damage.

(xi) The cabling rope shall be marked to allow awareness of when the cable will exit the duct mouth.

(xii) The pulling of cable shall be undertaken in the easiest direction, taking into account the gradient of the duct and presence of bends. Bends near the drum end produce a smaller increase in pulling tension than bends near the pulling end.

Preparation and Sealing of Cable Ends

2 The preparation of cable ends and the means of attaching the cabling rope are summarised in Clauses 1103(3) and 1103(4) of the Specification. Cable ends are sealed prior to and after cabling operations. It is important to do this to prevent the water entry during all operational stages.

Fitting of Pulling Devices

3 Cable Grip and Splice - A spike with a diameter of approximately one half of that of the cable is selected. The spike is driven into the end of the cable until it is flush with the end of the conductors. The spike is driven a further 25cm into the cable with a drift. The conductors are folded into the hole left by the withdrawal of the drift using the point of a spare spike. Finally the end of the cable sheath is sealed.

4 A grip with a diameter slightly smaller than the diameter of the cable is selected this is put over the end of the cable and worked up as far as it will go. When the grip has been pushed right home, the end of the grip is taped back to encourage it to grip the cable when pulling tension is applied.

Cable Guides

5 Cable Guides are used to lead cables or ropes where required, or where specifically instructed by the Engineer. The cable guide also protects the cable or rope from sharp edges and corners and protects duct edges when cabling. Table 1 gives guidance as to the choice and suitability of cable guides.

6 The bending of cables during cabling must be kept to a minimum, particularly where the cables are coaxial or optical fibres. Suitable cable guides shall be used to prevent cables being drawn over sharp edges of manholes, duct mouths or other projections that will cause damage to the sheath of the cable.

Cable Trailers and Jacks

7 Where used, a cable trailer shall be positioned on the carriageway or footpath as near to the manhole as possible. A cable guide shall be secured to the trailer using a chain or a length of draw rope.

8 In exceptional cases, it may be necessary to use cable jacks when the drum size or site conditions prohibit the use of a cable trailer.

9 The drum shall be positioned as close to the manhole as possible and in line with the duct. The cable shall be led from the top of the drum, vertically down into the cable guide. Particular care must be taken when cable jacks are used, as they are less stable than cable trailers. When cable jacks are in use the cable shall be drawn in at a slower rate.

Use of Winches

10 The winch shall be inspected and tested before any cabling is undertaken. The engine shall be started, the capstan drive engaged and the emergency stop operated. Where the capstan fails to engage, or the emergency stop control does not remain in the operated position, the inspection test shall be deemed to have failed. Where failure occurs, Works cannot recommence until repairs have been made and with the approval of the Engineer.

11 When the Engineer has been satisfied that the winch is in good working condition, cabling can proceed. The winch shall be positioned coincident with the proposed line of pull. The handbrake shall be applied and where the winch needs to be anchored, any ropes or chains used shall be attached to the tie back shackles where fitted and pre-tensioned to minimise any movement of the winch under load.

Cable Guides	Use
No. 1	For cabling in 90mm straight bore ducts. To protect cable from duct and box edges during cabling operations. Secured in the duct by clamp screws.
No. 2	To protect cable entering or leaving 90mm ducts that are not in line through jointing chambers. The angular deviation must b less than 30º. Secured in the duct by clamp screws.
No. 4a	To extend the duct entry to the cable-drum trailer. Secured to the cable drum trailer with chains provided. Each guide is 3m long. More than one may be used as necessary.
No. 5	To guide light ropes and cables over joint box edges at the winch end. Use with a Clamp Guide No. 2a.
No. 6a & 6b	For heavy cabling. Used with Bellmouth 1A to extend the duct entry to the cable-drum trailer. A number of these guides may be connected together. Connected to the trailer with a length of draw rope. Bore: 3½". Length 6a: 5', 6B: 10'
No. 12	To turn cables of less than 78mm dia. in manholes to give an angular deviation of up to 135º to give an angular deviation of up to 135º degrees in the horizontal plane. A wheel is supported in an adjustable framework.
No. 13a	To turn cables of less than 32mm in diameter in surface boxes to give an angular deviation of about 90º in the horizontal plane. A wheel is supported in an "A" frame with an adjustable clamp.
No. 14	To turn cables of less than 78mm diameter in manholes and chambers where anchor points are provided and to give an angular deviation of up to 135º. Can be used horizontally but is intended for use vertically to allow cable to be pulled smoothly in to position.
No. 15	To guide small cables (not fibre optic) and cabling ropes over manhole edges.
No. 16a	For use with fibre optic cables. A lightweight turning wheel. May be used horizontally or vertically.
No. 17a	To guide steel wire rope into or out of the duct mouth. May also be used with other cabling ropes.
Rollers Rope Guiding Surface Type	Used to guide drawropes and cabling ropes out of jointing chamber entrances to prevent damage to the rope. Consists of a metal roller mounted on a frame, which has two lugs for location.

Table - 1: Cable Guides

12 The jacks shall be lowered and firmly screwed down. Where necessary, on uneven surfaces or to prevent damage to the pavement or carriageway, wooden packing pieces shall be used.

13 Once the winch and any necessary cable guides are sited, the draw rope or cabling rope shall be wound around the capstan starting at the inner end and working out. The hand held end of the rope must always leave from the top of the capstan. Two people shall operate at the winch end. The second person shall safeguard the winch-person from any interruptions. The second person must ensure that there is no build-up of discarded rope around the winch-persons' feet during cabling operations. It is the winch-persons' duty to operate the winch and maintain a steady tension during the pull.

14 It is usually necessary for only one person to feed the cable from the trailer into the duct. Two men are to be used if "figure of eighting" is necessary or cable jacks are used. Once cabling has commenced and the cable is under tension, no person shall go near the rope or into the chamber under any circumstances. If difficulties arise, i.e. the rope jams, the tension must be released before any attempt is made to remedy the situation. Communication between the winch end and cable end must be established. The use of hand held radios would generally achieve this.

15 To keep pulling tensions to a minimum, cables are lubricated when being drawn in. When both ends are ready to begin cabling, the winch shall be started, the capstan engaged and the engine speed increased as necessary. It must be ensured that the capstan speed is constant and that the rope is drawn off the capstan. To stop winching at the end of a pull, the hand tension on the rope is released, the capstan drive is disengaged and the engine stopped.

1104 General Preparatory Works for Micro-bore Sub-duct Installation into existing duct lines

1 Micro-bore sub-duct shall be installed in strict accordance with the Virgin Media document: **NSH3150 – Micro Bore Sub-duct and Blown Fibre Cable Planning and Installation Guide.**

1105 Installation of Coax And Copper Cables

1 Multiple pulls are allowed only at the discretion of the Engineer. Following approval by the Engineer, Coax and Copper cables may be pulled together, but the practicality will depend on the tightness of the ducts. Copper and Coax Cables are pulled using a metal sock, which is taped with insulation tape between the sock and cable at the same time.

2 In addition to the cable being pulled, a draw rope shall be provided for future use either during or after the installation of the cable.

3 During cable installation care should be taken to ensure the ducts and chambers remain free from the ingress of all foreign matter.

4 The bending radius of any cable shall never be less than the minimum recommended by the cable manufacturer. Cable minimum bending radii data is available on request.

5 To prevent over-stress where a bend occurs on a duct run, the cables shall enter the duct at the end nearest to the bend. A bell-mouth must be used at all duct entries.

6 All cables shall be kink free and twist free at all times. Any cables found to be kinked, twisted or damaged before, during or after pulling shall be rejected and replaced at the Contractor's cost.

7 The maximum permissible longitudinal pulling tension for each type and size of cable shall not exceed the cable manufacturer's data. A mechanical fuse shall be used to ensure that this is complied with.

8 To reduce friction during pulling operations the Contractor must use a friction reducing lubricant approved by the Engineer. Cable pulling shall be executed without causing damage to the cable, it's sheath, the ducts or the chamber. A bell mouth shall be used at all times.

9 The Contractor shall submit details of the equipment he proposes to use, together with a method statement for the different cable types and situations.

10 All Coax and Copper Cables are put into top, outside ducts, unless instructed by the Engineer or by details provided in the issued Works Packages.

11 At each cabinet a cable loop, normally the size of the cabinet pit, is left to allow for any possible vehicle collision with cabinet.

12 At each turning chamber a loop of cable is left. Should there be more than one cable, the cables are looped together with cable ties, or passed through the cable management system where fitted.

13 Unless deemed otherwise by the Engineer cables must be labelled in cabinets and chambers, and at regular intervals on the duct network where internal cable routes are employed. Hellerman type collets with cable straps are currently being used in the following colour coded fashion:

Copper	*W*hite with numbers or letters in black.
Coax	Yellow with numbers or letters in black.
Fibre Optic	Refer to document s008 – Identification and Labelling Virgin Media Fibre Optic cable system (Appendix 06G). (also relevant for Blown Cable)

1106 Installation of Fibre Optics

General

1 Fire Optic cables (Standard and Blown) are less robust than metallic cables and are required, for transmission purposes, to be installed in the longest lengths possible.

2 Cables shall be removed from the drum with the drum in a vertical position without the cable being drawn across the drum flange. Precautions should be taken to prevent the cable kinking, ravelling or twisting, and to prevent excessive abrasion, crushing, bending or tensile loads, in accordance with the information provided by the cable manufacturer.

3 The bending radius of any cable shall never be less than the minimum recommended by the cable manufacturers. Cable minimum bending radii data is available on request.

4 Standard Fibre Optic cables are installed in a similar manner to copper and coax cables and thus points 1105(1) - 1105(13) apply. However, additional precautions must be taken.

5 Blown Fibre Optic cables shall be installed in strict accordance with the Virgin Media document: **NSH3150 – Micro Bore Sub-duct and Blown Fibre Cable Planning and Installation Guide.**

Standard Fibre Optic Cable with Steel Central Strength Members

6 Fibre Optic cables (FOC) with steel central strength members are connected to the cable bonded rope by a fitted swivel connector. A mechanical fuse shall be used to ensure that the manufacturer's recommended tensile loads are not exceeded. The type of cable grip used shall be of the correct type for the cable being installed. The cable end should remain sealed at all times during its installation to prevent the ingress of water and other contaminants.

7 The cable is prepared by ensuring the plastic coating is removed from the strength member. The strength member is wrapped with plastic adhesive tape before it is cut with bolt cutters. The cable butt is inserted in the lower body section of the connector using the appropriate collets {see 1105(13)}. There are four collet sizes 2.3 mm, 3 mm, 4 and 5 mm and it is essential that the correct one is used.

8 The cable strength member must be slightly proud (at least 2 mm) of the inner face of the collet. The "0" ring and its mating face are checked for position and cleanliness. The spring is inserted and the middle body tightened on to the lower body section.

9 The washers and bearings are cleaned and re-greased, and the swivel section assembled to the lower and middle body. The appropriate fuse is inserted, having been aligned with the marks on stub and bush. The cable is sealed to the connector with a 100mm length of 37/12 shrink down material using standard procedure.

Standard Fibre Optic Cable without Steel Central Strength Members

10 FOC's without steel central strength members are fitted with a suitable grip and connected to the cable bond rope by a connector swivel. The connector shall contain a mechanical fuse to ensure that the manufacturer's recommended tensile loads are not exceeded

11 A lightweight turning wheel guide is used when, due to the length of cable to be pulled, there are a large number of turning situations. The guide is designed to handle cables up to 25 mm in diameter, any number of guides can be used on a pull.

1107 Intermediate Chambers

1 Due to excessive lengths of cables to be pulled it is normal practice to select an intermediate chamber. The cable remaining on the drum is removed and laid out on a tarpaulin layer in a figure of eight formation having dimensions of approximately 3 x 6 metres. A diamond shape is formed at the cross over point to ensure the weight is not concentrated at one point. The remaining cable is drawn into the cable route in the other direction.

1108 Lubricants and other Precautionary Measures

1 Fibre cable should only be pulled on a cable bonded rope in order to reduce friction. To further reduce friction a lubricant is used.

2 At the duct entrance a bell-mouth is used to avoid any rubbing on the edges of the duct.

3 When turning from one duct to another in a chamber a cable guide is used at the re-entry duct to avoid damage to the cable at the edges of the duct.

1109 Sub-Ducting (Standard)

1 Standard Sub Ducting shall be treated as cable when installed.

Installation

2 In all instances sub-ducts should only be positioned in the bore allocated by the duct allocation schedule. If during any part of the cabling operation this information is unsure or questionable, the Engineer, or his appointed representative, should be contacted to give a decision.

3 Within the Civils Works, the Contractor will have brushed and mandrelled to test all the main ducts and rodded to install a draw rope in every duct thereafter. A draw rope shall be provided for future use either during or after the installation of the sub-duct.

4 The outside of the sub-duct shall be lubricated during installation. Duct lubricants shall be applied using the appropriate applicator for the sub-duct being used. The lubrication pump and the applicator shall be set up in accordance with the flexible guide used to protect the sub-duct at the draw pit, where the sub-duct drum is set up.

5 The sub-duct drum and winch shall be aligned and secured in a safe and satisfactory manner. Snatch blocks and installation wheels shall only be attached to anchor irons in draw pits to aid the pulling operation where approved by the Engineer. The winch rope shall be attached to the sub-duct pulling grips using a non-fused connector.

6 Sub-duct pulling shall be at a steady, smooth rate. The operators of the take-up winch and pay-off drum shall be in continuous communication, so that speed control and emergency stopping are instantly possible.

7 Bell mouths will be used at all duct entry points, including intermediate draw pits/turning boxes, in order to avoid any damage or undue stressing of the sub-duct, and to reduce pulling tensions in general.

Jointing and Setting Back

8 Allowances should be made for any expected draw back of sub-duct subsequent to pulling. The sub-duct shall be cut back square at the ends using the correct tool for the size of the sub-duct, the work being done at draw pits, turning boxes or other access points.

9 The ends of the draw ropes are to be joined using acceptable rope splicing methods and the bores of the sub-ducts shall be chamfered using the correct chamfering tool for the size of the sub-duct.

10 The prepared sub-duct shall be joined together using a sub-duct in-line connector of the correct type for the sub-duct being used. The connector shall be wrapped with approved adhesive tape to cover screws and sharp projections prior to installing a wrap round, heat shrinkable sealing sleeve, over the in-line connector and the ends of the sub-duct. Preparatory works shall be completed in accordance with the manufacturer's recommended installation instructions.

11 Using standard cable bearers, sub-ducting should be dressed directly between duct mouths and not around pits, unless it is essential to maintain standing space, and then only if the cable pulling is unlikely to be adversely affected by the additional bends that may result. In these instances, approval by the Engineer should be firstly sought. It is recommended that the setting back operation is carried out once the cable pulling operation is complete. This will ensure that the sub-duct is as straight as possible during the subsequent cable pulling operation.

Sub-duct Cable Lubrication Tees

12 Lubrication tees shall be installed in the sub-duct at a draw pit, or jointing box, immediately preceding an area of expected difficulty. The sub-duct shall be prepared as for an in-line connector, and the split type of lubrication connector shall be used. Once the cable pulling is completed, the lubrication tee shall be replaced with a normal in-line connector, as described in Clause 1109(10) of the Specification.

1110 Termination of Coaxial Cables

1 Coax cables are to be labelled just above the top of the relevant entry duct. The cables will normally be cut about halfway up the height of the cabinet.

2 A "Heat-shrink" sleeve is slid over the first cable to be connected, and the cable is prepared using the appropriate coring tool. The centre core of the coax should be cleaned of any surplus dielectric by using a piece of perspex to avoid any damage to the copper coating on the centre core.

3 Following coring a connector is attached, whilst ensuring all joints are tight to avoid any water damage. The "Heat-shrink" joint should finally be pulled over the connector so that it overlaps both ends of the joint.

4 Following connection the cable should be secured to the cable management bracket with tie wraps.

5 Where several cables of larger diameter (eg. QR860) are terminated, the cutting position for attachment of connectors should be varied to allow easy access to connectors for tightening, and to reduce "bunching" of joints.

1111 Termination of Copper Cables

1 Following termination at each cabinet location, the cable will be tested for continuity and identification back at the MUX.

2 Copper cables generally enter the cabinet using the duct nearest to the termination frame and are labelled at a point between top of entry duct and bottom of termination frame.

3 The first termination position is identified and surplus cable is cut away. Usually, between 600 and 1000mm of outer casing is removed depending on the cabinet layout. The outer

sheathing and insulation paper is removed, the excess protective jelly is wiped off and the cable fixed to the termination frame.

4 Individual units are identified by coloured whipping in sequence:

Unit 1	Blue	*Unit 6*	White
Unit 2	Orange	*Unit 7*	Red
Unit 3	Green	*Unit 8*	Black
Unit 4	Brown	*Unit 9*	Yellow
Unit 5	Grey	*Unit 10*	Violet

5 An appropriate outrigger is fitted to the frame, at the first termination position to ensure sufficient termination lengths. The coloured whipping is tied back around the unit, inserted through the fixing slot on the connector block.

Pairs are then laid into connection slots using following colour code:-

Pair 1	White Blue	*Pair 6*	Red Blue
Pair 2	White Orange	*Pair 7*	Red Orange
Pair 3	White Green	*Pair 8*	Red Green
Pair 4	White Brown	*Pair 9*	Red Brown
Pair 5	White Grey	*Pair 10*	Red Grey

6 Terminations are made using the correct insertion tool for connection strip, ie. Krone strip/pouyet, sid etc.

7 Spare pairs are tied neatly in units and fixed behind termination strips. In all cases at least 100 mm of slack must be dressed neatly behind each termination to allow for re-termination when necessary.

8 On completion of termination entry ducts are sealed. Completed pairs are looped and earth tested between termination positions, using a loop test on a multimeter.

9 Covers on front of connection strips are attached and labelled for each DA, DP and MUX. The labels in the MUX should go top to bottom and the DA and DP should run bottom to top.

1112 Blown Fibre Optic Cable Installation

1 Blown Fibre Optic cables shall be installed in strict accordance with the Virgin Media document: **NSH3150 – Micro Bore Sub-duct and Blown Fibre Cable Planning and Installation Guide.**

1113 Fibre Optic Jointing And Termination

Installation

1 The main fibre ring route consists of Fibre Optic cables laid from the Head end or Hub Site passing each relevant node site in its ring and returning to the Headend or Hub via a diverse route.

Cable Length

2 Fibre Optic cables will normally be installed in engineered lengths of between 1 & 4 km, and wherever possible splices will be planned within the same range, leaving a minimum of 15m per cable end for splicing and positioning of cable. Deviations of above and below 5% of the planned length must be reported to the Engineer or his appointed Representative and detailed on the Contractors weekly report.

3 A minimum of 15 metres of spare cable shall be left in the associated draw chamber/manhole, with all spare cables being tied and sat in an organised manner and supported by any chamber ironwork when fitted so that future cabling operations are not impeded.

Fibre Text Tool

4 The Contractor shall ensure that all operatives strictly adhere to the fibre text tool process. This is as defined in document no. CNFS012 entitled: NMC Text RTU (Real Time Update) Process & Portal.

5 The process requires the operative to submit a text message prior to commencing works and again when works are completed. This information is then stored on a portal in order to identify where works are taking place on the fibre network.

6 This is an essential tool that helps to ensure that Virgin Media are aware of any works that are taking place to the fibre network, and enables a swift response to be made to any fault situation that may occur as a result of any works.

Safety

7 Safety is of prime importance in handling and splicing of fibres. No work should be commenced by operatives who are not familiar with the procedures to be adopted for avoiding the dangers associated with fibre cables. A hazard data sheet will be required for any substances covered by the special regulations referred to in C.O.S.H.H. Further reference to this requirement can be found in Code of Practice for the Installation of Fibre Optic Cabling.

Cleanliness

8 The optical and mechanical performance of a splice and its service life can be adversely affected by contamination with dirt and solvent residues. The working practices adopted should result in a clean environment. The Contractor shall ensure that the working area remains clean and uncontaminated, with any solvents utilised during the splicing process removed from the working area.

Cable Preparation

9 The coating used depends on the fibre source and the purpose for which the fibre is intended to be used. It is therefore necessary to check the set up and performance of the primary coating removal tool, on a sample of the fibre before commencing the full splice procedure.

10 The secondary coating jacket is to be cut back to the required length using suitable tooling. The length of the protective tubes and the length of the cleaved fibres shall be to suit the requirements of the splice closure being used.

Fibre Preparation

11 After removing the fibre coating any grease filling compound is to be removed using an approved cleaning gel. The primary coating should then be stripped for the length required to suit the fibre cleaver in use.

12 Cleaving should only be carried out using a good quality cleaver, approved by the Engineer. Cleaved end angles will be checked by the Engineer to ensure that these are less than one degree.

Fibre Colour Coding

13 Eight fibre per tube:
1 - blue, 2 – orange, 3 – green, 4 – red, 5 – grey/slate, 6 – yellow, 7 – brown, 8 – violet.

Twelve fibre per tube:
1 – blue, 2 – orange, 3 – green, 4 – brown, 5 – grey/slate, 6 – white, 7 – red, 8 – black, 9 – yellow, 10 – violet, 11 – pink, 12 – aqua/turquoise.

Blown Fibre Cable Twelve Fibre per tube: colour coding is in accordance with Virgin Media document: **NSH1520.4 Product Specification for Blown Cable**:
1 - blue, 2 – orange, 3 – green, 4 - brown, 5 - grey, 6 – yellow, 7- red, 8 – violet, 9 – white, 10 – black, 11 – aqua, 12 - pink

Fusion Splicing

14 The fusion splicer must be of good quality and approved by the Engineer. The Contractor shall carry out a test splice using sample pieces of the fibre to be used before completing the actual splice. The fusion splicer manufacturer's instructions should be carefully followed at all times, although it is essential that operatives are well trained and follow good working practices.

15 The splice should be encapsulated using splice protectors so that the bare fibre is at least 10 mm inside the protector. Further information can be found in the fibre closure package.

16 If during the splicing operation a splice is detected with unacceptable attenuation it shall be left and the next splice attempted. If this also exhibits high attenuation then the cleaver and /or fusion-splicing machine must be checked and adjusted as necessary. If the subsequent splice is acceptable then the high attenuation splices shall be broken down and re-spliced. A splice may be re-made a maximum of three times. If after splicing, no improvement is achieved the results shall be reported to the Engineer.

Fibre Optic Closure

17 The optical cable should enter the closure through suitable glands. The gland should ensure the environmental performance, provide cable support and prevent kinking at the face of the closure and provide strain relief.

18 On completion of the splices, encapsulation and placement in the closure, the whole unit is to be mounted, restrained and each business fibre clearly labelled. The coiled cable is to be carefully and tidily positioned in the splice chamber, on the brackets and bearers supplied.

19 Following jointing or termination, the optical fibre elements should be arranged to allow access to individual connectors, joints and elements, with minimal disruption to neighbouring components during subsequent repair, expansion or extension of the installed cabling.

1114 Backboards

General

1 Unless otherwise required by the Engineer, the Contractor shall take delivery of all backboard materials, construct the backboards off-site, deliver to site, fit backboards and commission.

2 Unless expressly required otherwise by the Engineer, backboards shall be configured substantially in the format given in the Works package.

Obtaining Equipment

3 The backboard equipment is supplied to the Contractor by the Engineer, by way of central Stores issue. The exact issue process shall be agreed with the Engineer.

Assembling and Testing Equipment

4 The Engineer shall verify that the equipment has been assembled onto the backboard correctly. At this stage, backboards are checked for continuity on all leads to ensure there is no shorting of the equipment, that the Reverse Amplifier is fitted, all connections are tightened to the correct torque, all terminators are greased and tightened to the correct torque and that the Board is in a neat condition.

5 Once all criteria is covered a ‘Pass Sticker’ shall be placed on the board with the initials of the Engineer, or his appointed representative, and dated. At this stage, the Engineer, or his appointed representative may fail the backboard construction, and shall place a ‘Fail Sticker’ on the Board, again initialled and dated, and the Engineer will inform the Contractor in writing of any remedial work required. The Contractor shall rectify the backboard, and the inspection process repeated until successful passing.

Backboard Fitting

6 Once the Engineer, or his appointed representative is satisfied with the backboards, the backboards can be transported to the appropriate Cabinet locations.

7 Unless otherwise instructed by the Engineer the Project No. and Cabinet No. should be affixed to both the backboard and the outside of the Cabinet. The Project No. and Cabinet No. (sticky backed letters and numbers) are issued with the drawings accompanying the Work Packages.

Power Boards

8 Materials equipment and workmanship shall comply with BS 7671 Regulations for Electrical Installations (IEE Wiring Regulations), the Electricity at Work and the Rules and Regulations of the Electricity Supplier who provides the supply. All materials will be provided by the Employer.

9 Whilst there are regional variations in the layouts and precise make up of the Powerboards, the components to be fitted to them will generally be comprised by a Fused Cut-out, a Residual Current Device (RCD), and a Consumer Unit incorporating Miniature Circuit Breakers (MCBs). All components are to be fixed in accordance with Manufacturers instructions using corrosion resistant fixings.

10 The Contractor shall carry out the inspection and testing of electrical installations and provide Inspection and Completion Certificates to the Engineer in accordance with BS7671 (IEE Wiring Regulations).

11 All testing shall be carried out to the satisfaction of the Engineer using test equipment approved by the Engineer.

12 The Contractor shall ensure that enclosures, following drilling, cutting or removal of cable entry knockouts, are cleaned of all waste and surplus material prior to any further work being undertaken.

1115 Testing And Commissioning

Commissioning

1 The Contractor shall use Time Domain Reflectometer (TDR) testing for all cables, which shall be used to confirm:

(i) Length of cables - this may also be used for the purposes of measurement for payments (in this instance calculated lengths will need to be reduced to take account of spare cable at chambers and cabinets).

(ii) Destination and Continuity.

2 Once cables are connected to cabinet equipment, power supplies will be fitted and installed (by others), and the line voltage to the Amplifiers connected and allowed to warm up for a period of not less than 24 hours, prior to any adjustment to the Amplifiers' levels.

3 The Contractor shall power up the optical RX equipment only after the Engineer has approved the Optical Time Domain Reflectometer (OTDR) and power meter test results. On completion of the 24hr warm up period commissioning of the optical receiver and Amplifier can take place.

4 The Engineer shall supply the relevant details for commissioning and design levels appropriate to the equipment supplied by the Engineer's, together with all testing parameters.

Testing General

5 All testing equipment used must have a valid and fully traceable calibration history. The Contractor shall ensure that all testing equipment he proposes to use is fully calibrated and that there are appropriate current Certificates of Calibration. Copies of these Certificates shall be supplied to the Engineer, before the commencement of any testing, who may also request that current Certificates are to be produced from time to time.

6 The Contractor shall also supply all necessary equipment and suitable tenting for use in inclement weather, to prevent delay in commissioning. No commissioning shall take place in the rain unless tented.

Testing Optical Fibre Cables - General

7 Acceptance testing of optical fibre cables shall take the following forms:

(i) Optical Loss Measurement - Power Through Measurements;
(ii) Assessment of Component Compliance - Optical Time Domain Reflectometer (OTDR) Testing.

The Optical Loss Measurement shall be used to provide a single valued measurement of optical loss within a fibre optic span. These measurements shall be taken using a light source and power meter, operating at wavelengths given within the relevant specification clauses, and suitable test leads. The results obtained should be recorded, together with the fibre optic span identification and the location of the light source and power meter.

The OTDR, operating at wavelengths given within the relevant specification clauses (together with suitable launch and tail leads), shall be used to provide details of the fibre optic span length, the attenuation coefficient and the insertion losses across connectors and joints. The results obtained should be recorded together with fibre optic span location and location of OTDR during testing. The Contractor should note that for the purposes of

OTDR testing, it is essential, for future maintenance purposes, that any traces supplied on 3.5" diskette are capable of being viewed in the field at any time without the need to refer to any office based PC or software emulation package. Therefore the Contractor shall ensure that the test equipment is of a suitable type, approved by the Engineer.

Testing Telco Optical Fibres - OTDR Tests

8 OTDR tests shall be performed on each and every Telco fibre to determine the integrity of the fibre and the quality of each splice. OTDR tests will be carried out from the headend/hubsite to the first node on the ring, then from node to node between intermediate nodes, with a final check made from the last node back to the headend/hubsite. OTDR tests will be performed in both directions at 1310nm and 1550nm, and will measure the fibre optic span length, attenuation coefficient and connector and joint insertion losses.

Measured losses from each OTDR test should not exceed the limits given below:

- No individual splice loss exceeds 0.1 dB @ 1310nm.
- No individual splice loss exceeds 0.1 dB @ 1550nm.

- The average loss per Km @ 1310nm on any fibre link, inclusive of splices, cable and connectors, should not exceed 0.4 dB.

- The average loss per Km @ 1550nm on any fibre link, inclusive of splices, cable and connectors, should not exceed 0.3 dB.

Testing Telco Optical Fibres - Optical Loss Measurements (Power Through Measurement)

9 Optical Loss measurements to gauge end-to-end power attenuation shall be performed on each and every Telco fibre, in each direction and at both 1310nm and 1550nm. Power Through Measurement tests will be carried out from the headend/hubsite to the first node on the ring, then from node to node between intermediate nodes, with a final check made from the last node back to the headend/hubsite. These tests will be performed in both directions at 1310nm and 1550nm using an optical light source and power meter.

Measured losses from the Optical Loss measurement tests should not exceed the limits given below:

- The average loss @ 1310nm on any fibre link, inclusive of splices, should not exceed 0.4 dB/Km.

- The average loss @ 1550nm on any fibre link, inclusive of splices, should not exceed 0.3 dB/Km.

Testing CATV Optical Fibres - OTDR Tests

10 OTDR tests shall be performed on each and every CATV fibre to determine the integrity of the fibre and the quality of each splice. OTDR tests will be carried out between the headend/hubsite east to each CATV node in both directions and headend/hubsite west to each CATV node in both directions. OTDR tests will be performed at 1310nm and 1550nm, and will measure the fibre optic span length, attenuation coefficient and connector and joint insertion losses.

Measured losses from each OTDR test should not exceed the limits given below:

- No individual splice loss exceeds 0.1 dB @ 1310nm.
- No individual splice loss exceeds 0.1 dB @ 1550nm.

- The average loss per Km @ 1310nm on any fibre link, inclusive of splices, cable and connectors, should not exceed 0.4 dB.

- The average loss per Km @ 1550nm on any fibre link, inclusive of splices, cable and connectors, should not exceed 0.3 dB.

Testing CATV Optical Fibres - Optical Loss Measurements (Power Through Measurement)

11 Optical Loss measurements to gauge end-to-end power attenuation shall be performed on each and every CATV fibre, in each direction and at both 1310nm and 1550nm. Power Through Measurement tests will be carried out between the headend/hubsite east to each CATV node in both directions and headend/hubsite west to each CATV node in both directions

Measured losses from the Optical Loss measurement tests should not exceed the limits given below:

- The average loss @ 1310nm on any fibre link, inclusive of splices, should not exceed 0.4 dB/Km.

- The average loss @ 1550nm on any fibre link, inclusive of splices, should not exceed 0.3 dB/Km.

Testing Spare/Dark Optical Fibres, Fibres not Terminated at the Optical Distribution Frame (ODF) or Node and Fibres not Spliced Through at Joints- OTDR Test

12 OTDR tests shall be performed on each and every spare/dark fibre to determine the integrity of the fibre and the quality of each splice. OTDR tests will be carried out from either Hubsite to Hubsite or Headend to Headend, or from hubsite/headend to unspliced joint for cables not spliced through at joints. OTDR tests will be carried out in both directions at 1310nm and 1550nm, and will measure the fibre optic span length, attenuation coefficient and connector and joint insertion losses.

Bare end OTDR tests shall be performed on all fibres not terminated at the ODF in the Hubsite/Headend, fibres not terminated within the node or fibres not spliced through at joints. Tests will be carried out in both directions at 1310nm and 1550nm. OTDR tests will measure the fibre optic span length, attenuation coefficient and connector and joint insertion losses.

Measured losses from each OTDR test should not exceed the limits given below:

- No individual splice loss exceeds 0.1 dB @ 1310nm.
- No individual splice loss exceeds 0.1 dB @ 1550nm.

- The average loss per Km @ 1310nm on any fibre link, inclusive of splices, cable and connectors, should not exceed 0.4 dB.

- The average loss per Km @ 1550nm on any fibre link, inclusive of splices, cable and connectors, should not exceed 0.3 dB.

Testing Spare/Dark Optical Fibres, Fibres not Terminated at the ODF or Node and Fibres not Spliced Through at Joints - Optical Loss Measurements (Power Through Measurement)

13 Optical Loss measurements to gauge end-to-end power attenuation shall be performed on each and every spare fibre, in each direction and at both 1310nm and 1550nm. These tests will be carried out using an optical light source and power meter from either Hubsite to Hubsite or Headend to Headend, or from hubsite/headend to unspliced joint for cables not spliced through at joints.

Bare end Optical Loss measurements to gauge end-to-end power attenuation shall be performed on all fibres not terminated at the ODF in the Hubsite/Headend, fibres not terminated within the node or fibres not spliced through at joints. Tests will be carried out in both directions at 1310nm and 1550nm using an optical light source and power meter.

Measured losses from the Optical Loss measurement tests should not exceed the limits given below:

- The average loss @ 1310nm on any fibre link, inclusive of splices, should not exceed 0.4 dB/Km.

- The average loss @ 1550nm on any fibre link, inclusive of splices, should not exceed 0.3 dB/Km.

Optical Fibre Test Leads - OTDR Launch Leads

14 The geometry and overall specification of the optical fibre within the launch lead should be compatible with that of the optical fibre to be tested.

Launch leads intended for connection to OTDR equipment shall be of a length suitable to give unambiguous readings to the optical fibre and cabling components under test. Additionally the lead should be terminated one end with a connector of the same design, style and manufacture as used on the fibre optic span to be tested.

Optical Fibre Test Leads - Light Source and Power Meter Test Leads

15 The geometry and overall specification of the optical fibre within the launch lead should be compatible with that of the optical fibre to be tested. Test leads shall be terminated with connectors of the same design, style and manufacture as used on the fibre optic span to be tested.

Presentation of Testing Results and Records for all Optical Fibres

16 Typical Cable Data and Test Record Sheets are reproduced in Series 1100 Appendix of the Specification. The Contractor shall ensure that records are supplied in formats, substantially in the form of the sheets included in Series 1100 Appendix of the Specification, which shall be approved by the Engineer, prior to the first submission.

17 It is essential that all fibre optic tests are presented in a standard format for ease of use for maintenance purposes.

18 The fibre route test results follow the following format:

(i) The final package is to be presented in a folder, with a title page, containing, at both 1310nm and 1550nm, one hard copy of the traces, one copy on labelled 3.5" diskettes, Optical Loss Measurement (Power Through Measurement) results and a complete set of FAS results.

(ii) Traces are to be printed one per page on Supertrunk routes and two per page on Nodal ring installations.

(iii) CATV fibres, including spares, for each Node are to be presented Hubsite or Headend (East) to Node/Node to Hubsite or Headend (East) on one page with the Hubsite or Headend (West) to Node/Node to Hubsite or Headend (West) on the following page.

(iv) Telco fibres are to be patched through at each MUX location, including spares, and traces displayed in both directions.

(v) Traces are to be shown with the A and B cursors at launch and end reflection resp. and the trace expanded to make best possible use of the dimensions of the screen.

(vi) A complete FAS table is to be printed for all fibres.

(vii) All traces and FAS tables are to be displayed at both 1310nm and 1550nm for all fibres.

(viii) Optical Loss Measurement (Power Through Measurement) results recorded for both East and West CATV fibres are to be used to calculate split ratios for the lasers feeding the rings so it is imperative that they are accurate.

Testing - Coaxial Cables

19 Time Domain Reflectometer (TDR) tests shall be performed on each and every coaxial cable, in both directions, to determine the continuity, destination and length of each cable.

20 The signal input and quality level at each node, DA and DP shall be checked using a spectrum analyser.

Testing - Copper Cables

21 The continuity of each and every copper cable shall be tested using a purpose built tester to perform a Loop/Tap Out test.

Presentation of Testing Results and Records for Coaxial and Copper Cables

22 Typical Cable Data and Test Record Sheets are reproduced in Series 1100 Appendix of the Specification. The Contractor shall ensure that records are supplied in formats, substantially in the form of the sheets included in Series 1100 Appendix of the Specification, which shall be approved by the Engineer, prior to the first submission.

1116 Records

Record Sheets

1 Typical Cable Data and Test Record Sheets are included in the Series 1100 Appendix. The Contractor shall ensure that records are supplied to the Engineer within 24hrs of the completion of each test section. These records should be supplied in the formats provided by Test Record Sheets included within this Clause.

2 The data and record sheets should be considered as typically required by the Engineer, but should not be considered as an exhaustive set. The actual presentation of test results will be agreed with the Engineer prior to submission of the first set of test results. The Contractor should note that the Engineer may choose to review the agreed presentation from time to time.

3 The Contractor is to fully allow in his rates and prices for completion of Cable Data and Test Record sheets, the submission to and approval of the sheets by the Engineer, together with any subsequent delays due to non-approvals or queries raised by the Engineer.

1117 Additional Cable Testing Requirements

As-Build and Cable Testing Requirements - General

1 Series 100 and this Series 1100 outline the broad Specification requirements in respect of Record Drawings (As-Build Drawings) and Cable Testing. Series 1400 specifically outlines additional procedures for testing and accepting optical fibres.

2 Two additional documents also form part of the As-Build and Testing Processes:

(i) the VM National As-Built Standard Specification – *Contractors should particularly note that there are numerous references to previous ntl and TW standards/requirements within this document – these should be considered as VM-approved for the purposes of submitting a Tender*

[National As-Built Specification(Gary Taljaardt280108).zip]

(ii) the VM GIS Team As-Built Park Requirements document

[GIS Team As-Built Pack Requirements(Formatted)(Updated_amr010710).doc]

Extra-over As-Build/Testing Requirements

3 From time to time, there are instances where additional As-Build data and increased levels of Testing are required. Invariably, it will be the level of Testing that is increased. Typical instances include:

(i) different Business Customer Jobs/Projects
(ii) 3rd Party Client Works, including Network Interconnections
(iii) Core/National Network Testing requirements

4 It is often the case that for some of these works, more onerous fibre splice and termination tests are called off, such as CD and PMD tests. These will therefore be considered as extra-over or additional to the Base minimum (see Series 100), and separate line items for individual cable tests are included in the Schedule of Rates, where specified additional tests are required.

5 Where extra-over As-Build/Testing Requirements are requested for the typical reasons noted above, these should be separately specified (and paid) in the Works Order, on an individual job-specific basis.

Early Receipt of As-Build/Testing Records

6 Notwithstanding the 24hr delivery requirement for individual test sections of the works under Clause 1114.1 above, from time to time, there are instances where Virgin Media (or its customers) require As-Build data and Testing Records as reasonably soon as possible, after completion of the Works, but certainly ahead of delivery with the Application for Payment. Both Business and Core Networks tend to call for this, often driven by the need to confirm (at an early stage) with the 3rd Party Client, that a service has been delivered.

7 In a small number of instances, this may be requested on a next-day basis, but this is clearly functional on the test results being in compliance with the Specification, such that there is no re-work required. In these instances, Testing Records may be delivered to and/or signed-off by VM's local Operational Teams, but should be confirmed by the Engineer in the first instance..