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Summary

Specification
Document No: TM00044

Optical Fibre Cable – Outside Plant

Technical Requirement

Contents

01 Purpose

The purpose of this Specification is to provide the Contractor with detailed Technical Requirements which must, unless otherwise directed by the Superintendent, be complied with in performing WUC (as defined in the General Conditions of Contract.

02 Scope

This Specification applies to the Design Elements and Deliverable Items identified in Schedule 4 of the Supplementary Agreement, associated with the Technology area:

Optical Fibre Cable - Outside Plant and also Fibre to the Premises (FTTP)

The document refers to specifications for optical fibre cable design and construction in the outside plant network.

For specifications for Conduit (including pits and manholes) installation work associated with Optical Fibre cable installation, refer to Technical Specification TM00042 “Conduit Route Installation”.

For specifications for Copper Cable installation work associated with Optical Fibre cable installation, refer to Technical Specification TM00043 “Copper Cable”.

For specifications for FTTP Design and Installation refer to the following Telstra publications:

015526 A14 “Access Network Design Fibre to the Premises (FTTP) ODN Design Specifications”, **017833** “External Plant Construction Specification – Fibre to the Premises” and associated documentation 017833 A04,A05, W01, W02, W03, W04 and W05, **016390W37** “Access Network Design Fibre to the Premises (FTTP) ODN Design Specifications” , **016390W38** “Data Services, Building FTTP (GPON) into TRAC”, **016390W40** “Data Services, MITS - FTTP Build”, **008532A36** “Recording Fibre to the Premises (FTTP) in NPAMS”, **011844W41** “Fibre to the Premises (FTTP) - Plan Symbols Definitions”.

The order in which the Technical Requirements are set out in this Specification is listed below and corresponds with the Work Breakdown Structure Elements as defined within the Contract:

- Design
- Material
- Installation
- Labelling
- Commissioning
- Testing
- Cutover
- Recovery

03 Technical Requirements

3.1. Design

3.1.1. Data Requirements

Contractors requiring access to data stored within Telstra systems shall request such access through the Telstra Business Unit, Data Services

3.1.2. ISO9001

This International Standard is one of three International Standards dealing with quality system requirements that can be used for quality system assurance purposes.

ISO9001 “Quality systems - Model for quality assurance in design, development, production, installation and servicing”.

Note: For use when conformance to specified requirements is to be assured by the supplier during design, development, production, installation and servicing

3.1.2.1. AS 1199-1988, Sampling Procedures and Table for Inspection by Attribues

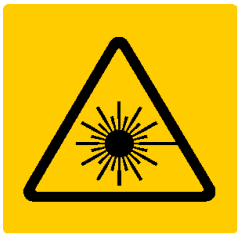
Scope

Establishes sampling plans and procedures for inspection by attributes.

Inspection by Attributes: Inspection wherein the item or unit of product is either classified simply as conforming or nonconforming or the number of non-conformance’s in the item are counted, with respect to a given requirement or set of requirements.

Attribute: A characteristic which is appraised in terms of whether it does or does not meet (go or no go) a given requirement

3.1.3. Laser Safety



All Internal and contractor staff must have completed Laser Safety Training before working on Telstra’s fibre network. NBN 01014 (currently at Revision E. NBN 01014 E)

Refer to Optical Fibre and Laser Safety Document SP- 000531 EDMS Library ref: ADY-758
http://objects.in.telstra.com.au/documents/ADY-7584

Visible Fault Locator / Visible Light Source

VFL’s are useful tools for basic fault finding and fibre identification but are potentially dangerous if used incorrectly. These use a very bright, deep red coloured laser which can be hazardous if viewed directly and its reflection from a shiny surface can also be hazardous.

All staff (internal and contractor) working on any part of the Telstra optical fibre network must note that :-

1. VFL's with laser power ratings greater than 3R MUST NOT BE USED
2. Any VFL in use must be correctly labelled as per the IEC / Australian Standard 60825-1 where the Laser Class is clearly stated.
3. A VFL must never be pointed at any person.
4. Correct practice is to connect a VFL to the fibre under test prior to switching it on.

The current Serialised VFL is available as 40009488 and is shown below. This unit complies with the requirements of the Telstra Laser Safety Standard.

3.1.4. ACIF C524 Scope and Overview

3.1.4.1. Scope

This Industry Code applies to persons who are:

a) Owners of an external Communication Network covered by the Scope of the Code;
b) Lessees of an external Communication Network covered by the Scope of the Code;
c) Employees of the owners or lessees; and
d) Contractors to the owners or lessees and persons employed by or subcontracted by such contractors.

The construction, maintenance, and safety provisions of this Industry Code apply to all external Communication Network systems whether or not the system is:

a) In service or out of service;
b) Being constructed and has never been Energised or operated in some form;
c) Being constructed on or near other Utility infrastructure.

This Industry Code is intended to provide guidance on the basic principles of installation, maintenance and safety of external Communication Networks with the purpose of achieving the minimum requirements for electrical, structural and network reliability, as well as setting out the minimum provisions that are considered necessary for the safety of employees and the public under the specified conditions.

3.1.4.2. Overview

Where applicable, cross-reference to relevant benchmarks and industry guidelines are made to give more specific guidance. These are appended to this Code.

A cross reference example is the Design Suite of Documents 015526 for guidance and compliance.

Pit and Pipe Design application
015526a01 Access Network Design Pits & Conduits (Standard Urban Application)
015526a05 Access Network Design Mains (Large size cables)
015526a06 Access Network Design Rural Cables (Direct Buried)
015526a07Access Network Design Commercial & Multi-Dwelling Developments
015526a08 Access Network Design Designers Application Guide (Infrastructure Upgrades)
015526a09 Access Network Design Designers Application Guide (New Infrastructure)

Plough and Rural application
015526a06 Access Network Design Rural Cables (Direct Buried)

Design and "As Built" Plan Specification
015526a12 Access Network Design Plan Specifications

Wideband Deployment Standards
005747 –A076 Network Deployment Rules.
Wideband designers must follow current deployment rules for example extending the Access Network, FAP placements, cable sizes, splicing, etc.

3.1.5. Standards for Works beyond Telstra's Network Boundary

The *Communications Cabling Manual (Published by Standards Australia's Communication Technologies Group)* provides information on installing cables within a customer's premises. This information is presented in two forms:

- Standards that specify equipment and cabling requirements
- Instructions that amplify and explain in more detail the requirements of the Standards.

3.1.6. Network Categories

Diversity of the optical fibre distribution system is important when considering network survivability issues and optical fibre management in general. Several different classes of exchanges exist, all requiring separate design constraints.

Network categories define the various transmission network architectures in terms of their commercial and strategic importance.

Table 1 defines the network categories applicable to cable plant, and will be used to determine the appropriate network standards.

Note: The highest transmission system carried, or proposed to be carried, on a cable determines the Cable Plant Category of that cable.

Category	Transport Architecture	Switching Architecture	NGN Architecture
A	MTH -MTH	TNS - TNS	ASN - ASN
B	MTH - LTH	TNS - LAS	ASN - EAP
C	LTH – LTH (Country)	LAS - LAS	EAP - EAP
D	LTH – LTH (Metro)	LAS - LAS	EAP - EAP
E	LTH - TAP	LAS - RAU	-
F	TAP - TAP	RAU – UNIVERSAL PGS	-
G*	Lead-In		-

Table 1 – Transmission Network Categories

MTH Main Transmission Hub

LTH Local Transmission Hub

TAP Transport Access Point

TNS Transport Network Switch

LAS Local Access Switch

RAU Remote Access Unit

ASN Application Service Node

EAP Ethernet Aggregation Point

* Lead-In refers to cable installed from a FAP to the customers' premises in private property. This cable is not going to serve other customers in adjacent properties.

Category A, B, C, E and F cables are predominantly direct burial optical fibre cables, however where these cables are located in major cities / towns they will normally be installed in ducts.

Category D cables are predominantly installed in ducts.

Local Access Switch (LAS) is an AXE Node, S12 Host etc.

Remote Access Unit (RAU) is a RSS, TSU, RSU, IRIM, SiteLight locations etc.

Universal Pair Gain System is an RCM, NI-RIM, DCS-20 etc.

3.1.7. Land Access Requirements

For all land access procedures, refer to the National Notification and Compliance System (NNACS) on-line database, or the Telstra Land Access Group website:
http://www.in.telstra.com.au/ism/ccmla/index.asp

3.1.8. Route Selection

Due to the strategic importance of all optical fibre cables, route selection is critical and will require considerable planning and design effort to avoid future damage to the cable. This extra effort will ensure that the installation when complete will: -

- Offer to Telstra, the most secure route ie. Avoid areas of high risk, e.g. expansive soils, future mining operations and inappropriately positioned creek / river crossings to ensure satisfactory long-term cable performance
- Result in the shortest viable cable route with minimum deviations and meeting the design criteria for the route
- Be able to be maintained under all climatic conditions.
- Have minimum impact on the environment

Where a metallic cable design is used (e.g. Underwater cable), avoid proximity to power transmission lines.

3.1.8.1. Separations from Working Cable

Except for cable crossings in rural areas, cable installations shall not be designed to encroach closer to existing cables than the distances as shown in Table 2:

Installation Type	Telstra Cable	Other Carrier's Cable
Plough parallel to Major Cables (e.g. IEN)	5.0 m	10.0 m
Plough parallel to Minor Cables (e.g. Cat E /F)	2.5 m	5.0 m
Open Cut parallel to Major Cables	2.0 m	4.0 m
Open Cut parallel to Minor Cables	0.5 m	1.0 m

Table 2 – Separations from Working Cables

Note: For encroachments closer than 1.0 m to the Major cables, or 0.5 m to the Minor cables of other carriers – hand excavation is mandatory.

3.1.9. Guidelines for installing Single Mode Optical Fibre (SMOF) Cables in Expansive Soils

- If necessary soil survey about the major road (for maintenance access). Use local, experience authorities eg. Soil Conservation Authority to determine what soil conditions are like. Aim to pick the best route. As required, by the soil survey, establish the soil properties (COLE or Atteberg limits).
- Whilst surveying, have an expert on soils present to identify the worst soil types. Experienced soil professional can provide prompt advice about expansive soils.

Select the cable route in stable soils that can be identified from a soil survey. Confirm by soil sampling and laboratory testing and visual examination. A soil pattern can be quickly established. Where there are specific problems and no alternative exist, need to sample to find the best results.

3.1.10. Rodent/Termite Infested Areas

Rodent proof dielectric cable (Serial / Item: 484/53***) is recommended for areas where the cable could be subject to damage from rodents such as rats, mice, rabbits, etc. High rodent risk normally coincides with expansive soils, rodent proof cables are suitable for use in these areas. Current external underground optical fibre cables (S484) have a nylon sheath for protection against termite attack.

For protection of cable joint closures against termite attack refer to Telstra Work Instruction 010256 W06 (Formerly Appendix 7 Part 6) “Underground Joint Closures – Use of Denso Termiteshield Tape”.

3.1.11. CBD Access Network

The Central Business District (CBD) access network, formerly referred to as the Business Access Network (BAN) infrastructure is designed to enable Telstra to pro-actively provide a secure and flexible access in CBD / Urban environments that allows for provision, growth and upgrades on a “just in time” basis.

3.1.11.1. CBD Architecture

The CBD (BAN) architecture is typically an optical fibre cable loop (ring) structure that integrates all the fibre requirements for Wideband / Broadband services for business customers and fibre requirements for other network elements such as RIMs, Pay-Tv hubs etc under a single sheathed cable.

The infrastructure is intended to provide the capability to interconnect telecommunications systems over point-to-point or shared links eg. SiteLight, to provide services such Data Vault, Mobiles, Pay-Tv, Megalinks and Macrolinks etc.

3.1.11.2. Product Range for Jointing and Terminating CBD Networks

A complete range of products for constructing CBD access networks (referred to as BAN products) comprises the following;

- Modular Exchange and Customer termination hardware.
- Openable joint closures, allowing easy access to individual systems fibres.

3.1.11.3. Other Network Uses of ‘BAN’ Products

Other applications of these products in the transport network layer shall only be on the basis of where they have been specified in the tender documents, otherwise standard closure and termination serial and items shall be used.

3.1.12. Plans & Records

Prior to commencing work on any live cable, or fibres, a full set of up to date plans and records must be available. These plans and records must be studied before any cable alteration is undertaken. If any of the proposed cable works or alterations are not in agreement with the existing plans a thorough investigation must resolve the problems before any work is to commence. Customer cards must be read and any active services to customers must be noted. Particular care must be taken where Access Electronics systems eg. RIM etc. are present on the cable as Outages on these systems may affect a significant number of customers. These systems may also be carrying urgent services such as police, ambulance, doctors, etc. which may not be adequately noted on cable records. It is important that this identification is carried out at both the exchange and customer ends of cables to confirm that no fibre transpositions or cable alterations have been made, and which have not been recorded.

3.1.13. Conduit / Duct Selection

In order to minimise the risk of damage to optical fibre cables from overhauling future new cables or removing cables, the following guidelines, in order of preference, should be used for selecting a duct for the installation of an optical fibre cable

Option 1 Choose a conduit occupied by only optical fibre cables.
Option 2 Choose a vacant conduit.
Option 3 Choose a conduit occupied by fibre / or copper cables that can then be retained exclusively for optical fibre cable use and has little chance of any cable being removed from the duct.
Option 4 Discuss with Contract Manager/Planner/Technology Specialist on other available options, and submit an exemption request where required.

When selecting a conduit from a nest of conduits or from a different route:

- Avoid mixing, Mains, Distribution and sub-duct in one conduit;
- Select the lowest run of conduits;
- Begin with the conduit nearest the manhole wall, or if symmetrical the side closest to the property boundary line;
- If the conduit nearest the wall is unsuitable select the next suitable conduit away from the wall at the level;
- If a suitable conduit is not available at that level move to the next highest level and repeat the process;
- If there is a choice in alternative conduit routes, the following guidelines, in order of preference, must be used for selecting the conduit run for the installation of an optical fibre cable. Select the route:
  - That has the greatest depth of cover;
  - Is least likely to be relocated or damaged;
  - Is the shortest distance;
- Check if any conduit has already been allocated (full or in part) for other cable or subducts.

3.1.14. Subducting

3.1.14.1. General

Subducting as part of optical fibre cable installation is not the standard practice for Telstra's network. Subducting should only be used in the following situations.

- Under special circumstances small lengths may be used as secondary protection for the cable in situations outlined below :-
  - Sharp bends in pits or manholes, or
  - Significant changes in levels, or
  - Possible damage to the cable within the manhole or duct entry, or
  - Security issues.
- For optical fibre cables as specified by Network Operations or Infrastructure Services.
- In the case of a congested duct route and:
  - A copper cable greater than 200/0.40 mm, 100/0.64 mm, 50/0.90 mm is likely to be installed in the near future for network relief, and;
  - The only available duct space is where the new fibre cable is to be installed, and;
  - There is no bare fibre cable (non-subducted) already been installed in the duct, and;
  - After subducting for the new fibre cable, there is still enough space for hauling in the future copper cable.
- Where other telecommunication carriers will install a cable in Telstra's conduit.

Only one optical fibre cable shall be installed in an empty sub-duct, and under no circumstances may a second cable of any type be drawn into the same sub-duct, or into any other occupied subduct i.e. overhauling of cables in sub-duct is not permitted.

3.1.14.2. Subduct Sizes

The preferred size for optical fibre cable less than 20 mm diameter is PE 32 (28 mm ID) subduct to AS - 1159 type 50, class 6. For cables greater than 20 mm diameter the preferred size is PE 40 (35 mm ID) subduct, to the above standard.

A subduct shall have a tensile strength and crush resistance, complying with AS-1159 type 50, class 6 PE pipe.

3.1.14.3. Flexible Secondary Protection

In those instances where sub-duct is unsuitable as a form of secondary protection, the use of flexible conduit will provide a suitable alternative. Two types of flexible conduit are currently approved for use within the Telstra network:

- Pipe, Agflow, 50 mm x 20 m (S073/00187);
- Conduit, PVC Corrugated White, 25 mm x 50 m. (S151/00423);

This type of secondary protection is intended to prevent accidental damage due to activities in close proximity to the cable, and is suitable for use in:

- Pits;
- Manholes;
- Cable Tunnels ;
- Cable Wells;
- At Cable Joints;
- Inside Exchange Equipment Rooms, etc .

The requirement for fitting secondary protection will normally be specified within contract documents.

3.1.15. Network Cable Sizes and Architecture

3.1.15.1. General

The following is provided as a guide for dimensioning network cables, when accurate forecasts are not available. The fibre counts for network cables range between 36 and 720 fibres (f). Refer to Table 3.

ESA	Architecture	Minimum Cable Size from Exch. (f)		Recommended Cable Size from Exch. (f)		Type of Joint Ref.3.2.8	Remarks
		In Conduit	In Solid	In Conduit	In Solid		
CBD	Non- Tapering	72	N/A	144, 360, 720	N/A	UCNCP	Min 12f lead-in
Urban	Non Tapering or Tapering Star Configuration	36	N/A	72, 144	N/A	UCNCP	Preferred non-tapering
Rural	Tapering Star Configuration	36	36	36, 72	72	UCNCP or O/J	
IEN	Tapering	36	36	36, 72	72	UCNCP, UCN/UCNP	In Rural ESA's, allow min. 12f for CAN usage at each end of Exch.

Table 3 – Network Cable Dimensioning

The major factors that determine whether to dimension to minimum or recommended cable sizes are:

- Conduit availability along the proposed cable route;
- Reliability of the available wideband & narrowband forecasts;
- Local knowledge of the wideband growth of existing and potential customers;
- The selection of Transmission technology;
- Financial policy on the provision of Fibre Network at the time.

3.1.15.2. Cable Types and Application

Following are descriptions, and application guidelines of the current range of S484 SMOF cables. Refer to Section 3.2.6 for more details of the cable construction, fibre counts, Serial and Item numbers and sheath markings. Refer to Table 4 in Section 3.1.15.4 for standard drum lengths.

3.1.15.2.1. Standard Cable

- Suitable for all hauling applications
- Standard fibre counts range from 12 to 720 fibres
- Standard cables have individually coloured jelly filled loose tubes which are SZ (reversed helical stranding) stranded around a Fibreglass Reinforced Plastic central strength member to form a cable core wrapped with water swellable tapes and yarns. Coloured fibres are contained within loose tubes
- FlexTube cables, 360F and 720F, soft rubberised tubes that are less prone to kinking, reduced diameter and high fibre density. There are radial strength members that are encased in the sheath of the cable. The tubes are bundled and surrounded with aramid yarn and then covered with the PE and Nylon bonded sheath.

3.1.15.2.2. High Strength (HS) Cable

- For duct and direct burial applications;
- Standard fibre counts range from 12 to 144 fibres;
- High strength cables have a similar core construction to Standard cable, but have a more robust construction proving increased tensile strength and crush performance;
- High strength cables are larger in diameter than standard cables; consequently, shorter lengths can be accommodated on standard drums.

3.1.15.2.3. Aerial Cable

- Aerial Optical fibre cables are of loose tube non - metallic self-supporting construction, with a black high density polyethylene sheath. The cable consists of a Fibre Reinforced Plastic (FRP) central strength member and coloured loose tubes containing the fibres;

- Standard fibres counts range from 12 to 72 fibres;

- These cables are suitable for spans up to 150 m where a self-supported aerial cable is required such as in areas of steep terrain, rocky or marshy land, and alpine parks;

- Aerial cable should only be considered where traditional duct or plough installations are not cost effective;

- Aerial cable is designed to withstand a combined wind loading of 100 km/hr, ice loading equivalent to 5 mm radial thickness and temperatures between –30oC and 70oC;

- Suitable fittings for self-supporting aerial cables i.e. support brackets, spiral vibration dampers, and dead end terminations, are not serialised but may be sourced from: Preformed Line Products (Australia) of Northmead NSW, and Dulmison of Wyong NSW. Alternatively, a recommendation may be sought from Prysmian Telecom Cables & Systems Australia Pty Ltd;

- All metal fittings are to be corrosion resistant;

- For application requiring span lengths > 150 m but <500m, Long Span Aerial cable designs are available as special orders (from Prysmian) For such special aerial cable requirements other than the ones listed in Table 6, the Serial Manager is to be contacted on Tel 02 8576 6660.;

3.1.15.2.4. Underwater Cable

- Underwater cable is filled loose tube cable with corrugated steel and double heavy wire armouring covered with special marine bitumen, with a high density polyethylene outer sheath for good abrasion resistance;

- Underwater type cables are recommended for shallow water applications such as river and harbour crossings where potential for cable damage by small anchors or severe tidal conditions exists;

- Standard fibre counts range between 12 and 360 fibres.

3.1.15.2.5. Rodent Proof Cable

- Rodent Proof cables have mechanical properties similar to High Strength cables, with rodent protection provided by the inclusion of dielectric rod armour in the sheath;

- The standard fibre counts range between 12 and 360 fibres;

- A 360 fibre and 144 fibre Rodent proof cable for duct applications only is also available for deployment in ducts and these are not suitable for direct burial.

- This cable is recommended for use in areas where rodent protection is required, for duct and direct burial applications.

3.1.15.2.6. Internal Tie Cable

An Optical Fibre Tie Cable (herein referred to in this specification as tie cable) is a Single Mode Optical Fibre (SMOF) Fibre Cable with the following standard fibre counts.

- 2 fibre
- 4 fibre
- 12 fibre
- 24 fibre
- 36 fibre
- 72 fibre
- 144 fibre

Tie cables for internal use only are a non-metallic cable with a flame retardant, low smoke generation, low toxic gas emission and zero halogen thermoplastic type sheathing material. 12 & 24F cables are generally 900-micron tight buffered construction. 36F and greater are of loose tube construction with the cable core unfilled, but has filled loose tubes (i.e. no filling compound in the cable interstices).

When higher fibre count cables are needed for use as internal tie cable, standard cable type can be used (e.g. when a 360 fibre cable is needed).

3.1.15.2.7. Internal Riser/Distribution Cable for Customers Site Deployment

- This riser cable consists of a number of 900 μm tight buffered optical fibres reinforced with water swellable yarns and sheathed with NHFR (flame retardant, low smoke generation, low toxic gas emission and zero halogen) compound;

- Standard fibre counts are 12 - 24 fibres;

- These cables are normally used within the building in Local Area Networks (LAN) applications.

3.1.15.3. Haul Lengths

The haul length for any non- tapered section (IEN or CAN) shall be as far as practical. Loops shall be left as required for Fibre Access Points (FAPs) and other locations as specified. Refer to 3.3.12.

3.1.15.4. Standard Cable Drum Lengths

The standard drum lengths for SMOF cables are, as shown in Table 4.

Cable Type	Fibre Count	Maximum Length (m) on Standard Drum	Standard Length on a Standard Drum
Standard	12-72	24000	?
	144	15000	?
	360	8000	?
	720	5500	?
High Strength	12-72	12200	?
	144	7000	?
Aerial	12-72	8400	?
Rodent Proof	12-72	12200	?
	144	7000	?
	360	?	?
Underwater cable	12-360	3000m is recommended maximum length (longer lengths require higher lead time and are expensive – Consult the Serial Manger)	?

Table 4 – Standard Cable Drum Lengths

3.1.16. Jointing and Housing of Cables

3.1.16.1. Joint Closures

The current joint closures specified for the Telstra network are:

- Universal Closure New (UCN) and Universal Closure New with Ports (UCNP) In-Line Closures;
- Universal Closure New Canister With Ports (UCNCP) MAX Openable Closures;
- 24 Fibre and 24/72 Fibre Openable Closures.

All IEN cables (categories A, B, C and D) shall be jointed and spliced using the UCN or UCNP type in-line closures and standard organiser trays. For 624 fibre cable the UCNP 9-30 is suitable by using 24 fibres per splice tray.

The UCN /UCNP in-line closures are the standard closures for through jointing e.g IEN. UCNP In-line closures are a direct replacement for UCN closures. Either UCN or UCNP may be used for new installations. UCNP end caps may be used as replacements for UCN closure end caps.

Access network cables (Category E and F) may be jointed and spliced using the 24 fibre, the 24/72 fibre, or the UCNCP MAX Openable closures. The 24F closure is mainly used for lead-ins and for small fibre

count (≤ 24F) CAN cables. (24 fibre standard cable for duct application is no longer available in the Serial List. Either 12 fibre or 36 fibre cable has to be chosen).

UCNCP MAX closures are the standard closures used to construct the Access network of various architectures (e.g. ring or loop cables) and to provide FAPs within that network, and can accommodate splicing of cables up to 624 fibres. They supersede the TYCO (Raychem) FIST Mk 11 closures, and Corning UCNCP VIP Closures.

Note: MAX, VIP and FIST are manufacturer product names.

3.1.16.2. UCN and UCNP Closures

Appropriate applications for IEN are:

- For cables not exceeding 24 fibre splices, use UCN or UCNP 7-10;
- For cables with greater than 24 and up to 120 fibre splices, use UCN or UCNP 7-20;
- For 144 fibre splices, use UCN or UCNP 9-20;
- For 360f and 720f splices, use UCN or UCNP 9-30.

UCN and UCNP closures can accept single or multiple cables in either of the two ends.

3.1.16.3. Installation of Corning MAX Closures

For all new installations of the Corning UCNCP MAX closures, Telstra Publication 018050W01, "Installation of Corning MAX Closures – Including NGN Network" the above Work Instruction, and as applicable, the Corning Installation Instructions must be followed.

3.1.16.4. Cable Joint Accommodation

In both the buried and conduit network all optical fibre cable joint closures must be located in suitable sized manholes or pits. The minimum accommodation requirements are:

- For UCN or UCNP 7-10 closure ….No. 6 Pit;
- For UCN or UCNP 7-20 closure ….No. 8 Pit (or P6 Pit and Collar);
- For UCN or UCNP 9-20 closure ….No. 9 Pit'
- For 24F Openable Closure……..No. P5 Pit (or existing D, J or P3 pit)
  No.6 Pit (or existing 4 Pit) for IEN cables;
- For 24/72F Openable Closure …….No. 6 Pit;
- For UCNCP Closures…….Concrete 9 Pit (as a minimum) or a manhole.

The size of the manhole or pit shall be such to accommodate the joint closure and minimum bend radii of the cable, and allow neat racking of the cable.

The minimum pit sizes specified above allow for joint accommodation and minimum lengths of looped cables. These may not be of sufficient size to house the desired cable lengths/loops for particular installations, or other than Standard type optical fibre cables, refer to 3.3.12, where larger pit sizes or a manhole may be required.

3.1.17. ExchangeTerminations

3.1.17.1. General

All categories of Optical fibre cables shall be terminated at Exchanges at an ODF i.e. Optical Fibre Distribution Frame (OFDF) or High Density Optical Distribution Frame (HDODF). (Both generally referred to as OFDF unless otherwise specified).

The OFDF and HDODF rack systems are based upon modular subracks, which may be equipped to provide splicing and patching facilities.

Some Access network cable architectures previously utilised BAN OFDM's to terminate street cables in OFDF racks in Exchanges. These modules house from 24 to 96 fibres with or without patching.

For detailed design and construction specifications for ODF's refer to: Technical Specifications TM00183 ODF, TM00183 AO1 High Density Optical Distribution Frame (HDODF), TM00183 A02, Optical Fibre Distribution Frame (OFDF), TM00183 A03 – Tyco BAN OFDM's, TM00183 A04, Optical Fibre Tie Cables, TM00183A05 Optical Suite Frame, TM00183A06 Optical Equipment Frame, TM00183A07 ODF High Density WBT V2 HDODF, TM00183A08 Medium Density ODF, TM00183A09 WBT Optical Subracks and TM00183A10 ODF High Density WBT V3 HDODF.

3.1.17.2. Termination Requirements

The termination requirements for ODF's in Telstra's network are as follows:

- For all new optical fibre cable installations, the ODF design and capacity should allow for 100% patching. 100% patching will apply to all transmission systems with the following provisos;
  - Amplified DWDM system aggregate LINE fibres shall be direct Spliced
  - Passive DWDM Systems shall be patched using SC-APC Connectors only.
  - Direct Splice is permitted if optical budget cannot be met by patching
- For all new cable installations, with the above exceptions, all fibres shall be spliced to pigtails and terminated at a patch panel on the exchange ODF (to allow for 100% patching) using SC-APC Connectors;
- When fibres are to be used for direct splicing DWDM links by breaking an existing pigtail of an already terminated fibre, then the reticulation of the remaining pigtail shall be such that it does not compromise the long term operation and use of the ODF, and the Transmission and Recording Control (TRAC) database shall be updated in the remark field to indicate that the fibre has been direct spliced (not patched);
- Storage of excess pigtail shall not occur in the ODF, except where managed within an HDODF. In all instances correct length pigtails are to be used to avoid excessive pigtail storage requirements;
- The standard pigtails for use in the Telstra network are 2.0mm outside diameter with ITU-T G652.D standard fibre, and must be procured only from an approved Vendors. 2.4mm & 3.0mm cords are obsolete for new connections.

3.1.17.3. OFDF Rack Capacity

The capacity of the rack to terminate fibres is limited by the number of pigtails that are able to be housed in an orderly fashion in the left-hand side of the rack, and the number that can be ducted away from the rack.

If an excessive number of optical fibre pigtails are run into an ODF rack, it will become congested, prone to service disruption and therefore unusable.

Recommended maximum rack capacities and specifications are:

- For new cable and new rack installation using a Type 92 A rack or one side of Type 92B rack, a single 312 fibre cable or a multiple of cables with a maximum total fibre limit of 300 or 312 fibres., shall be terminated using narrow “modified” Warren & Brown (W&B) TC249 Series modules, S494000488; 489; 490; 491; 492, and 526. Refer to TM00183 A02;

- The growth of fibre termination on the ODF can be staggered over a period of time, but proper positioning of the splice and patch modules shall be planned to meet the ultimate maximum capacity of 300 fibres using the TC249 Series modules;

- For an existing Type 92A rack or one side of the Type 92B, where cable(s) have been terminated using W&B TC248 modules/subracks S4940093 -96, 000112 -113, 00163, 00251, 00286, the recommended total fibres that can be terminated is 240 fibres;

- For new cable installations on an existing rack, preference should be given for usage of TC249 Series modules. Refer to TM00183A02;

- For termination of more than 312 fibres eg. 2X312f cables etc, the Tyco HDODF is preferred. The HDODF rack has a capacity of 936 fibre terminations in a fully patched arrangement, (i.e. up to an equivalent of three 312 fibre cables can be terminated in an HDODF. It requires a footprint of 1200mm W X 300mm D x 2200 mm H. Refer to TM00183 A01.

3.1.18. Diversity of Optical Fibre Distribution

3.1.18.1. General

Diversity of the optical fibre distribution system is important when considering network survivability and optical fibre management in general. Several different classes of Exchanges exist, all requiring separate design constraints.

3.1.18.2. Transmission Hubs

Optical fibre system diversity is required at exchanges classed as Transmission Hubs, which rely on geographically diverse paths to provide network survivability. Some examples of networks requiring this level of diversity are as follows:

- Digital Service Protection Networks (DSPN);

- SDH ring networks

- DWDM ring networks

- Diverse Intercapital bearers into a transmission hub

The diversity shall include where possible, or where specified in the Design requirements, separate optical cable entry points into the building, separate OFDF's and separate equipment suites and separate cable trays. Grey coloured cable tray denotes the “Main Fibre Path” and Blue Fibre trays the “Diverse Fibre Path”. Fibre cables should be run in the corresponding coloured cable Tray. This ensures that any one point of damage to either cable or equipment cannot totally isolate a Site or Equipment Floor.

3.1.18.3. Larger Exchanges (> 480 Fibres)

At exchanges terminating more than 480 fibres, more than one OFDF will be required. This will ensure optical fibre congestion does not occur at any one point and will provide for better optical fibre management in general. It will also ensure that a level of diversity exists for the optical distribution system.

3.1.18.4. Smaller Exchanges (< 480 Fibres)

At these sites one OFDF should be sufficient and will generally be located in the equipment suite.

3.1.18.5. Small Optical Fibre Installations

At sites where only a small number of fibres are installed e.g. ≤ 12 fibre cable terminating at a Rural Automatic exchange (RAX), all fibres can be terminated onto a Termination and Patching module, or pigtail storage subrack. This may be preferable especially in remote locations due to limited accessibility to splicing equipment in the event of a re-arrangement or fault.

3.1.19. Tie Cables between OFDF's

Refer to: Technical Specification TM00183 AO4 “ODF –Optical Fibre Tie cables”.

3.1.20. Bridging fibres/cables between ODF’s

Refer to: Technical Specification TM00183 “Optical Distribution Frame”.

3.1.21. Interconnection at Intermediate Exchanges

Subject to the conditions outlined in section 3.1.17.2, interconnections of fibres at intermediate exchanges shall be done by patching for all products (transmission systems).

When building new optical fibre links, if the fibres to be used are not already terminated on the ODF, a new patch panel is be installed and those fibres are to be terminated on the panel and the connection is to be carried out through the patch panel.

For systems which require "Return loss" for each individual event along the fibre link to be greater than 50 dB (eg. metro SDH, Transmission systems operating at minimum 10Gbit/s TDM in single wavelength or in WDM configuration) and DIN connectors are encountered, they must be replaced by SC-APC connectors, where permissible before patching.

Where it is not possible to replace existing DIN connectors with SC-APC connectors due to space limitations, and as mixing of connectors is not allowed in the patch panel, splicing can be adopted for those connections only.

3.1.22. Customer Terminations

All fibres in lead-in cables shall be terminated at the customer's premises to provide a robust, secure and flexible access to services. Cables will be terminated at a building Customer Optical Fibre Termination Unit (COFTU) or termination rack e.g. Customer Equipment Cabinet. The COFTU or rack for a building is used to facilitate the interfacing of the lead-in cable and internal cables.

In multi storey buildings the building COFTU or termination rack is usually located in the communications room in the basement of the building, and fibres are then distributed by riser cables to an Optical Fibre Termination Unit (OFTU) on each floor to serve the customers on that floor.

Customer terminal boxes/equipment should not be installed any higher than 2.2 m from floor level.
For fibre counts up to 24 fibres, this can be achieved by the use of:

- A wall mounted BAN COFTU, either S49400236 (12F) or S49400140 (24F) ;
- A rack mounted 12F BAN COFTU, S49400466;

  Note: In the above units each splice tray (SOSA-SE) shall be dedicated to a fibre circuit, so that individual circuits can be worked on without affecting other services.

- A 12 Fibre Wall Box, External, Splice/Patch, S49400298. An external, IP65 waterproof wall mounted splice/patch unit, fitted with 4 small splice trays for splicing a total of 12 incoming and 12 outgoing fibres.12 fibre patch panel included. May also be pole mounted using Pole Mounting Bracket Kit, S49400300;
- A 12 Fibre COFTU, Wall Mounted, S49400236. A single compartment termination unit with a screw secured or key lockable removable cover. Can be fitted with one or two 6 fibre splice trays, and patching for 6 or 12 fibres.

And for higher fibre count cables, by the use of:

- A rack mounted 48F OFDM, Serial 49400321.
- A rack mounted 72F OFDM, Serial 49400561 or 49400575 (one is a right hands side opening panel and the other is the same panel but can open from the left. Either can be modified on site to open the other way.
- A 24 & 36F Plastic Wall mount box BUBI suitable for deployment in coastal areas that is External IP55 rated.
- A rack mounted 24F OFDM, Serial 49400211.

  Note: In the above unit each splice tray (SOSA-SE) shall be dedicated to a fibre circuit, so that individual circuits can be worked on without affecting other services.

- A 24 Fibre Wall Box, External, IP65 Rated, Splice/Patch. S49400299. An external, waterproof wall mounted splice/patch unit, fitted with 8 small splice trays for splicing a total of 24 incoming and 24 outgoing fibres. 24 fibre patch panel included. May also be pole mounted using Pole Mounting Bracket Kit S49400300;
- A wall mounted 48F COFTU, S49400454, with separate access to the Telstra and customer sides. Provides space to splice up to 48 fibres to pigtails located in through connects at a patch panel, which forms the division between the Telstra network and the customer. Non patchable Splice ONLY;

- Wall mounted OFTU S49400140. For up to 24 fibres and intended for use where an optical test point is required between a Carrier and Customer, via a patch panel. Fitted with separate compartments for the carrier and customer terminations. Item 140 is fitted with a single splice compartment, and Item 00139 is fitted with twin splice compartments;

- Splice/ Patch Trays rack mounted 6-12F S49400466, and 24F S49400162 (Commscope) and S49400463(W&B), replace S49400125 and 144. For housing both splicing and patching facilities in an optical fibre termination rack, and can be front or rear mounted;

- Wall mounted enclosure S49400372. This enclosure features an inner rear 19 inch frame assembly, removable body and clear plastic window, with accessories for terminating 96 fibres;

- Wall mounted 96 fibre Termination Cabinet S49400542. This cabinet is designed for splice only termination of optical fibre cables in multi-story buildings. The associated items S49400543 – "Tubing, Clear, Large Protection" and S49400544 – "Entry Kit, Oval Port" are used with the cabinet.

  Note: To enable recording in the Module Inventory and Tracking System (MITS) database, each termination is recorded against a patching position number. Where splicing and patching occurs in the same termination module, the number of fibres terminated, whether patched or directly spliced to equipment, should not exceed the number of patching positions available in that module. If a fibre is spliced directly to equipment, the corresponding number of that fibre on the patch panel should therefore be left vacant to enable recording.

3.1.23. Maintenance Considerations

To enable future routine maintenance to be effectively undertaken, the following must be strictly in accordance with the standards:

- Route design;

- Route marking, i.e. marker posts/transponder pegs (or detectable tape);

- Route reinstatement;

- Cable type selection i.e. rodent, pest, expansive soil, etc;

- Exchange cable documentation.

3.1.24. Underwater Installations

3.1.24.1. Underwater Cables

Underwater cable (Serial 484/50***) is recommended for river and harbour installations where the potential for cable damage to standard cable designs, from marine craft and severe tidal conditions, exists. These cables can be used in water depths up to 30m. The maximum length of cable per drum that can be manufactured locally in Australia for a 312f cable design is 3 km. Where the route design requires single cable lengths of longer than 3 km (for 312f underwater cable), manufacturing and shipment is to occur from an overseas plant, which can potentially cause longer lead time. Due to non-availability of underwater joints to cater this type of cable, in the event of cable cut, the entire cable length requires to be replaced (repair of the underwater section is not feasible). This has to be born in mind when selecting underwater cable route.

3.1.24.2. Environmental Issues

Underwater cable installation requires careful consideration of the environment. It is essential that disturbance to the landfall and seabed be minimised in addition to minimising any impact on the flora and fauna (land or marine). Initial installations are subject to specific environmental specifications, as are any subsequent maintenance/repair activities.

3.1.24.3. Installation Plant

Installation plant and vessels must be of a suitable design for the location and conditions expected for the installation. The contractor shall be responsible for the adequate design of equipment, and ensure that all safety and environmental conditions are satisfied.

3.1.24.4. Cable Design

Underwater cables must not only be suitable for initial installation, but shall be of adequate strength to enable recovery should repairs be required in the future.

3.1.24.5. Splice Closures

No splice closures are available for deployment in underwater situation. (Dedicated submarine cable and dedicated joints are to be procured for such situations eg. Spenser Gulf or Bass Strait submarine cable)

3.1.24.6. Route/Landfalls

Details of route and landfalls shall be supplied with each particular project. These details shall include:

- Manhole anchoring method and location;
- Armour termination specification;
- Depth of burial;
- Separation of cables (if dual installation is intended);
- Cable protection method from the beach (or land) manhole to the low water mark;
- Exact location of cables.

3.1.24.7. Cable Installation

Unless otherwise stated in the contract documents, underwater cable installation methods used will be at the discretion of the contractor, however, details of cable installation method, i.e. open cut, sea plough, diver jetting, etc shall be specified and demonstrated to the satisfaction of the Superintendent, to permit approval, prior to acceptance.

The installation method chosen shall not cause any increase in attenuation to the fibres (either short or long term), or loops in the laid cable, and shall be fully compliant to the cable manufacturer's installation guidelines.

Unless otherwise specified, the depth of burial together with the means of affording cable protection shall be detailed by the Superintendent.
At the landing sites, the cable shall be anchored and protected fully against land erosion or vandalism.

3.1.25. Environmental

The Operative shall meet all pertinent legislative requirements and pay particular attention to the approval requirements. Environmental risks include but are not limited to disturbance to flora & fauna, disturbance to historic & aboriginal heritage artefacts and sites, works across waterways, spreading of diseases and weeds, erosion and sedimentation (also related to reinstatement), contamination of soils and water, air and noise pollution, asset and waste management. Site environmental practices must meet the relevant minimum requirements outlined within Telstra's Environmental Handbook.

For Health Safety and Environment requirements refer:

Safety, Security & Wellbeing site
Safety, Security & Wellbeing (SSW) - Safety, Security & Wellbeing (SSW) Home (unily.com)

Environment site
https://telstra.unily.com/sites/environment-operations/SitePage/160951/environment-operations

Contractors should refer to their relevant Contract for Health Safety and Environment requirements in addition to any specific directions contained within this document.

3.1.26. Hauling into Pre-Existing Conduits

The Designer shall assess as to whether Roding & Roping of pre-existing conduits, in full or in part, shall be performed on this project as part of the Design process for a new cable.

The purpose is to identify blockages and allow remedial action to be taken in a timely manner.

The following is a general guide based on perceived risk:

Conduit Type	Risk of Blockage	Recommendation
Asbestos Cement	High	Rod & Rope at the Design stage.
Earthenware	High	Rod & Rope at the Design stage.
PVC	Low	Rod & Rope at the Design stage if conduit congested or suspected/known problem or requested by the Planner.

3.1.27. Straight Line Diagrams

As part of the Detailed Design a Straight Line Diagram is produced. The CADLink Straight Line Diagrams are used by designers and constructors to identify works and confirm data in cutover or damage situations.

They readily give constructors a clear idea of what is required as well as splicing arrangements.

3.2. Material

3.2.1. Materials to be Used

All materials used by the contractor must have the serialised material orders placed on Prysmian by IBM (procurement) on behalf of Telstra, or be approved for use and purchase by the Superintendent.

Approval shall only be given in writing and may be withdrawn or amended at any time if there is reason to believe that the material, process or test procedures have been altered from that originally detailed, or has proven to be unsatisfactory.

3.2.2. Spare Material

Contractors shall advise the Superintendent of all "non-standard" spare materials/components that are required to ensure ongoing operation of the installed plant. In the event that no spare material is available, details of items, quantities and location of essential spares which should be held shall be provided by the Contractor.

3.2.3. Product Qualification Testing

Where equipment or materials other than those permitted are proposed to be used qualification testing and type approval is required. The qualification testing and type approval may involve appropriate testing for mechanical, transmission and any other performance characteristics considered necessary and shall generally be determined by the Telstra Approving Authority. It is primarily the Contractor's responsibility to satisfy the appropriate Approving Authority of the suitability of the qualification test program.

Qualification testing must be performed prior to commencement of use of the installation equipment or material.

Qualification testing, where necessary, shall be conducted once every twenty-four months on typical cable designs used or whenever a sufficient change has occurred on either the installation equipment or material for which type approval is being sought.

3.2.4. Warranty

The warranty for the cable and associated accessories provisioned through Telstra Product Sourcing Agreements (PSA's) will be provided by the supplier. In the event where material is sourced elsewhere, a warranty arrangement must be negotiated and agreed to by the Superintendent.

3.2.5. Faulty Material

Responsibility for faulty manufacturer's design or workmanship is via Defect Performance Reporting (DPR) and is as follows:

- When detected prior to acceptance/hand over, it is the responsibility of the contractor to pursue resolution of the problem with the relevant Vendor;

- When detected subsequent to acceptance/hand over, it is the responsibility of the Asset Owner or his delegated representative to ensure resolution of the problem through the contract management group.

3.2.6. Optical Fibre Cable

3.2.6.1. General

SMOF cables are the standard cables used in the outside plant network.

All underground cables are of loose tube construction. The cable consists of optical fibres (not ribbon) contained in loose tubes and where required fillers. Generally, these tubes are laid up with "SZ" stranding around the FRP central strength member for ease of mid span access jointing. Some cables consist of a single loose tube without an FRP central strength member. These cables use yarns for additional strengthening in addition to, or in place of, the FRP central strength member. Cables consist of 6, 12 or 24 fibres per loose tube.

All external optical fibre cable designs are of dielectric construction (i.e. non-metallic) with the exception of Underwater cable.

External SM@RTCORE & MiniSm@rt cables are water blocked without the use of petroleum based jelly filling compound to prevent the ingress of water and other impurities. Most external cables have a blue outer nylon hard jacket to provide protection against insects (i.e. termites & ants) and to assist hauling into ducts. In all these cables the nylon jacket is bonded to the polyethylene sheath, therefore it cannot be stripped by itself. Stripping tools should cut the whole sheath. This characteristic differentiates bonded cables from traditional nylon jacketed cables. Nylon Rip Cords are provided for within the cable for assistance in cable preparation for jointing/termination of the cable

Aerial and Underwater cables have a black polyethylene sheath.

Cables for internal applications such as Internal Tie have a blue LSZH sheath, and Riser Customer Premises cables may have a Blue, Red, Yellow, Orange, Black or blue NHFR sheath.

All cables are sheath marked and have a unique cable number, see 3.2.6.5 for quick and easy recording and tracing of the cable.

3.2.6.2. Serial / Item Code

The following Serial/Item (S/I) codes are used to identify the fibre type and fibre count in Telstra optical fibre cables (This only applies to the old S/I numbers).

Serial 484 represents SMOF cable. The 3 digit serial number is followed by a 5 digit item number. The first two digits of the item number represent the cable design construction, refer to Table 6. The third digit of the item number is either a 1, 5, 7 or 8, where;

- -1 represents cables with fibre counts 6-72;
- - 5 represents fibre 120 or 144 cable;
- - 7 represents 312 fibre cable;
- - 8 represents 624 fibre cable.

And the final two digits indicate the fibre count.

E.g. S484/24112 is a Single Mode Standard 12 fibre optical fibre cable, where 112 represents the fibre count, as shown in Table 5.

Fibre Count	Item No.
12	S484/24112
36	S484/24136
72	S484/24172
144	S484/24544
312	S484/24712
624	S484/24824

Table 5 – Optical Fibre Cable Serial and Item Codes

3.2.6.3. Cable Design Construction - Cable Codes and Standard Fibre Counts

The standard cable design construction and fibre counts available under Serial 484 are as shown in Table 6.

Serial/ Item	Core/Sheath Code	Sheath/Jacket Marking	Fibre Counts
484/24***	FNPEHJC/STD	STANDARD BONDED SM@RTCORE®	**12,36,72,144,312 and 624**
	FNPEHJC/STD	STANDARD BONDED Sm@RTLink®	**12,36, 72 and 144F**
	FNPEHJC/STD	Flextube	**360 and 720F**
484/31***	AERIAL	AERIAL – SHORT SPAN	**12, 24, 36 and 72**
484/36***	FNPEHJC/HS	HIGH STRENGTH BONDED KLEENCORE®	**12, 24,36, 72, 120**
484/50***	FMDHWPJ	UNDERWATER	**12, 24, 36, 72, 144 and 312**
484/53***	RODENT - DIELECTRIC	RODENT DIELECTRIC BONDED ARM@CORE®	**12,24, 36, 72, 120 & 360 for duct only use**
484/62***	LSZH/TIE	INTERNAL TIE	**12,36,72,144 and 360**
484/92***	INTERNAL CABLE CUSTOMER PREMISES	INTERNAL RISER CUSTOMER PREMISES	**12,24**

Table 6 – Serial 484 SMOF Cable Construction – Cable Codes and Fibre Counts

3.2.6.4. Colour Code for Optical Fibres and Loose Tubes

Single tube cables such as 12f standard cables have a single white coloured tube. For all other cables each tube is colour coded for identification purposes. In all cables the fibres in each tube are colour coded. 12-360f cables have 12 fibres per tube, and 624f cable has 24 fibres per tube. The colour code sequences for fibres, and for tubes in 12f to 624f cables, are shown in Table 7:

TUBE OR FIBRE NO.	TUBE OR FIBRE COLOUR	TUBE NO.	TUBE COLOUR		624F CABLE ONLY	
			COLOUR	STRIPE	FIBRE NO.	FIBRE COLOUR (*Note 1*)
1	Blue	13	Blue Black	Black	13	Blue [1]
2	Orange	14	Orange	Black	14	Orange [1]
3	Green	15	Green	Black	15	Green [1]
4	Brown	16	Brown	Black	16	Brown [1]
5	Grey	17	Grey	Black	17	Grey [1]
6	White	18	White	Black	18	White [1]
7	Red	19	Red Black	Black	19	Red [1]
8	Black	20	Black	White	20	Clear [1]
9	Yellow	21	Yellow	Black	21	Yellow[1]
10	Violet	22	Violet	Black	22	Violet [1]
11	Pink	23	Pink	Black	23	Pink [1]
12	Aqua	24	Aqua	Black	24	Aqua [1]
		25	Blue	White		
		26	Orange	White		

Table 7 – Colour Code for Optical Fibre, Loose Tubes & Fibres

Note 1: Fibres 13 to 24 are marked with black rings around the fibres.

3.2.6.5. Cable Marking

The cable sheath/jacket is repeatedly marked at a spacing not exceeding one metre as follows:

"TELSTRA PRYSMIAN 'A TICK' 06/04 CN4321X SMOF STANDARD BONDED SM@RTCORE® 12/24 00001 M↑"

Where:

- "PRYSMIAN" represents the cable manufacturer's company name .
- 'A TICK' denotes compliance to AS/ACIF S008, Australian Standard Requirements for authorised cabling products;
- "06/04" is the month and year of manufacture;
- "CN4321X" is the unique factory production number. This information will help in identifying (and separating) cables in the ground, as well as identifying and recording the cable;
- "SMOF" indicates Single Mode Optical Fibre. ;
- "STANDARD BONDED SM@RTCORE®" (or "HIGH STRENGTH BONDED SM@RTCORE®" etc.) identifies the cable type /application;
- "12/24", the "12/" is the number of fibres in unit 1 and "/24" the total number of fibres;
- "00001 M↑" is the length mark in metres, at the point designated with the"↑".

3.2.7. Splice Protectors

Heatshrink splice protectors are the standard splice protectors for all splices on 250 or 900 μm fibres.

There is one preferred size to suit the various splice trays used in the Telstra network, and it is important to choose the most suitable size for the particular application;

- Splice Protector S49400408. Has a shrunk diameter of 2.6 mm and length of 45 mm, and is to be used with splice trays in Corning UCNCP MAX and VIP closures, and is more suitable to be used on splice trays in the Tyco FIST closure and HDODF. (Commscope Brand)
- There is also a WBT splice protector that is extremely similar in spec and some jointers prefer to use these in the WBT splice trays. They are not suitable for other applications and may only be used in WBT splice trays. This old part number that has been blocked is S49400295

If you are having issues with putting the Commscope splice protectors into holding combs , ensure that you have shrunk them down correctly as there has been issues with not putting enough heat into the protectors and they have not shrunk down sufficiently.

A guide to the preferred diameter splice protector for some particular splice tray applications is shown in Table 8.

Application	Preferred Protector Diameter (mm)
W&B splice trays for UCN/UCNP In-line closures (refer 4.4.11)	2.6
Tyco (Fibernet) splice trays for UCN/UCNP In-line closures.(obs)	2.6
Tyco FIST closure SOSA-SE trays.	2.6
Corning UCNCP Max and VIP closures (refer 3.4.10)	2.6
24/72 Openable closure (rubber splice holders)	2.6
Exchange terminations- W&B OFDF splice modules (S49400093) with yellow splice holders.	2.6
Exchange Terminations - Tyco HDODF	2.6

Table 8 – Preferred Splice Protectors

3.2.8. Splice Closures

The range of current splice closures used for the optical fibre cable network is shown in Table 9.

Previously Channell manufactured Fibre Openable Joints (OJ's) were orderable via Telstra Serials 494, 509 & 513 with common components suitable for both fibre and copper use. With the recent change of copper OJ's moving to a different supplier's product which uses a gel sealant instead of heat shrink cable sealing method. It has been decided to consolidate all Channel heat shrink sealable OJ's onto the Serial 494 product family.

NOTE : Small Openable Joints used in the optical fibre network will continue to use the same Channell supplied, heat shrink sealed joints and not adopt the gel sealant type used in the copper network.

Ensure that construction fibre network staff order and use only the approved 24 & 24/72 small OJ's supplied by Channell Australia Pty. Ltd.

Telstra Material Number	Closure Type - Description
509/00080	UCN 7-10 In-Line
509/00081	UCN 7-20 In-Line
509/00082	UCN 9-20 In-Line
509/00084	UCN 9-30 In-Line
49400312	Splice Closure In-line UCNP 7-10
49400313	Splice Closure In-Line UCNP 7-20
49400314	Splice Closure In-Line UCNP 9-30
49400315	End Cap 7 Inch (UCNP)
49400316	End Cap 9 Inch (UCNP)
49400317	Sealing Gland, Single Port 7 Inch
49400318	Sealing Gland, Single Port 9 Inch
49400319	Splice Closure In-Line UCNP 9-20
49400361	Openable Joint 24/72 Fusion Splice Kit
49400362	Channell 180060 single sided splice module
49400363	Hinge, splice tray cover O/F closure
49400364	Latch , splice module O/F closure
49400365	MAIN PORT KIT,24/72 OPT/FIBRE CLOSURE
49400366	BASE,SPLICE MODULE 24/72 O/F CLOSURE
40007311	ENCLOSURE,OPTIC FIBRE 24 FUSION KIT
40007315	TAPE,SEALANT 1.5MM X 25MM X 5M
40007316	SLEEVE,HEATSHRINK O/J KIT EXP ID 28MM
40007317	MAINTENANCE KIT,MAIN PORT 24F JOINT
40007318	O-RING, 24F OPENABLE JOINT ENCL 95MM
40007319	O-RING,24/72F OPENABLE JOINT ENCL 135MM
40007320	CLAMP,24 FIBRE OPENABLE JOINT ENCLOSURE
40007321	CLAMP,24/72 FIBRE OPENABLE JOINT ENCL

49400508	UCNCP 9-24 Max with Loose Tube Tray
49400509	UCNCP 9-24 Max with no Loose Tube Tray
49400510	UCNCP 9-28 Max with Loose Tube Tray
49400511	UCNCP 9-28 Max with no Loose Tube Tray
49400287	UCNCP 9 -18 VIP
49400297	UCNCP 9 -28 VIP

Table 9 – Optical Fibre joint/splice closures

Note: Those in the shaded area are obsolete for use in new closure installations.

3.2.9. Splice Trays and Components for UCNCP Closures

Telstra Material Number	Splice tray/Component
49400512	Splice Tray UCNCP MAX Grey
49400513	Splice Tray UCNCP MAX Blue
49400514	Splice Tray UCNCP MAX Black
49400515	Splice Tray UCNCP MAX Red
49400288	Splice Tray, UCNCP VIP White
49400289	Splice Tray, UCNCP VIP Black
49400290	Splice Tray, UCNCP VIP Red
49400291	Splice Tray, UCNCP VIP Blue
49400292	Tubing Protective Jacket 570-595mm
49400293	Kit, Cable Gland Dual
49400294	Lid, Splice tray VIP

Table 10 – UCNCP Closure Splice Trays and Components

Note: Those in the shaded area are obsolete for use in new closure installations.

3.2.10. Splice Tray Kits for UCN/UCNP Closures

Telstra Material Number	Description
49400264	Organiser Splice 1 Tray Kit 6-12 fibres
49400265	Organiser Splice 2 Tray Kit 18 –24 fibres
49400266	Organiser Splice 3 Tray Kit 36 fibres
49400267	Organiser Splice 5 Tray Kit 60 fibres (this serial item is being changed to 6 Tray kit 72 fibres to suit 72f cable)
49400284	Organiser Splice 10 Tray kit 120 Fibres
49400268	Organiser Splice 12 Tray Kit 144 - 288 fibres (2 sets for 288 fibres)
49400269	Organiser Splice Single Expansion Tray Kit

Table 11 – Splice Tray Kits (W&B) for UCN/UNCP In-Line Closures

3.2.11. Cable Storage

All optical fibre cables should be stored under cover. When it is not proposed to use the cable for one year or more the cable must be kept under cover or wrapped in black plastic sheeting.

3.2.12. Optical Connectors

The standard optical connector used by Telstra is the SCAPC (Angled SC). This connector has an 8° angled optical face.

Since the introduction of A Grade connectors into Telstra in 2013 we are now changing the SCAPC, SCPC, LCPC & LCAPC connector allowances from 0.3dB to 0.2dB to better reflect the actual Telstra Grade A connector losses. Telstra Grade A spec is for 0.07dB typical and 0.15dB max; so a 0.2dB allowance is still sufficiently conservative.

Retain older connector IL allowance at 0.3dB to cover off the legacy DIN connectors and IEC Grade B SCAPC connectors that were the norm prior to 2013.

Set the IL allowance for single mode MTPA connectors at 0.35dB to reflect the MTP Elite performance level of the Telstra spec. Connector IL for MTPA Elite grade is 0.10dB typical and 0.35dB max

The SCAPC connectors are readily identified by their emerald green coloured casings and are used on:

- OMF
- OFDF
- OFF
- OSF, OEF
- All Customer service delivery points.

3.2.13. Optical Connector Cleaning Materials

For all Optical Fibre Cleaning Materials refer to Telstra publication 018334 (TAF0001-446806) “Fibre Interface Inspection and Cleaning – Requirements for Telstra Networks”, table 2 "Optical Fibre Cleaning Items Available on Telstra S/I".

3.2.14. Optical Fibre Modular Termination Equipment

3.2.14.1. OFDF and HDODF (High Density Optical Distribution Frame)

Refer to Technical Specification TM000183-A02 Optical Distribution frame – OFDF, and Technical Specification TM000183A01 “High Density Optical Distribution Frame HDODF”.

3.2.15. Access Termination Materials

A list of optical fibre termination materials used for the construction of Access networks (specified as BAN products) is contained in Table 12. This includes splicing and patching OFDM’s based on Tyco (Raychem) SOSA - SE splice trays, which may be used in some exchange installations, refer to Technical Specification TM00183 –A03 “ODF -Tyco BAN OFDM’s”.

Telstra Material Number	Description
49400211	Optical Fibre Distribution Module (OFDM) 24F, 1 Drawer, BAN
49400194	Optical Fibre Distribution Module (OFDM) 48F, 2 Drawer, BAN
49400195	Optical Fibre Distribution Module (OFDM) 96F, 4 Drawer, BAN
49400196	Optical Fibre Distribution Module (OFDM) 48F, 3 Drawer, Patch 24F, BAN
49400197	Optical Fibre Distribution Module (OFDM) 96F, 5 Drawer, Patch 24F, BAN
49400198	Patch Panel - OFDM 24F, BAN (fits S49400196 and 197)
49400214	Patch Panel - COFTU 12F Rack Mounted Unit 1.5 RU, BAN (fits S49400213)
49400215	Patch Panel - COFTU 12F Wall Mounted Unit, BAN (fits S49400212)
49400236	12 Fibre COFTU, Wall Mounted
49400243	Customer Optical Fibre Termination Unit (COFTU), Wall mounted, 48F
49400139	Optical Fibre Term. Unit (OFTU), 24F, Twin FSC, Lockable, Wall Mounted
49400140	Optical Fibre Term. Unit (OFTU), 24f Lockable, Wall Mounted
49400298	12 Fibre Wall Box, External, Splice/ Patch
49400299	24 Fibre Wall Box, External, Splice/ Patch
49400300	Pole Mounting Bracket Kit
49400204	Anchor, Pigtail Optical Fibre, BAN
49400209	Cutter, Loose Tube Optical Fibre, BAN

49400162	24F Splice /Patch Termination Cabinet(Tyco), replaces S49400126 and 144
49400463	24 Fibre Splice/Patch Tray, Rack mounted 1RU (Warren and Brown) - replaces S49400126 and 144
49400466	6-12 Fibre Splice/ Patch Tray, Rack Mount 1 RU - replaces S49400126 for Wideband applications
49400372	96 Fibre Wall Mounted Enclosure
49400542	Wall Terminated Cabinet, 96 Fibre
49400543	Tubing, Clear, Large Protection
49400544	Entry Kit, Oval Port

Table 12 – Access Termination Materials

3.2.16. Marker Posts & Signs

The approved marker post system comprises a 500 mm Telstra gold triangular top section fitted to a white tubular pipe section. Refer to Table 13.

Telstra Material Number	Description	Comments
44800043	Post, 1.3 M O/F Cable Marker with Signs	Fitted with signs S448/00036,38 & 53
44800061	Post, 2.0M, O/F Cable Marker with Signs	Fitted with signs S448/00036, 53 & 62
44800050	Post, 2.0M, O/F Cable Marker Flat Base with Signs	One end flattened & installed directly in the ground. Fitted with signs S448/00036,38 & 53
44800051	Support, Marker Post 450mm Long	Used in conjunction with S448/00043 & 61
44800044	Support, Marker Post 600mm Long	Used in conjunction with S448/00043 & 61
44800054	Support, Marker Post 750mm Long	Used in conjunction with S448/00043 & 61
44800036	Sign, Warning O/F Cable Marker	Fitted to one side of the yellow triangular portion of all posts
44800038	Sign O/F Triangular, Cable Marker Location	Fitted on top of the yellow triangular portion of the post, S448/00043 & S448/00050 only
44800053	Sign, O/F Cable Identification Details	Fitted to one side of the yellow triangular portion of all posts
44800055	Sign, Warning, Metallic Cables	Field fitted to a post where metallic cables are in the vicinity of the O/F cable
44800062	Sign, O/F Cable Marker Location	Rectangular plate which is fitted to the side of the yellow triangular portion of 448/00061
44800063	Sign, O/F Triangular, Multiple Cables	Field fitted to yellow triangular portion of posts where more than one O/F cable is in vicinity

Table 13 – Marker Posts & Signs

3.2.17. Transponder Peg and Detectable Marker Tape

Telstra Material Number	Description
49400032	Transponder Peg
49400085	Detectable Marker Tape 2kM

Table 14 – Transponder Peg and Detectable Marker Tape

3.2.18. Cable Identification Tag and Accessories

Telstra Material Number	Description
09700104	Rectangular White PVC Tag
69900123	Permanent Marking Pen
26900092	Plastic cable Ties - 2.5mm X 100mm
26900099	Plastic cable Ties - 3.5mm X 200mm

Table 15 – Cable Identification Tag and Accessories

3.2.19. Conduit Sealing Plugs and Devices

Devices and plugs for sealing Conduits are, as shown Table 16.

Further details are available in Telstra Technical Specification TM00042 “Conduit Installation”.

Telstra Material Number	Description
07300216 to 00218	Rubber Plug
07300074	Tapered Polyethylene Plug
43800024	Pressure Type Duct Plug
TDUX Conduit Sealing System	
07300160	Installation Tool Complete
073000229	CO2 Gas Cylinder (10 per carton)
07300193	TDUX-45 Conduit Sealing Kit
07300194	TDUX-60 Conduit Sealing kit
07300195	TDUX-90 Conduit Sealing Kit
07300196	TDUX-100 Conduit Sealing Kit
07300197	TDUX-125 Conduit Sealing Kit
07300228	TDUX CL- 80 Duct seal Clip (seals 3 or more cables)
07300227	TDUX CL- 60 Duct seal Clip (seals 3 or more cables)
07300200	TDUX CL- 40 Duct seal Clip (seals 3 or more cables)
07300199	TDUX CL- 20 Duct seal Clip (seals 3 or more cables)

Table 16 – Conduit Sealing Plugs and Devices

3.2.20. Bracket Sets for Housing In-Line Closures

Telstra Material Number	Description
49400472	Bracket Set for UCN/UCNP 7/10 or 7/20- for use in P6, P8 or P9 pits, or manholes
49400473	Bracket Set for UCN/UCNP 9/20 or 9/30 – for use in P9 pits or larger manholes

Table 17 – Bracket Sets for In-line Closures

3.3. Installation

3.3.1. Labelling of Plant

Unless otherwise specified, all plant installed under this Specification shall be labelled in accordance with the details contained within Telstra Publication 000 511 "Numbering, Labelling and Data Entry Requirements of Network Inventory".

Optical Fibre cables shall be labelled as shown in Section 3.3.26, and cable sheaths shall be identified as per Technical Publication 004 527 A19 " Standard Identification Scheme for Transmission Paths – Optic Fibre Cable Sheaths".

3.3.2. Recording of Plant

All additions or alterations to Telstra network plant shall be recorded in the appropriate Telstra Systems. It is the responsibility of the Contractor to input the appropriate data to these systems prior to commissioning and handover. Contractors shall arrange the necessary systems access/data input by contacting Data Services.

The identities and data input requirements (data elements) for each of the systems associated with Optical Fibre cable installation are, as shown in 3.4.5.

When recording or altering details in Telstra Systems, the requirements in the Schedule 9 document, 013 310 "Contract Identification – Contractor Database Requirements" are mandatory.

3.3.3. Network and Customer Outages

When any work is to be performed on cables that have working fibres contained within the sheath, it is necessary to take all possible precautions to ensure that no unplanned network outages occur. Where an outage is unavoidable, notification must be sent to any customer likely to be affected.

3.3.4. Plant Location Procedures - Other Than Emergency works

All Constructors have a *Duty of Care* to observe with regard to Telstra plant when they break ground.

A plant location must be sought sufficiently in advance of construction activities through the 'Dial Before you Dig' service by:

- Go Online – visit www.1100.com.au and logon using your user name and password OR register as a new user
- iPhone APP – visit 1100.com.au and download APP
- Call 1100 – Call the DBYD national call centre on 1100 to register and lodge an enquiry from anywhere in Australia

Plans of Telstra network facilities will be provided free of charge upon request and all Constructors must undertake manual exposure i.e. potholing when excavating or working closer to Telstra plant than the following approach distances:

Note: For plant in kerbed and guttered or otherwise established footway reserves - a minimum clear distance of 600 mm must be maintained from where it could be reasonably presumed that plant would reside.

- In non-established or unformed reserves/terrain, this approach distance must be increased to 1.5 m.

- In country/rural i.e. where terrain is open to wider variations in reasonably presumed plant presence, the following minimum separations for approach distances must be maintained:

Parallel to major plant in rural areas	10 m;
Parallel to other plant in rural areas	5 m;
Hand digging parallel to major plant	1 m;

- Potholing needs to be undertaken manually with care and employing techniques least likely to damage cables, for example shovel blades/trowels should be oriented parallel to the cable rather than digging across the cable.

Telstra will hold Constructors liable for any damage to plant where Telstra considers a breach in care has occurred.

3.3.5. Directly Buried and Duct Applications

High Strength (HS) cables shall be used for all direct buried applications. Standard cable shall be used for in-conduit installations.

3.3.5.1. Optical Fibre Cable Mechanical Performance Data

Table 18 below contains cable specifications, and performance data relating to maximum hauling tensions, crush resistance and minimum bending radii for all types of Sm@rtCore SMOF cables used in the Telstra Network which must be complied with during the design and installation of optical fibre networks. Refer to 3.3.11.7 and 3.3.11.8.

Table 18 below contains cable specifications, and performance data relating to maximum hauling tensions, crush resistance and minimum bending radii for all types of FlexTube SMOF cables used in the Telstra Network which must be complied with during the design and installation of optical fibre networks. Refer to 3.3.11.7 and 3.3.11.8.

Table 18 below contains cable specifications, and performance data relating to maximum hauling tensions, crush resistance and minimum bending radii for all types of MiniSm@rt SMOF cables used in the Telstra Network which must be complied with during the design and installation of optical fibre networks. Refer to 3.3.11.7 and 3.3.11.8.

Cable Description	Fibre Count	Nominal Outside Diameter (O.D.)*mm* Sm@rtCore	Max. Hauling Tension *kN*	Short Term Crush (10 min.) *kN/100mm*	Long Term Crush (2 hrs.) *kN/100mm*	MBR Under No Load *mm*	MBR Under Full Load *mm*
Standard	12-72	10.0	2	2	1	100	200
	144	13.6	4	2	1	140	250
	312	18.3	4	2	1	165	300
	624	21.6	4	2	1	220	400
High Strength	12-72	15.0	4	6	3	225	450
	120	19.6	5	6	3	300	600
Rodent Proof	12-72	14.4	4	6	3	220	440
	120	17.9	5	6	3	270	540
Underwater	144		4				
	312	19.3	5	6	3	290	580
	12-72	32.3	30	5	2	650	975
Internal Tie	144	34.3	30	5	2	690	1035
	312	41.0	30	5	2	820	1230
	12-72	9.4	2	1.0	0.5	85	200
	72	9.4	2	0.5	0.25	100	200
Aerial	120	13.5	2	0.5	0.25	135	200
Internal Riser	144	13.2	2.5	1.0	0.5	120	240
	312	15.9	2.5	1.0	0.5	160	300
	12-72	13.5	2.7	2	1	400	500

Table 18 – Optical Fibre Cable Mechanical Performance Data

Cable Description	Fibre Count	Nominal Outside Diameter (O.D.)*mm* FlexTube	Max. Hauling Tension *kN*	Short Term Crush (10 min.) *kN/100mm*	Long Term Crush (2 hrs.) *kN/100mm*	MBR Under No Load *mm*	MBR Under Full Load *mm*
Standard	360	18.3	4	2	1	165	300
	720	21.6	4	2	1	220	400
Rodent Proof	360	14.4	4	6	3	220	440
	720	17.9	5	6	3	270	540
Underwater	144		4				
	360	19.3	5	6	3	290	580
	12-72	32.3	30	5	2	650	975
Internal Tie	144	34.3	30	5	2	690	1035
	312	41.0	30	5	2	820	1230
Internal Riser	144	13.2	2.5	1.0	0.5	120	240
	312	15.9	2.5	1.0	0.5	160	300
	12-72	13.5	2.7	2	1	400	500

Table 19 – Optical Fibre Cable Mechanical Performance Data

Cable Description	Fibre Count	Nominal Outside Diameter (O.D.)*mm* MiniSm@rt	Max. Hauling Tension *kN*	Short Term Crush (10 min.) *kN/100mm*	Long Term Crush (2 hrs.) *kN/100mm*	MBR Under No Load *mm*	MBR Under Full Load *mm*
Standard MiniSm@rt	12-72	10.0	2	2	1	100	200
	144	13.6	4	2	1	140	250

Table 20 – Optical Fibre Cable Mechanical Performance Data

3.3.5.2. Guard Post (Bollard) Placement

To protect Telstra's plant, guard posts shall be used where there is danger of vehicular traffic proceeding over underground plant, or into above ground installations.

3.3.6. Direct buried cable

3.3.6.1. Route Preparation

All Cable Plant Categories A, B, C and D ploughed optical fibre cable installations must be pre-ripped to a depth greater than the ploughed depth and such that a sufficient bed of fines is provided at cable depth. The only exceptions shall be in sandy soils, which are known to not have rock to cable depth and

after periods of excessive rain to avoid damage to the cable and the need for excessive reinstatement works. The final rip shall be in the same direction as the plough. For Cable Plant Categories E and F ploughed cables route preparation will vary depending upon soil conditions and the type of ploughing equipment used, but shall ensure satisfactory long term performance of the cable.

Any identified exclusion or sensitive areas (Cultural, Environmental, etc) are to be clearly identified and suitably marked prior to any construction activity in the area eg. flagging tape, barrier fencing, etc. Installation activities are to be adapted to ensure encroachment into these areas does not occur. For example: Only one sighter flag/post to be placed at a time and a ground spotter required to be present and to be in radio contact with all machine operators during works in the vicinity of sensitive areas.

Directional boring is the preferred installation method for creek and river crossings. Creek and river crossings must be prepared, such that the depth of cover is adequate under all conditions. Extra cable protection should be considered. For ditched cable installations, the bottom of the trench shall be prepared so as to ensure that the cables performance is not compromised.

3.3.6.2. Ploughing

The cable must be installed using Telstra certified cable tension limiting equipment.

For Telstra's policy on plough certification, refer to Telstra Specification TM00044 A02 "Optical Fibre Cable Plough Compliance".

The standard depth of cable shall be 0.9m, apart from where circumstances specifically require the cable to be buried deeper.

The depth of laying optical fibre cable by direct burial will vary according to the category of cable. Refer to Table 21 for cable categories and depth of burial minimum standards.

Category	Transport Architecture	Switching Architecture	Next Generation Network(NGN) Architecture	Minimum Depth of Burial (m)
A	MTH -MTH	TNS - TNS	ASN - ASN	0.9 Refer Note 1 & Note 2
B	MTH - LTH	TNS - LAS	ASN - EAP	0.9 Refer Note 1 & Note 2
C	LTH – LTH (Country)	LAS - LAS	EAP - EAP	0.9 Refer Note 1 & Note 2
D	LTH – LTH (Metro)	LAS - LAS	EAP - EAP	0.9 Refer Note 1 & Note 2
E	LTH - TAP	LAS - RAU		0.9 Refer Note 3 & Note 4
F	TAP - TAP	RAU – UNIVERSAL PGS		0.9 Refer Note 3 & Note 4
G	Lead-In			0.6

Table 21 – Cable Plant Categories and Depth of Burial

Notes: Category A, B, C, E and F cables are predominantly direct burial optical fibre cables, however where these cables are located in major cities / towns they will normally be installed in ducts.

Category D cables are predominantly installed in ducts:

Note 1. Fibre cables to be laid at a minimum of 900mm below surface – where 'going' is easy, cables should be laid at a greater depth than minimum.

Note 2. The following circumstances require the cable to be buried to a minimum of 1.2M (3.3.6.3 still applies)

- Flood plain
- Tilled crop land
- Areas prone to Land erosion & water run-off
- Road crossing, creek/river crossings, dry water course
- Roads bordering farm lands
- Reactive soil
- Dispersive soil

Such areas must be detailed by the designer in the design pack

Note 3. This category of cable is normally installed in ducts but there are some direct buried applications;

Note 4. The objective for Category E and F cables is for these categories to be all buried to a depth of 0.9 m, but it is acceptable for all Category F cables and Remote Integrated Multiplexer (RIM) Category E cables to be buried to a depth of 0.75 m.

3.3.6.3. Variation to Depth of Burial

In extreme examples it may not be possible to achieve the minimum depth specified. For example in solid rock in may be possible to bury at a lower depth and cover in concrete.

To vary the minimum depth of directly buried cable less than the minimal depth specified, permission must be granted by the Telstra Principle in each instance. Telstra principal will engage designers and specialists to ensure the proposed alternative provides an acceptable alternative level of protection for the cable.

3.3.6.4. Dual Cable Ploughing

When multiple dielectric cables (e.g. non-metallic optical fibre cables) are co-ploughed then there are no restrictions to them being installed together in the ground. Normal zero tension requirements apply to each of the cables.

In the event where metallic cable(s) e.g. copper cable, or cable that contains a metallic element, are co-ploughed with dielectric cable(s), then the dielectric cable(s) shall be ploughed under the metallic cable with a separation of not less than 300 mm between the dielectric and metallic cables.

Detectable marker tape, refer to 3.3.9.5, must be used for all installations where optical fibre cable is directly buried including where dual ploughing with metallic cable.

Where it can be realistically and practically achieved, the marker tape should be installed above and separated from the metallic cable by 300 mm.

Where a metallic guard wire is to be installed above the metallic cable (separation of 300 mm). The optical fibre detectable marker tape may be installed with the guard wire.

Where no guard wire is being installed and extra depth for the marker tape is desirable (e.g. in paddocks where deep ploughing likely), the tape may be installed at the same depth as the metallic cable.

For guard wire installation specifications, refer to Technical Specification TM00043 “Copper Cable”.

3.3.6.5. Expansive Soil & Rocky Areas

HS (High Strength) cable is to be used for all direct buried installations, including areas where expansive soils or rock are encountered.

In areas where rock exists, the decision to use Standard cable in pipe in lieu of HS cable may be made by the Designer. Standard cable installed in conduit, subducts is not a cost effective alternative to the use of directly buried HS cable, but may be justified where short/isolated sections of rock are encountered.

HS cable generally should not be used in conjunction with conduits, subducts, or split pipes, but may be used where extra protection to the cable is required. In reactive soil areas, split pipe does not provide any protection to the HS cable from the reactive soil forces, and direct burial of the HS cable is the recommended method. Using split duct for HS cable installation in a reactive soil area would void the manufacturer’s guarantee on the HS cable performance and hence it is not recommended.

3.3.6.6. Ditching

Where ditching is used for cable installation, the optical fibre cable shall be laid in the trench under zero tension. The trench shall be back filled in a manner which ensures that the cable's performance is not compromised. It is permitted to co-install a metallic cable in a trench with an optical fibre cable as long as there is a minimum of 300mm separation between the cables.

3.3.6.7. Shared Trench with Power Cables

Where optical fibre cable is installed in a shared trench with power cable, the OFC is to be installed above the power cable with the following separations:

- LV cable (<1000V); 100 mm. (Power cable installed with protective covering);
- HV cable (<22kV); 300 mm /450 mm*.

* Where power cable has no protective covering.

All shared trenches must be recorded on cable network plans.

3.3.6.8. Laying Off Cable

Where a directly buried cable is to be installed through a short section of conduit e.g. at a road or river crossing, through rock etc. and a joint is not required in that vicinity, if the cable length permits it is preferable that the cable be laid off the cable drum and hauled through the conduit, then re rolled on the drum for continued ploughing, rather than cutting the cable and creating a joint in the cable.

3.3.7. River and Waterway crossings

Each river and waterway crossing situation is unique and requires appropriate civil installation strategy and technique. Before deciding on the most appropriate solution for installation of the fibre cable from one side of the river/waterway to the other, consider the following: Extreme weather conditions, disaster recovery and importance of the fibre path, possibility of attaching fibre to permanent substantial bridge structures.

River or waterway crossings must be installed with the following factors in mind:

- If directional boring, ensure that the placement of Manholes and depth of bore takes into account the local weather & environmental conditions;
- While deep ploughing the cable directly into dry river beds ensure minimum depth of 1200mm and a nominal depth of 1500mmis achieved;
- Consider attaching the cable to substantial permanent bridges in Galvanized Iron conduits on the downstream side of the bridge wherever possible, ensuring that the bridge is not about to be replaced;
- For waterways, other than for small creeks or gullies, optical fibre cable will be installed in conduit to provide greater protection, or future access or installation, unless otherwise specified by the Principal (Telstra);
- Creeks and channels which have permanent water are to be crossed using directional boring techniques;
- Where there is not permanent water, cable or conduit may be installed by plough or trenching;
- To prevent erosion of banks, installation at bends in creeks or rivers should be avoided;
- Avoid locations where there are strong currents, rapids, flood lines or severe tidal activity;
- Choose locations where the banks are naturally sloped to minimise earth work during construction. Avoid steep slopes and unstable soil conditions;
- Consider the depth of water, and boating, shipping or other activities on and beneath the water, and where possible avoid areas of heavy use or where there is a potential for conduit /cable disturbance or damage ;
- Depth of burial of conduit within the river/waterway shall consider scour, where normally, the depth recommended for soil conditions should suffice with an absolute minimum of 600 mm depth and preferably at a depth of 1.2m;
- Directly buried cables shall be installed in firm creek material at a depth not less than 1.2 m;
- Where possible, the route should take the shortest path across the waterway, perpendicular to the water flow;
- Banks should be reinstated with minimum slope, and stabilised by appropriate compaction e.g. sheep's foot roller, planting of seeds or using other suitable erosion control products;
- Reinstatement should direct water run off away from the disturbed banks by constructing diversion banks;

- At each major crossing , a manhole is to be installed on each side of the crossing with a 30 m loop of cable housed securely in each manhole;
- Pits or manholes shall be placed on top of banks, with cable or conduit buried at standard depth of cover measurements between the pit/manhole and waterway. Placement of the manholes should be such that they will not be affected by extreme flooding events, taking into account the known recent and past local conditions.
- All waterway crossing conduits are to be sealed using an appropriate sealing method. Refer to 3.3.14.

Data on extreme and high risk areas can be gained from reinstatement works for the previous ten year period. This will give a good insight to any significant issues in the area.

3.3.8. Cable Location and Exposure

The required separations from existing working cable for new cable installations are, as shown in 3.1.8.1.

3.3.8.1. Exposure Excavations

Where an existing optical cable is required to be exposed during new construction or maintenance activities, the following procedure must be followed:

- Excavate by hand tools or machine to locate the cable marker tape (with or without metallic element);
- Without excavating to any greater depth, excavate by hand tools or machine to similar depth but 500 mm offset from the cable marker tape;
- Continue excavating to below the nominal cable depth along the offset trench;
- Using hand tools only, excavate carefully to expose the cable below the marker tape.

3.3.8.2. Pot – Holing

- Hand dig to depth of marker tape;
- If marker tape is not found, hand dig to expose cable and mechanical aid may operate outside 1 m of cable location.

3.3.8.3. No Metallic Element Present

- Locate transponders;
- Pot-hole the working cable every 50 m.

3.3.8.4. Continuous Metallic Element Present

- Locate working cables continuous over length;
- Peg or spray location every 10 m and at deviations of 1 m from a straight line.

3.3.8.5. Cable Crossing

- Proposed cable shall cross at 90º to working cable;
- Expose working cable by pot-holing;
- Cover exposed cable with protective barrier, refer to 3.3.8.6;
- Machinery shall not operate within 1 m of unprotected working cable;
- Dig away from protected working cable with mechanical aid.

3.3.8.6. Cable Protection

Exposed working cables shall be protected by a mechanical barrier placed over the exposed cable to prevent damage during installation activities.

Suitable material is steel beam 600 mm x 50 mm x 10 mm, steel channel 600 mm x 50 mm x 10 mm, or bent steel plate 600 mm x 50 mm x 10 mm.

3.3.9. Route Marking

3.3.9.1. Route Marking System

The system to mark and detect buried optical fibre cables comprises three parts:

- Marker posts;
- Underground marker system comprising a detectable marker tape and transponder pegs where required;
- Accurately surveyed route together with "marked-up" plans showing the locations of all route markings. Refer to 3.4.1.

In instances where soil corrosivity is known / proven (see CSIRO - Soil Assessment Manual) to render the stainless steel metallic component of the detectable tape ineffective during the expected lifetime of the cable, the addition of transponder pegs are required. The use of detectable tape is allowable in lightning prone areas without the adoption of any special precautions other than to endeavour to maintain a 300 mm separation between the tape and the cable.

3.3.9.2. Marker Posts

An approved marker post together with the appropriate attached caution/location signs, refer to Table 13, must be used on all directly buried optical fibre cable routes, where cable is in conduit across "open" grass type areas, and at road, creek and waterway crossings, to accurately show the location of the cable. Marker posts are not required where cable is in conduit in typical urban street type areas.

Marker posts are to be installed at regular intervals along the route, eg, five to ten per kilometre, so that from any position along the cable at least two other posts can be seen in both directions under all conditions including high "flora" growth periods. Marker posts shall also be installed at deviations of greater than 600 mm from the general cable route direction, at changes in direction of the cable route and both sides of waterways and road crossings. This requirement does not apply at bends where the change in direction is constant. In this case sufficient posts shall be installed and appropriately marked to accurately show the location of the cable.

Buried cable joints, pits and manholes are to be clearly indicated on the cable plans and be able to be located via a distinct "marker" system.

Extra or special purpose signs shall be erected in areas where the chance of cable damage is considered high.

Where dual cable ploughing occurs i.e. optical fibre and copper cables, then only the one type of marker post i.e. the optical fibre type, is required along the route, unless otherwise specified. Additional signs to the optic fibre cable signs, indicating the presence of copper cable, may be attached to the marker as an option where specified.

Marker post location signs must have stamped on them in clear lettering the following information:

- Cable direction;
- Approximate distance to cable.

It is mandatory for all marker post location signs to be stamped with reference numbers in numerical sequence from the Exchange (Prime/Main/Controlling) end of the cable route.

3.3.9.3. Buried Pit/Manhole/Joint Marking

Place one cable marker post adjacent to the centre line of the pit/manhole or joint. Mark this post with distance to cable as well as ‘B/Pit’ and install a transponder above the centre of the pit and in line with the marker post when backfilling.

3.3.9.4. Transponder Pegs

Transponder pegs in conjunction with detectable marker tape, refer to Table 14, shall be used where highly corrosive soil environments are known / proven to exist. Transponder pegs must to be placed vertically in the plough line, approximately 300mm above the cable adjacent to the marker tape, and checked that they are operational with the appropriate locator. Transponder pegs, when used, should be used as follows:

- Typically five to ten per kilometre;
- At road, creek or river crossings;
- At significant changes in route direction, e.g. tangent point of curves in plain or mountain country;
- Between any two transponders the cable must be located within a 1 m corridor along the straight cable route line indicated by these markers. This applies to smooth curves or slight deviations from straight lines.

The locations of transponder pegs must be measured during cable installation, and recorded on cable route plans to ensure that accurate cable relocation is possible. Transponder pegs must be checked for correct operation by the installing party, immediately after installation.

3.3.9.5. Detectable Marker Tape

Detectable Marker Tape is a laminated plastic tape with a stainless steel trace wire securely retained to the tape.

It is a mandatory requirement that the tape shall be used on all directly buried optical fibre cables including those installed by plough or trenching techniques.

The only exception to this is where the soil has corrosive properties in which case transponder pegs shall be used.

The tape shall also be used on those sections of a directly buried optical fibre cable route where the cable is contained within conduit e.g. at road/creek crossings.

The tape shall be installed directly above the cable /conduit with a minimum separation of 300 mm, and in those instances where conduit has been installed by boring/drilling it is permissible for the tape to be installed within the conduit. The tape shall not be left coiled in pits or manhole.

In addition to its mandatory use on directly buried optical fibre cables, the tape may also be used in semi - rural or outer metropolitan situations where long conduit installations are used to contain the optical fibre cable, where some difficulty may be experienced in locating the route by reference to the location and surface appearance of pits/manholes.

3.3.9.6. Marking Waterways & Road Crossings

Waterways, irrigation channels and road crossings must be adequately marked i.e. marker posts / transponder pegs at start and finish of bore / conduit run. For waterways and irrigation channels, waterway marker post signs, S148/00247 must be installed on each side.

At road crossings marker posts must be installed on each side of the crossing. The posts and their signs must indicate the cable direction and distance to the cable. Detectable marker tape or 2 pair copper cable must also be installed in the duct /pipe.

3.3.10. Reinstatement

For compliance with Telstra's Environment policy you must refer to 018502a02 Telstra's Environmental Handbook. Note that **Section 2.4** of the Environmental Handbook details the reinstatement methods of trenches.

The route shall be permanently reinstated, properly and compacted to the required depth. Telstra has a legal, obligation to maintain cable routes in an acceptable and safe condition until reinstatement is complete, this includes locations where complete reinstatement depends on vegetation regrowth. The aim of reinstatement must always be to return the route as close as possible to its previously undisturbed condition.

The route shall be left clean and tidy with the debris associated with ploughing cleared up, removed and dumped at a tip or similar. The route should be cleared of rocks brought to the surface during ploughing operations.

Special reinstatement activity is needed at erosion control banks, to reinstate the immediate area to its original condition and in these instances directional boring is the preferred technique.

Special attention needs to be given to reinstatement near farm dams (and also at creek and river crossings) as a wash out of the cable route above or below the dam, could cause expensive reinstatement costs.

All excavated, ditched or similarly opened road crossings should be backfilled with well compacted granular material, e.g. graded crushed rock approved by the State Authority. Compaction should be in 300 mm maximum thickness layers by mechanical rammers. Clay must not be used. Consolidation of

depressions at roads and track crossings may be required to be filled and reinstated several times before reinstatement can be considered complete.

3.3.11. Installation in Pipe/Conduit

All optical fibre cables are to be installed such that:

- The maximum allowable hauling tension is not exceeded;
- The maximum allowable crush is not exceeded;
- The allowable minimum bending radius of the cable is not exceeded.

For the first set of cable(s) installed in a new conduit: the aggregate diameter of all cables should not exceed 95% of the internal diameter of the conduit and there should not be more than 6 cables installed initially.

3.3.11.1. Conduit / Subduct Clearing

Before cable installation, ducts and subducts shall be clean and free from obstructions.

3.3.11.2. Cable Hauling Equipment

Only certified cable hauling equipment is to be used.

For cables with a hauling tension of 2 kN or greater, a Telstra compliant winch must be used. This is to be equipped with a tension monitor and an automatic shutdown device calibrated and locked to operate when a preset maximum tension of 2 kN is reached, thereby stopping the haul and not exceeding the maximum hauling tension, refer to 3.3.11.8, of the cable. (A winch calibrated to 2 kN is to be used for all cables, including those with max. hauling tensions > 2kN.)

Alternatively, for cables with a maximum hauling tension less than 2 kN, an approved fusible link having a breaking force less than the stated requirement, as measured by a NATA certified laboratory, may be used, providing approval has been obtained from the Principal. (A copy of the certification for the fuse type must be provided with the commissioning and hand over documents).

For Telstra's policy on hauling winch certification, refer to Telstra Specification TM00044 AO1 "Optical Fibre Cable Hauling Winch Compliance".

3.3.11.3. Hauling Eyes

Cable types that are supplied with hauling eyes.

For the majority of cables the following hauling eye dimensions apply:

- Up to 72 fibres: Max hauling eye O.D. = 20 mm;
- More than 72 fibres: Max hauling eye O.D. = 25 mm.

Some high fibre count High Strength, Rodent Proof, and Underwater cables exceed these O.D. limits. The minimum tensile rating of all hauling eyes is equal to 1.5 times the cable tensile rating.

3.3.11.4. Woven Wire Cable Grips (Snotters)

Armoured external cables are suitable for hauling using a steel woven wire grip/stocking (snotter) i.e. Rodent, dielectric, or underwater cables, without the immediate risk of damage to the sheath and core of the cable. Grips are not suitable where hauling tensions will exceed 2 kN.

Wire grips can be used on normal cables if hauling eyes are not fitted. Care must be taken to avoid cable damage and stripping of the sheath by attaching the correct sized grip in a proper manner. Once installed onto the cable, The wire grip must be completely covered with insulation tape. On completion of the haul at least 2 m of cable should be removed from the cable end fitted with the wire grip.

3.3.11.5. Swivels

Swivels are to be used when hauling optical fibre cable with a winch. Swivels must be fitted between the hauling rope and cable end in order to eliminate the possibility of damage from torsion forces which may build up when using winches. Depending on the fibre cable , you may need to use a fusible link as well as the swivel to ensure safe hauling tensions are not exceeded and you must also refer to manufacturer's recommendations.

3.3.11.6. Ropes for Hauling Optical Fibre Cables

The only approved hauling rope for mechanical hauling of optical fibre cable is Kevlar/Spectra braided rope eg. Superbraid®/ Spectra™. This rope must be manufactured with a braided core of Kevlar/Spectra fibre cordage, and braided polyester cover, and have an outside diameter of not less than 8 mm.

The Kevlar/Spectra braided hauling rope must be at least of sufficient length to always extend between the cable end and the winch with the immediate cable load.

Where more than one winch is being used on a haul, the rope between winches and without the immediate cable load should be Kevlar/Spectra type hauling rope. The connection between the hauling ropes must be able to withstand a load in excess of 2 kN, and provide a smooth profile to avoid any damage to existing cable(s) or ducts.

Other ropes shall not be used for mechanical hauling of cable or hauling ropes. For mechanically drawing in hauling ropes, approved hauling rope shall be used; e.g. double braided hauling rope (Material number 67500301).

Blue/yellow polypropylene rope (Material number 67500294) SHALL NOT be used for mechanically hauling optical fibre cable. It may be used for manual hauling, e.g. over short sections, for lead-ins, and cabling within buildings.

3.3.11.7. Maximum Cable Crush and Bending Radii

Suitable installation equipment such as cable guides, slippers and wheels (capstan) are to be used so that the dynamic and static bending and crush performance requirements are complied with.

Cable rollers systems must be of such design not to exceed the minimum bending radii (MBR) and crush performance of cables, as shown in Table 18

When housing cables the MBR and Minimum Outside Loop dimensions, refer to Figure 1, must not be exceeded. Minimum Outside Loop (L) = MBR x 2 + 2 x OD.

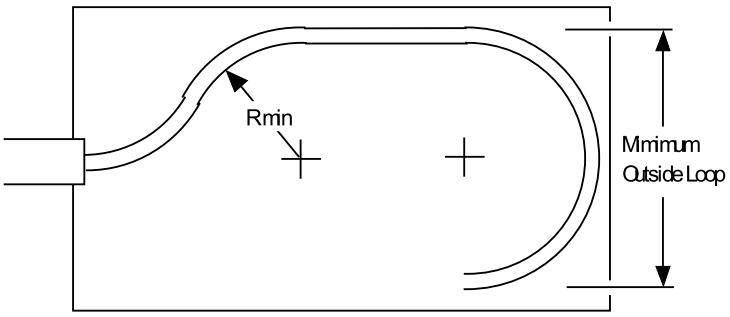


Figure 1 – Minimum Cable Bends

3.3.11.8. Maximum Hauling Tensions

The cable manufacturers specified maximum tension limits, as shown in Table 18, must not be exceeded.

Telstra certified winches are calibrated with a locked shut down device set to operate at a maximum hauling tension of 2 kN. Therefore, when using a certified winch for hauling all current optic fibre cables 2 kN or greater, these specified maximum hauling tensions should not be exceeded or reached before shut down occurs.

3.3.11.9. Tensile Strength of Obsolete Cables

To determine the rated hauling tensile strength of cables previously installed in the network the following maximum hauling tensions apply:-

- For blue sheath cables (supplied since 1992) the rated hauling tension is:
  - 2 kN for up to 72 fibre and;
  - 4 kN for greater than 72 fibre.
- For black sheath cables (supplied up to 1992) the rated hauling tension is:
  - 1.2 kN for up to 60 fibre and;
  - 2 kN for greater than 60 fibre.
- For 'LEAD-IN' cables 0.6 Kn.

3.3.11.10. Overhauling – Placement of New Cables

When overhauling all good engineering practices should be followed. With any cable, whether optical fibre, copper or coaxial there will always be a need to have sufficient space available within the duct or pipe to satisfactorily overhaul an additional cable.

Where it is not obvious that sufficient space exists, the conduit must be proved with a suitable mandrel prior to attempting any overhauling. As a guide where the conduit capacity is questionable (e.g. the aggregated existing plus new cable/subduct diameters exceeds 80% of the internal diameter of the conduit) the conduit must be proven with a suitable mandrel 1.5 times the size of the cable. If this is

successful and it can be reasonably assumed there will be no damage to any cables, subducts or infrastructure, proceed with the haul.

If at any stage the proving of the conduit becomes difficult or the conduit cannot be proven and there is a possibility of cable damage, then upgrade the conduit. Once all sections of the proposed haul have been proven then determine hauling tensions and lay off points if required.

- Pressure roping should be used in preference to hand rodding, to minimise the possibility of intertwining of cables during hauling;
- Always use lubricant on the cables, rods, rope and mandrel when overhauling existing cables;
- Existing optical fibre cables should be restrained from moving in the same direction as the haul;
- During the haul supervision must be provided at entry, exit and change of direction locations.

Only one optical fibre cable shall be installed in any sub-duct, and overhauling of other cable(s) into an occupied sub-duct is not permitted.

3.3.11.11. Hauling Detail Sheet

The following requirements are to be clearly displayed on a Hauling Detail Sheet, refer to 9.1 Attachment 3 TM00044 F01, for any project which hauls over existing pressurised air-cored cable.

- The following details should be completed and forwarded to the regional CPAS contractor, refer to Table 22, 24 hours before hauling commences:
  - Contractor Name and on site Supervisors contact point;
  - Exchange name, DA(Distribution Area), Cable number and pair range of existing cables;
  - Location;
  - Duration of haul;
  - Work Order number;
  - Current pressure of existing cables to be overhauled.
- A copy of the Hauling Detail Sheet must be on site when work is in progress. The remaining details should be completed and included with the “as built” file returned to Telstra upon completion of the project;
- Confirm that all pressurised air-cored cables have been tested both prior to and after hauling to ensure they maintain air pressure.

CPAS monitoring is done via the CPAS Telemetry Centre. The contact number is 1300 556 727. Email address is cpas.air.off@team.telstra.com Please specify or select the region required when contacting the CPAS Team.

For Air Machines/Compressors the contact is Adam Walters on 0409 989 039.

State	CPAS FSD region Leads	A/H Contact	Mobile Phone Number
Qld	Northern Region	Kerry Seery	0438 462 519
NSW	Central Region	Paul Craig	0407 294 575
VIC/TAS	Southern Region	Jason McGregor	0419 552 698
SA/NT/WA	South West Region	Jason McDonald	0429 683 730

Table 22 – CPAS Contractor Contact List

3.3.11.12. Overhauling - Maximum Allowable Hauling Tension

The maximum allowable hauling tension must be determined prior to any overhauling of optical fibre cable into an occupied duct.

This is determined by:

- Establishing the hauling tension of the new cable and the maximum hauling tensions of the existing cables in the conduit or pipe, including those in subduct, refer to Table 18, and 3.3.11.9, and;

- Of all the hauling tensions, haul to the lowest, with an upper limit of 2 kN for Optical Fibre cable. Where small sized twisted pair cables (<100/0.40) exist, also only haul to a maximum of 2 kN;

Vacant subduct should be treated as a cable having a maximum allowable tension of 5.6 kN.
To limit the hauling tension, a certified winch equipped with a preset shut down device should be used. For hauling over existing optic fibre cables with maximum tensions below 2 kN e.g. lead-in (0.6 kN), or pre 1992 60 fibre cable (1.2 kN), a mechanical hauling fuse rated at the lowest hauling tension or an equivalent tension limiting device may be used.

If during a haul the tension begins to exceed the maximum hauling tension previously determined, the haul must stop immediately. Do not continue; retrieve the cable and, if possible, lay off the cable at an intermediate manhole/pit.

3.3.11.13. Overhauling - Care of Existing Plant

The existing network must be cared for at all times and not interfered with during the course of installation of either rods or the rope .or cable.

If the cables and/or joints need to be moved during work tasks, they are to be handled carefully and replaced correctly in the pit on completion of the task.

Avoid lacing the rope through existing cables, as this will cause undue pressure to be inserted upon the cables and joints.

Care must be taken to ensure existing cables, identification tags, joints or other plant are not caught up with and dragged by the hauling rope or cable being installed.

Existing cables or subduct should be constantly observed for movement (through dragging). If there are any significant signs of cable gathering, or of cable or subduct movement at any location along the route, the haul should be ceased immediately, and action taken e.g. reapply lubricants, restraint to prevent further movement /dragging of the cable(s) or subduct, before recommencing the haul.

Lead cables tend to be more fragile than plastic cables and do not have a great deal of tolerance to movement. If in doubt as to whether to move this type of cable, contact the job supervisor for directions.

3.3.12. Housing Cable in Manholes, Pits, Tunnels, Exchange Cable Chambers, and Exchange Buildings

3.3.12.1. Manholes

At least 15 m of cable is to be left neatly coiled in manholes at cable ends.

Where joints in cable are to be installed, and at cable ends housed in pits, sufficient cable must be left to allow for satisfactory housing of the cable and joint closure in the pit/manhole, and for the cable closure to be worked on in a suitable work environment (tent, vehicle etc.). Allowance must be made for the length of optical fibres to be accommodated within the closure.

Where possible only minimum cable requirements for jointing and housing should be provided to avoid multiple loops and over congestion, however provision of cable loops for future cable joints may be required.

The minimum length of additional looped cable for future installation of the 24 fibre or 24/72 fibre Openable closures is 6m, and for the UCNCP Access closure or the UCN/UCNP in-line type closures is 7 m.

The length of cable, with allowance for extra cable in deep and/or long manholes, access to splicing environment etc. will need to be assessed on an individual basis.

All cable shall be neatly arranged, securely fixed to the walls of pits and manholes and protected from accidental damage due to falling objects etc. It is essential that the minimum bending radius specifications for the cable are not reduced below that specified; refer to Table 18 and 3.3.11.7.

Loops are to be housed as smoothly as possible around manholes on strategically located wall brackets e.g. “Z” type support brackets 42600071, and secured in place with cable ties e.g. 26100061.

In manholes the preferred method is to house cable loops horizontally. This arrangement should be used for loops associated with joint closures or loops left for future joint installation. The loops should be housed as close as practicable to the roof of the manhole to reduce the chances of mechanical damage to the cable, to avoid entwining with other cables, and to avoid obstruction to other cables or plant, and conduits. Refer to Figure 2 and Figure 3.

3.3.12.2. Pits

Cables housed in pits shall be arranged and secured in neat loops to prevent entwining with other cables, and to minimise obstruction to other plant and conduits.

For cables installed in conduits, at each kilometre, at least a 10 m length of cable is to be neatly located in the nearest manhole/pit. Where a cable has been jointed within 500 m there is no requirement for the spare length (as spare cable is to be provided at the joint location).

At waterway and river crossings where manholes are installed over conduit at each side of the crossing, a 30 m loop of cable is to be neatly housed and secured in each manhole.

All cable ends must be sealed using a Telstra approved method e.g. plastic or neoprene endcaps held in place with PVC tape, or thermoshrink endcaps.

3.3.12.3. Exchange Cable Chambers

Cables are to be housed on cable trays in Tunnels and Exchange cable chambers. There must be adequate room on the tray for the cable to be housed in a safe manner, and the tray must have proper supporting structure and be in satisfactory condition. If these conditions cannot be met then, a new tray must be provided, or, the existing unsafe or improperly secured tray must be rectified.

In exchange buildings, the external cable is to be housed on a cable runway exclusive for Optical Fibre cable, between the cable chamber or building entry point and the OFDF rack or optic fibre cable tray that forms part of the exchange superstructure.

The runway should be as high as practical with the top of the runway approximately 300 mm from the ceiling, to prevent accidental damage to the cables. The minimum bending radius of the runway shall be 300 mm.

Where diversity of external optical fibre is required, separate optical cable entry points into the exchange shall be provided.

Internal Plant

In exchange buildings, the storage of excess fibre loops for external cables is permitted in cable chambers only. The excess fibre loops shall be neatly coiled up in the largest diameter loop as practicable which will reduce the number of loops stored and minimises cable volume in the cable chamber.

The cable tray 35302527, “TRAY, CABLE ST3 300MM X 3M” shall be the preferred minimum cable tray for internal sheathed fibre cable. Refer to TM00181, “Cable Runways” for further details.

Where diversity of external optical fibre is required, separate OFDF's and fibre runways shall be provided. The diverse fibre cable runway is blue in colour and the main path is the standard grey colour.

Excess fibre loops are not permitted in exchange equipment rooms. This applies to any existing cable loop storage platform that may exist. Excess fibre loops shall not be looped vertically on any optic fibre cable trays in exchange equipment rooms.

Internal sheathed fibre tie cables shall not have any cable loops or excess cable length. If re-termination is required, a new cable shall be run in place.

Cable is to be left clearly and permanently identified along its length, refer to Section 3.3.26.

Manholes, pits, exchanges cable chambers, tunnels, and the conduit system are to be left clean and tidy, with any spilt cable hauling lubricant thoroughly cleaned up and disposed of.

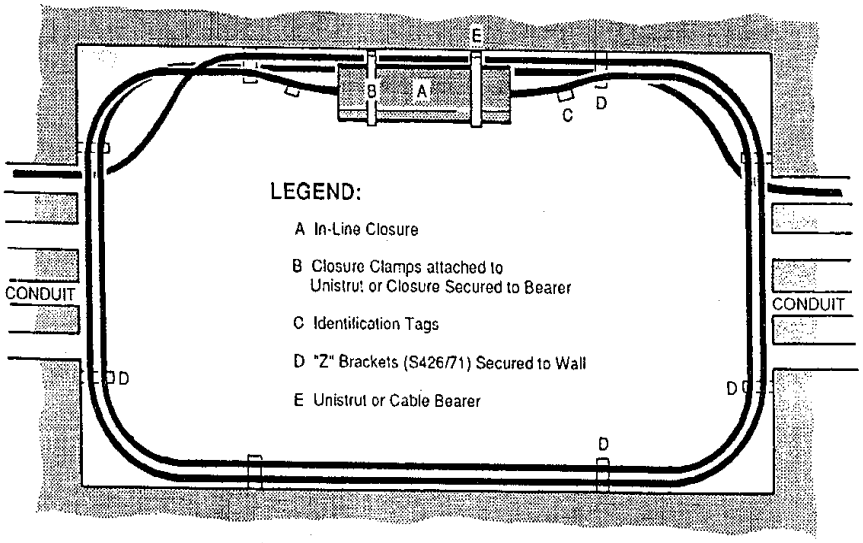


Figure 2 - In-Line Closure and Cable Housed in Manhole

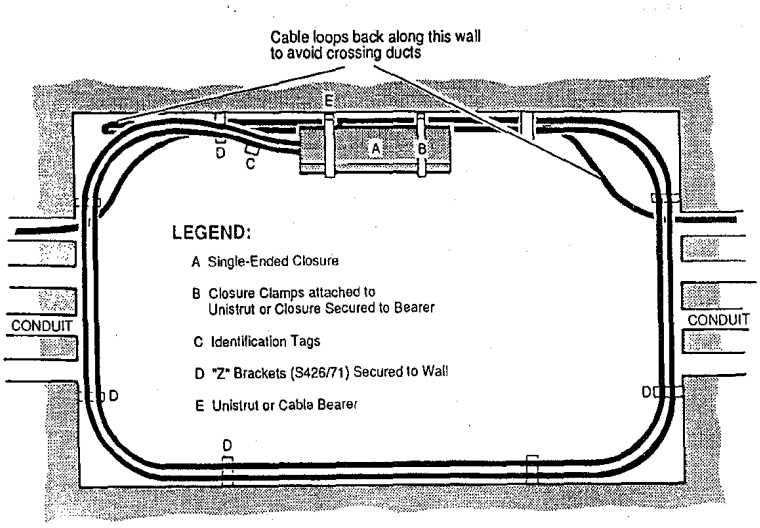


Figure 3 - Single ended Closure and Cable Housed In Manhole

3.3.13. Installing Subducts

Where subducts are required to be installed, the following procedures shall be complied with:

A subduct shall be installed in a conduit, without any deformation, necking or stretching.

Where a subduct passes through a manhole, it shall be neatly racked and housed against the wall with smooth gradual curves, and provide as close as possible a straight through appearance, that will least affect the cable hauling tension.

Any subduct jointing method used between manholes must not have internal or external sharp protrusions or decrease the inside diameter of the subduct. Suitable jointing methods are:

- Welding methods such as, butt fusion, electro fusion of polyethylene sleeves and socket fusion;
- Mechanical couplers such as Philmac 8144, Body 4 standard B for 31 mm x 31 mm or Plasson #69066 or set 7010 for 32 mm x 32 mm.

The tensile strength shall be such that it can meet all potential cable installation requirements including cable blowing techniques. Subducts shall be sufficiently air tight to withstand a cable blowing pressure of approximately 700 kPa.

Once installed a subduct shall allow passage of a mandrel equal to 95% of the internal diameter of the subduct.

Subducts shall be identified by the application of "Caution Optical Fibre Cable" adhesive tape (14100281), applied at 1 m intervals within manholes and at 5 m intervals in cable tunnels, exchange cable chambers and buildings.

Subducts containing other Carriers' cables are to be identified and clearly marked at each joint location, pit or manhole with the Carriers' name.

3.3.13.1. Hauling Subduct

Subduct should be hauled as for cables using appropriate hauling ropes, avoiding any damage, stretching, or elongation to the subduct, or damage to the ducts, manhole or any other cable or plant.

Attention must be taken to the rope/subduct and conduit interface, and steps should be taken e.g. use of cable guides, to reduce friction and prevent damage.

The rope/subduct attachment point should present a smooth profile.

Lubricants e.g. Polywater, should be used when hauling subduct. Lubricants must have long term compatibility with cable, rope and conduit material.

3.3.13.2. Hauling Subduct over Existing Cables/Plant

When hauling subduct into occupied duct, sufficient space must be available within the duct to satisfactorily overhaul the introduced subduct without causing any damage or movement of existing cable or plant in the duct.

The duct or pipe must be proved with a suitable mandrel 1.5 times the subduct diameter prior to attempting the overhaul.

Pressure roping of occupied ducts must be used in preference to hand rodding.

If at any stage the proving of the duct becomes difficult or it cannot be proven, then proving work should cease and Telstra consulted to arrange alternative action e.g. select another or upgrade the duct.

Action must be taken to ensure a clear path for the subduct and hauling rope through all manholes and pits, so that existing cables or other plant in the manhole or pit are not obstructed or rubbed against.

Existing cables or subduct should be constantly observed for movement (through dragging). If there are any significant signs of cable gathering, or of cable or subduct movement at any location along the route, the haul should be ceased immediately, and action taken e.g. reapply lubricants, restrain the cable(s), to

prevent further movement /dragging of the cable(s) or subduct, before recommencing the haul. If necessary arrange a new duct allocation with Telstra.

The maximum hauling tension for overhauling must not be exceeded. Refer to 3.3.11.12 to determine the maximum allowable hauling tension when overhauling subduct into an occupied duct.

3.3.13.3. Secondary Protection

In those instances where secondary protection is to be installed to cable which enters or exits conduits, the secondary protection shall be inserted into the conduit for a distance of 300 mm, over the cable.

Where secondary protection is applied it shall be secured to the cable rests/cable trays in a neat and secure manner using appropriately sized cable ties in such a manner that there is no intertwining with existing cables nor shall they obstruct the installation of new cables.

Optical fibre cables which have been fitted with secondary protection shall be identified by the application of “Caution Optical Fibre Cable” adhesive tape (14100281) applied both around the protection pipe/conduit and joint closures. This tape shall be applied at 1 m intervals within manholes and at 5 m intervals in cable tunnels, exchange wells and buildings.

3.3.14. Sealing Ducts and Cable Entries

The entry conduits (incl. subduct) from the Telstra underground conduit network into all buildings or network facilities, must to be sealed.

This includes; exchange cable chambers and entry manholes; customer building entries; and other network buildings, huts or facilities e.g. Mobiles huts, rural exchange buildings, above ground housings. This is to prevent the ingress of water, gases, vermin or other substances into the building or facility via the vacant conduit network, or via occupied ducts following the placement or removal of cable or other plant in the entry conduits.
Suitable seals or plugs shall be installed within each conduit mouth to prevent such ingress. Refer to 3.2.19 Table 16.

As specified by the Principal, the underground conduit network beyond those situations above shall also be sealed following cable installation or removal.

In the Sydney Cable Tunnel Network different seal types may be specified. For the specifications and installation instructions for sealing and re-sealing of cable ducts and bulkhead penetrations in the Sydney Cable Tunnel Network refer to the Sydney Tunnels Manager, telephone 02 92179708.

3.3.14.1. Penetration of Walls, Floors and Ceilings by Services

The 007338 E10-3 document must be followed for fire-stopping of openings in walls, floors and ceilings of Telstra buildings for the purpose of routing of wires, cabling and services between buildings and areas. It specifies types of fire stopping for permanent and temporary installations and covers scenarios with examples of correct and incorrect methods and has been agreed to in 2013 and must be adhered to by staff and contractors installing or removing cabling / services etc.

3.3.15. Tie Cable Installation

Technical Specification TM00183 A04, “ODF- Optical Fibre Tie Cables”.

3.3.16. Aerial Cable

Aerial Cable shall be installed in accordance with the design guidelines as shown in 3.1.15.2.3.

Attachments on poles shall be a firm fit and shall not present any hazard from protrusions, sharp edges etc. or obstruction/ interference to other plant or fittings. Cables shall be neatly and firmly secured to fittings and housed to not obstruct access to other plant on the pole.

All metal fittings shall be corrosion resistant, and any exposed metal shall be coated with an appropriate paint or finish.

Sag and tension tables for aerial optical fibre cable are available upon request from Prysmian Cables Australia Ltd.

Maximum allowable stress during installation	= 5 kN;
Minimum bending radius under no load	= 400 mm;
Minimum bending radius under full load	= 500 mm;
Minimum cable breaking load	= 27 kN;
Maximum allowable sag (%) of span	= 3.2%;

3.3.17. Cables with Bonded Coextruded Sheaths

Prysmian Cables Australia instructions should be followed for the removal of the sheath from cables with Bonded Coextruded Polyethylene and Polyamide sheath layers.

3.3.18. Joint / Splice Closure Assembly

Except were otherwise specified by Telstra, all joint closures shall be assembled as per manufacturer instructions.

Where all fibres in a cable are not fully spliced in an Openable joint, then additional splice trays should be installed to build out to the maximum cable capacity and the fibres laid up accordingly.

3.3.18.1. Through Joints on Directly Buried Cables

All through joints on directly buried cable will be installed using a standard UCN in-line joint closure.

3.3.18.2. UCN/UCNP Joint Closure Pressure Test

A pressure tightness test of 100 kPa is to be applied to all UCN/UCNP joints after sealing.

3.3.18.3. Openable Closures Pressure Testing

Openable closures must be sealed after transmission testing with the appropriate sealing clamp. Where specified in Manufacturer's instructions, a pressure tightness test shall be applied.

3.3.18.4. UCNCP VIP Closure (obsolete for new closure installations) – Fibre/ Splice Tray Installation

All splices are to be housed on 'splicing' trays only i.e. white, blue and red trays.

All main fibres must be housed in 'splicing' trays. The main 'splicing' trays must be installed from the bottom of the mounting frame for the fibres with the lowest range reading first. Subsequent trays and fibre readings are installed ascending from the bottom.

For main cable terminated to the local exchange, 6 fibres are to be housed per splicing tray (white). This is done by feeding 12 fibres from a cut loose tube into the splicing tray, and the first 6 fibres with the lower range reading housed in this tray, and the remaining six fibres routed to the tray immediately above via the protective jacket system (3 fibres per tube).

12 fibres are housed per 'distribution' (black) tray. All fibres in lead-in cables are to be housed on 'distribution' trays, and routed to 'splicing' trays via the protective jacket system (1 or 2 fibres per tube).

'Distribution' trays must be installed from the top of the mounting frame with the cable reading 1-12 first. Subsequent cables will be housed in trays descending from the top.

Where blue and white trays are installed at the same time the following procedures must be followed:

- Blue trays are to be located at the very bottom of the mounting frame;
- 5 tray spaces (the bottom 5 holes) are to be reserved for blue trays;
- White trays are to be located above the blue tray spaces;

Where red and white trays are installed at the same time the following procedures are to be followed:

- Red trays are to be located at the very bottom of the mounting frame;
- White trays are to be located above the red tray range.

Uncut loose tubes are to be stored as follows:

- In the UCNCP 8-18 closure up to 8 uncut loose tubes can be stored. The first 4 uncut tubes shall be stored in the centre storage rack holder, and any additional (up to 4) uncut tubes may be stored in the second or outer holder;
- In the UCNCP 8-28 closure up to 24 uncut loose tubes can be stored. The first 10 uncut tubes shall be stored in the centre holder, and any additional (up to 14) uncut tubes may be stored in the outer holder;
- Where both storage holders are used for uncut loose tubes, looping of cut tubes in the second holder before entering the splice tray is not required. The cut tubes may be routed directly to the splice tray.

Where cut fibres are spliced through between the white and blue trays for end to end testing of the cable ring, then these splices shall be housed on white splice trays.

3.3.18.5. UCNCP MAX Closure – Splice Tray Installation and Sequence Protocol

When setting up the Corning UCNCP MAX closures, the tray colour sequence protocol are now located in the Telstra Publication 018050W01, "Installation of Corning MAX Closures – Including NGN Network".

3.3.18.6. UCN UCNCP MAX Closure - Cable Entry Protocol

Refer to: Corning installation instruction: Telstra CAN Requirements for the Installation of Corning MAX Closures, G70381-K0006-U019-1-7.

3.3.18.7. SOSA Splice Tray Compatibility for Obsolete FIST Closures

SOSA splice trays are not compatible between FIST - GCO and FIST - GCO2 (Access Closure Kit Mk11), obsolete Openable splice closures. When adding/ replacing splice trays in existing closures the specified splice tray for the particular closure type must be used:

- FIST - GCO Closure -- SOSA - 4SE Splice tray;
- FIST - GCO2 Closure -- SOSA2 - 4SE Splice Tray.

Note: The FIST Access Closure Kit Mk11 closure has been replaced by the UCNCP as the standard Access closure, and the splice trays of FIST and UCNCP closures are not interchangeable.

3.3.19. Joint Closure Placement and Housing

In -line closures shall be placed in manholes in a safe position (ie. located under the manhole lintel). For high capacity cables e.g. Intercapital routes, if this cannot be achieved a protective cover of 3 mm galvanised steel mesh or similar shall be fitted over the closure. Protective barriers for UCN/UCNP 7-10, 7-20 and 9-30 In-line closures are available from Warren and Brown Technologies, Part No's TC2720 - 710PB, TC272-720 PB and TC2720-930PB respectively.

UCN/UNCP closures shall be securely housed in manholes and pits using appropriate clamps, support brackets and cable bearers.

Bracket sets, refer to Table 17, are suitable for housing UCN/UCNP In-line joint closures in pits and manholes. The bracket sets feature two quick release stainless steel (SS) clamps, which are fully adjustable to fit the closures diameters.

Openable closures may be housed either vertically or horizontally; however it is preferable that they be housed vertically wherever possible. Closures must be firmly held in position in the manhole/pit using appropriate pit support bars or mounting brackets, to support them and to avoid any stress between the joint and cable. They should be placed in an unobtrusive position so that they are safe from damage and unnecessary movement /interference, and not obstruct access to the manhole/pit or other plant within it.

3.3.20. Jointing/Splicing

3.3.20.1.1. Jointer's Qualifications

All jointing staff shall have successfully completed a nationally recognised Optical Fibre Jointing Course eg ICTCBL3010B & ICTCBL2065B and the appropriate Joint Closure Training Course as per Vendor training and or Documentation.

3.3.20.2. Fibre Splicing

All fibres are to be spliced using an approved Core alignment fusion splicing machine.

The approved splicing machine must be running up to date Firmware/Software and regularly maintained. The splicing machine must not be manually set to MMOF operation. With a current splicing machine set in auto mode, it will pickup the fibre type and apply the correct splice settings and splice optimally.

A mechanical splice tool may be used for emergency restoration purposes only, where a fusion splice machine is not available.

3.3.20.3. Exchange ODF Termination Splicing

Refer to 3.3.22 for Exchange ODF Termination specifications.

OMF & OFF – Refer to TM00183 A07 & A09

Fibres to be housed and installed in approved splice panels and installed using the manufacturer's instructions:

- Splice trays shall accommodate a maximum of 12 fibres at a time;
- A maximum of 2 loose tubes may enter the splice tray;
- There is to be no interference to the fibres by other trays or lid.

All splicing operations should occur between 450 mm and 1335 mm from the floor and should not require the use of ladders or special work platforms.

Active fibres and/or those specified for patching (generally to be 100%), are to be fitted with custom length pigtails to reach the patch panel, or where specified, to the designated transmission equipment location.

There are to be no kinks, or bends of a radius less than 30 mm, in any fibres, loose tubes or pigtails/ patchcords.

3.3.20.4. Cutting Fibre to Length

Fibres are to be housed in splice trays allowing sufficient length to reach the splicing machine and for up to three subsequent fusion splices to be made on a given fibre.

Some splice closures have different length requirements for fibre storage. Consult the specific product work instruction prior to cutting fibre to length.

In joints closures and termination panels, there should generally be sufficient fibre allowed to loosely coil 5 loops per fibre in splice trays, except for UCNCP joints where the length of spliced fibre to be stored on each splice tray shall be 1200mm, where there may only be sufficient fibre for 4 loops.

3.3.20.5. Minimum Distance Between Splices

For all new optical fibre installations the minimum distance between splices shall be at least 1 m with at least two turns of fibre at each end of the organiser tray.

3.3.20.6. Splice Loss

At joint locations, the average two way splice loss for jointed fibres shall not exceed 0.10 dB at 1550 nm and 1625nm.

3.3.20.7. Optical Fibre Identifier

When working on cables with a combination of working and non-working fibres, a fibre identifier must be used to determine whether a chosen fibre is the correct fibre and to confirm that the fibre is not carrying any traffic.

3.3.20.8. Bridging Fibres

Fibres within the cables to be bridged must be accurately identified prior to splicing. The use of an approved optical fibre identifier is essential to positively identify the fibres to be through spliced.

3.3.20.9. Splice and Splice Tray Labelling

In OFDF modular splice tray drawer units, numbered marking tags (e.g. Serial 438/00070) are to be placed on each splice protector with the fibre number. The tag must not foul any part of the splice holder. Refer to Figure 4. Trays are labelled as per 3.3.22.3.

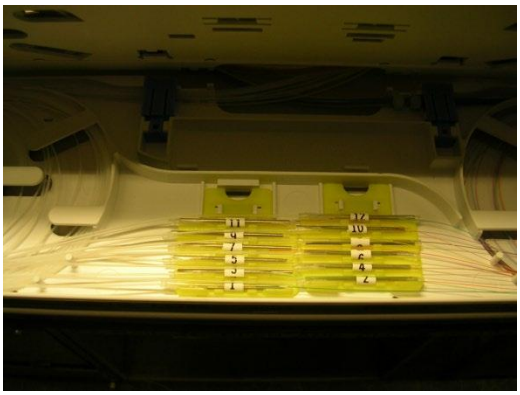


Figure 4 - Marking tags on splice protectors

In Tyco (Raychem) SOSA splice trays; do not fit numbered tags to the splice protectors, as bending of the splice protector will result. Record the fibre identity in the area provided at the centre of the tray or on the edge of the tray. Refer to Figure 5.

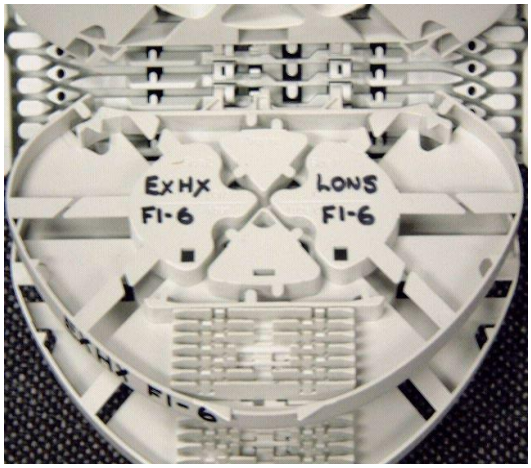


Figure 5 - SOSA tray labelling

In UCNCP splice trays, as for SOSA trays, numbered tags are not placed on the splice protectors, and the fibre identity is recorded on the inside of the splice tray.

The codes used to describe the fibre network are:

- Sheath Code: e.g. F LONS 3005 (F designates fibre, exchange code, sheath code; i.e. 3000-3009 denotes CAN usage);
- Fibre range: e.g. F 1-12;
- FAP ID: e.g. BB;
- Building ID: e.g. B2.

UCNCP VIP trays are to be labelled as such:

- Black Trays: Section code; fibre range e.g. BB-B2 1-12F;
- White Trays: Sheath code; section code; fibre range e.g. F LONS 3005 AA-BB 13-18F;
- Blue Trays: Sheath Code; section code; fibre range e.g. F LONS 3005 AA-BB 13-24F;
- Red Trays: Sheath code; fibre range e.g. F LONS 3005 25-36F (red trays are for through jointing - no section code required).

UCNCP MAX trays are to be labelled as such:

- Black trays: Section code; fibre range e.g. BB-B2 1-12F;
- Grey Trays: Sheath Code; fibre range e.g. F LONS 3005 F1- 6;
- Blue trays: Sheath Code, fibre range e.g. F LONS 3005 F1- 6;
- Red trays Sheath Code, fibre range e.g. F LONS 3005 F1- 12.

Connectors, Through-Connects & Attenuators
All fibre connections are cover in Telstra Publications 018334 “Fibre Interface Inspection and Cleaning – Requirements for Telstra Networks”, TM00183 “Optical Distribution Frame – Technical Requirements” and 000531 “Optical Fibre and Laser Safety”.

3.3.21. Inspection and Cleaning of Fibre Connector Interfaces

Mandatory requirements for the inspection and cleaning of fibre connector interfaces in the Telstra network are detailed in the Telstra Standard 018334 “Telstra Fibre Inspection & Cleaning”.

3.3.22. Exchange ODF Terminations

For the detailed specifications for the installation and termination of outside plant Optical Fibre cables in exchange termination frames, refer to Telstra Specifications:

TM 00183 ODF;
TM 00183 A01 ODF - HDODF;
TM 00183 A02 ODF- OFDF;
TM 00183 A03 ODF -Tyco BAN OFDM’s;
TM 00183 A04 ODF - Optical Fibre Tie Cables.
TM00183A06 ODF - Optical Equipment Frame (OEF)
TM00183A07 ODF - W&BT High Density Optical Frame (HDODF)
TM00183A08 ODF - Medium Density Optical Distribution Frame
TM00183A09 WBT HDODF & MDODF SUB-RACKS
TM00183A10 ODF - W&BT High Density Optical Frame V3 (HDODF)

3.3.22.1. Splice Tray / Loose Tube Layouts

For Standard OFDF – refer to TM00183-A02, all new installations regardless of whether the cable is top or bottom fed, shall have fibre installed from the top most allocated drawer downwards within the rack.

Splice Trays shall be populated from the bottom tray upwards within a drawer. (Where a cable .e.g. 120f, will populate more than one drawer then fibre is installed upward from the lowest drawer for that cable).

The loose tubes (12 fibre ranges) within a cable are to be allocated to the trays from tube 1 in the bottom tray upwards within the drawer, i.e. fibres 1-12 in the lowest tray, 13-24 next tray above and so on.

The maximum number of fibres that may be installed on a splice tray is 12.

Subracks, drawers and trays are numbered (for recording purposes) from the top down.

For splice and patch drawer layout for the HDODF, refer to TM000183 A01 “HDODF High Density Optical Distribution Frame”.

3.3.22.2. MITS (Module Inventory Tracking System)

All Optical Fibre termination equipment details are to be entered into the MITS DBoR.

The following information is provided to assist the Contractor with the required updates to MITS.

Definition
Distribution Frame (DF) - A grouping of connection points between pieces of equipment, allowing access to the traffic stream and the ability to “break” the traffic stream.

All DF details for all Card/DF connections are to be recorded in MITS. Before any DF terminations can be entered in MITS, the DF hardware must appear as an individual item in MITS. If the DF hardware already exists simply record the DF details against the equipment. If the DF hardware does not exist create the block or row in MITS. Choose the DF type from the list of allowable DF and terminating Masks in MITS as at which best suits the individual installation. All DF termination field entries are to conform to allowable values.

In MITS, all optical terminations now terminate to positions within equipment not to a distribution frame. Optical Fibre Terminations which previously used a distribution frame (e.g. ODFP, ODFD, ODFT, and ODFC) now terminate directly to a Subrack position or Drawer position. Where necessary create a Subrack or Drawer within a Rack, and use a DIR mask.

For details on MITS data entry requirements, and the allowable DF Masks and field entry allowable values, refer to Schedule 12, Procedure 000511 “Numbering, Labelling and Data Entry Requirements of Network Inventory”.

3.3.22.3. Fibre Labels – Splice trays

A minimum format label is required on splice trays, which shows the fibre sheath code and range of fibres. For multi tray subracks, trays are individually numbered and the fibre sheath code and fibre range label will be on the front edge of the tray.

3.3.22.4. Fibre Labels – Patch Panels

Positions on a patch panel will be labelled consecutively top down left to right, detailing the port position number within the panel, not the fibre number within the sheath i.e. this port number may or may not correspond with the fibre number of a cable that is connected to the port via a pigtail.

Note: This is particularly relevant where fibres from more than one cable may be connected to the same patch panel.

3.3.22.5. Labelling Pigtails and Patch cords

For pigtail identification in splice trays and patch panels it is necessary to label each end of the pigtails with approved permanent labels, showing the fibre number. (Where the fibre number does not correspond with the port number at a patch panel, or where pigtails from more than one cable feeds the patch panel, then the port number may also be added to the pigtail.).

Numbered tags are fitted to the pigtails in the rear of splice and patch modules as shown in Figure 6 and Figure 7.

Patchcords i.e. from the ODF to equipment etc are to be labelled showing the fibre sheath code and fibre number.

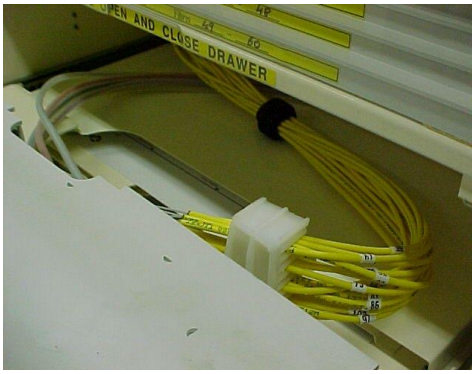


Figure 7 - Pigtails Labelled at rear of Splice Tray

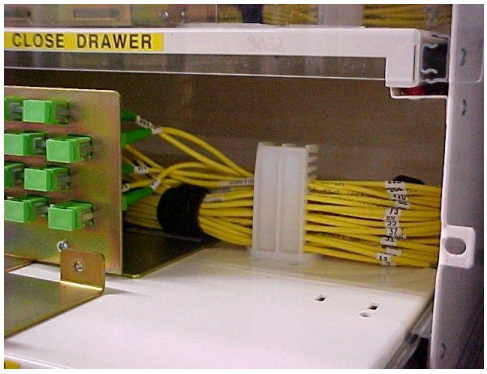


Figure 6 - Pigtails Labelled at rear of Patch Panel

3.3.22.6. Pigtail & Patchcords Reticulation

Pigtails and patchcords are not to be kinked or bent to a radius less than 30mm.

Cable ties are to be loose fitted, when used to tie pigtails and patch cords together. I.e. there is to be no crush force applied to any fibre.

No residual axial tension is to be applied to any cord or pigtail.

3.3.22.7. Pigtails/Patchcords in Splice Trays

OFDF's are not storage areas for excess pigtail or patch cord except where designed to do so e.g. built in storage spools or trays, and excess must not be stored in splice trays.

3.3.22.8. Attenuator Location

Standard Practice is to place any attenuator at the transmit equipment NOT the OFDF. Some attenuators may not work correctly if placed at the receive end. Refer specific equipment work instructions.

3.3.22.9. Installing Patchcords into Storage Modules

Patchcords enter and leave the storage module via the entry port on the left hand side, through the fanning strip and onto the preferred spool.

3.3.22.10. Removal of Bypassed Pigtail & Through-connects from OFDM's

To avoid future confusion, when a hard splice is installed bypassing a fibres patch panel or storage module's appearance (direct splicing is only approved as per section 3.1.17.2) the following shall be performed:

- Network Hazard shall be advised;
- The pigtail shall be removed from the OFDF rack;
- The through-connect, provided it has an individual mounting hole shall also be removed.

3.3.22.11. Bypassing Pigtail Storage Reels

When pigtail stored on storage reels is required to be bypassed by through splicing, or is required for connection to SDH end-equipment, the following rules shall apply, refer to Figure 8:

- All pigtail shall be removed from the storage reel to be bypassed;
- Pigtail to be trimmed to the correct length – no excess to be stored on OFDF;
- Excess pigtail length, for maintenance purposes, to be stored at the equipment end in an appropriate storage sub-rack;
- Pigtail stored on Termination & Storage Modules which incorporate splicing and storage within the one sub-rack (e.g. obsolete 32 F termination & storage modules) shall exit the storage sub-rack via the existing formwork and back-plane fanning strip – this is a mandatory requirement for future maintenance.

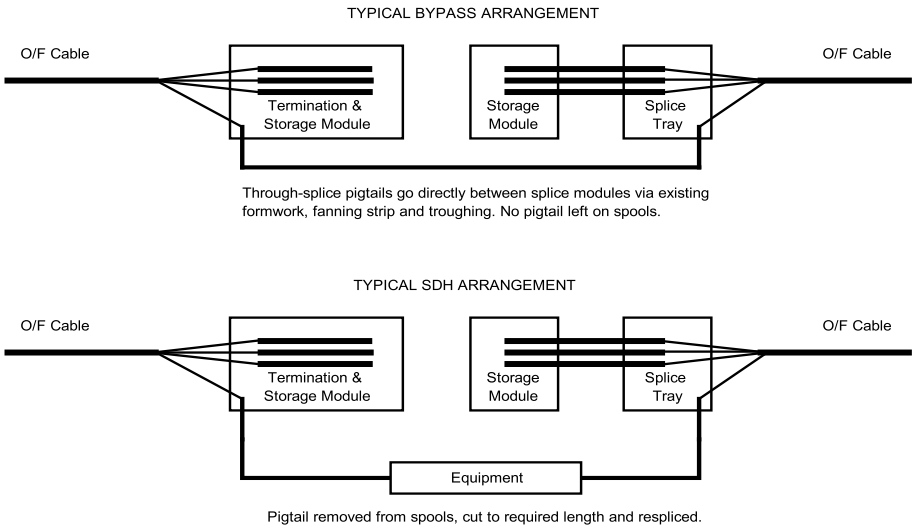
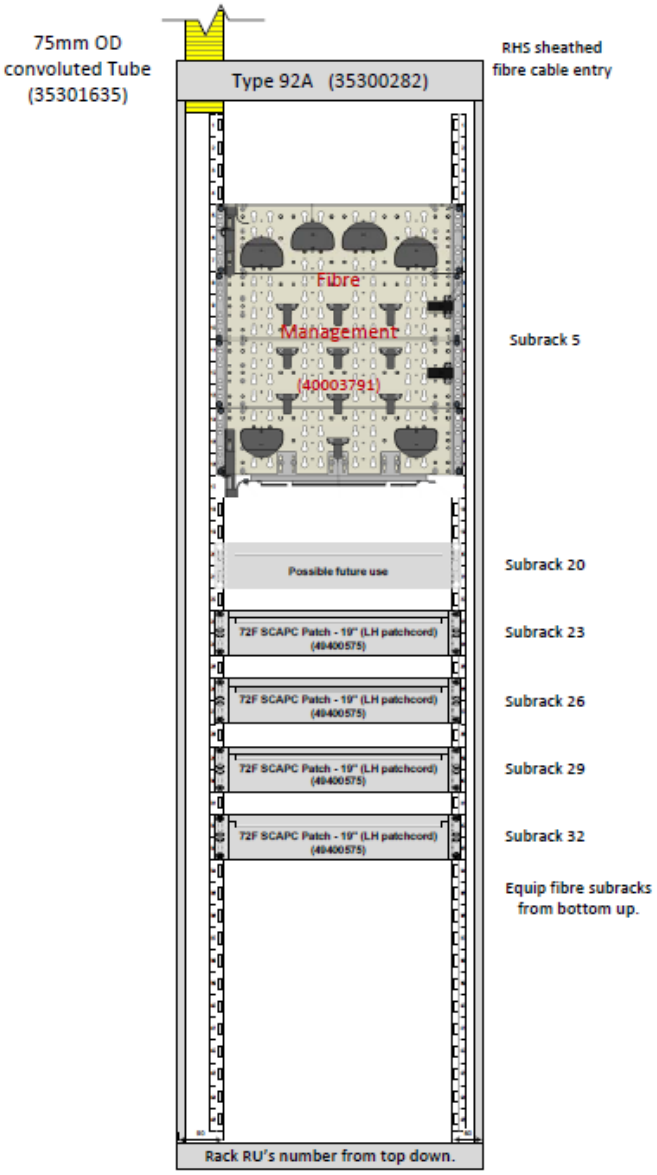


Figure 8 - Bypassing Pigtail Storage Reels

3.3.22.12. Type 92 Rack OFDF Preparation

Type 92 racks are now used and either the 92A or 92E racks. The following layout is now standardised and if you have also suits the 2100mm high Type 92E rack. Layout includes the new fibre management frame/panel.

Type92A Rack Based OFDF



4 x 72F subracks = 288F
Max OFDF rack capacity is 300F as per TM00183 A02
Type92A rack 2200mm high, 600mm wide, 300mm deep,
46RU of equipment capacity

3.3.22.13. Ducting allocation / Transmission cabling

For details on Optical Fibre Ducting refer to Telstra Specification TM00138 A01 “Common Station Facilities - Optical Fibre Ducting”.

The optical fibre ducting system specified in the above standard and outlined on drawing CN1279, Optical Fibre Duct, provides the cable separation necessary to achieve internal station optical fibre cable characteristics with standard Telstra 2.4 mm and 3.0 mm OF SM cord. No other cables shall be laid in the OF ducting.

The features of the ducting system are:

- To allow easy installation of optical fibre patchcords/pigtails between the OFDF rack and transmission equipment racks;
- At all times to maintain a minimum bending radius of 30 mm;
- To be modular and comprise of a range of fittings to allow the system to be easily installed in both old and new exchange overhead situations;
- To be able to be installed using standard hand tools;
- To be assembled using a mechanical fastening/joining system rather than gluing components together;
- Straight sections are capable of supporting a centrally applied weight of 50 kg over a span of 2 m;
- To provide a flexible drop-off system between the ducting and the rack slotted duct;
- To be able to add rack drop-offs as required without endangering existing patchcords/pigtails in the duct;
- To provide OFDF rack drop-offs to cater for up to 576 patchcords/pigtails.

3.3.23. Equipment

Only approved optical fibre installation accessories (jointing tools) equipment shall be used.

A summary of approved installation accessories is shown in Table 23.

Function	Application	Requirement
Fibre Coating Stripper	All cables	Any approved tool
Cleaving (new installations)	All cables	Precision cleaver with end angle better than 0.5°
Fusion Splicing of fibres	All cables	Any approved LID or PAS fusion splicer
Fusion Splicing of fibres	Emergency repair of all cables	Any of the above or an approved mechanical splice
Splice Protection	All fusion splices	Heat shrink splice protector for 250-250 µm, 250-900 µm or 900-900 µm
*Mechanical Splicing	Emergency repair using mechanical splice	3M Fibrlok connectors & splice assembly tool
Organising Fibres	Category A, B, C & D cables	Any approved joint tray
Organising Fibres	Category E & F cables	Any tray provided with the Openable joint
Joint Closure	Category A, B, C & D cables	Appropriate size UCNP closure, or alternatively the Access Openable closure for 312 or 624f cable
Joint Closure	Category E & F cables	Any approved Openable joint or UCNP closure

Table 23 - Approved Installation Accessories

* *Note 1:* Approved mechanical splices to be only used for the temporary repair of optical fibre cable. They maybe left as a permanent splice but if convenient should be replaced with a fusion splice at time of permanent repair.

3.3.24. Responsibility- Major Mechanical Aid Network Management

Ensure winch testing, calibration and re-certification is carried out on each winch every 3 years.

Ensure the performance analysis complies to Engineering test procedures and a certification plate is affixed to each winch on completion.

Authorise repairs, record incurred maintenance and compliance with engineering requirements.

Ensure that CIMS receives a signed copy confirming completion of each winch test, as verification and compliance with the Custodians, Accreditation ISO 9001, requirements. (email address is: F1201644@team.telstra.com)

3.3.25. Regenerator / Exchange Sites

- All cable within Regenerator/Exchange boundary shall be installed in pipe or conduit.
- Conduit entry shall be of robust design.
- All digging within Regenerator/Exchange sites shall be by hand unless directed by the Superintendent.

3.3.26. Cable Identification and Labelling

All cables shall be clearly marked and identified in Exchange cable chambers, tunnels, manholes and pits by fixing an identification tag to them, using cable ties that are not affected by wet conditions or UV radiation.

The standard cable labelling (tagging) system consists of a rectangular white PVC tag, permanent marking pen and plastic cable ties. Refer to 3.2.18. Table 15.

The tags are to be secured to the cable using the cable ties, with the excess cable tie trimmed off.

The details of the cable are to be clearly printed in block letters and numbers between the ridges of the tag with a permanent marking pen.

The Tags are to contain the following information:

- Exchange Service Area (ESA) code;
- Cable Number;
- Fibre Count;
- Fibre Number Range;
- Cable Section Identifier (ESA and FAP code).

An example of a typical identification tag layout is shown in Figure 9.

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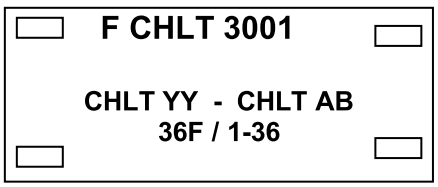

Figure 9 - Cable Identification Tag

Cables installed into CBD/Commercial buildings shall be labelled with the sheath code ID, at the entries to the telecommunications room/common area and floors fed within the site, and at the termination rack, COFTU or OFDM.

A guide to the minimum tagging requirements is shown in Table 24.

Location	Frequency	No. to be installed	Location of Tag
Pits (no joint, straight through cable)	Every Pit	1	As close to the pit centre as possible.
Pits (with joint)	Every Pit	2	One each side of joint
Manhole (no joint)	Every Manhole	1	At centre of manhole.
Manhole (with joint)	Every Manhole	2	One each side of joint
Cable Loop (in pit)	Every Pit	1	As close possible to the centre of the loop.
Cable Loop (manhole)	Every Manhole	1	As close possible to the centre of the loop.
Cable Loop (cable tunnel)	If loop specified	1	As close possible to the centre of the loop.
Cable Tunnels/Cable Wells	Every Cable Tunnel/ Cable Well	As required to adequately identify the cable	At the duct mouth entering or exiting the tunnel/well and thereafter at 10m spacing along the cable.
Through Telephone Exchanges and Equipment Buildings	Each Telephone Exchange and Equipment Building	As required to adequately identify the cable	At the point the cable enters the main exchange area or equipment area (MDF room or equipment room) and at the OFDF.

Table 24 - Cable Tagging Minimum Requirements

3.3.27. Cable Survey Records

Location of the cable and burial depths must be recorded by survey and the data supplied to Telstra at the completion of the project.

Note: Reference points for the survey (where used) must be stated.

Any unusual occurrences (i.e. unexpected geological conditions, adverse weather conditions during installation, unusual cable stress, etc.) are to be noted on the survey data.

3.3.28. Cable Repairs

Cables shall be repaired using standard procedures. All relevant cable joint and route details associated with the cable repair shall be included on the cable route plans as soon as the repair has been completed.

3.3.29. Fault Reporting

When any damage or a "near miss to a cable with potential to cause a "Service Interruption" occurs, such instances shall be reported to the Superintendent.

3.3.30. Handover

Documentation which will be available in the Commissioning Pack at handover of the work includes and is not limited to:

- Project brief;
- Final cable route plans;
- Cable termination and tap out details for all fibres;
- Cable acceptance test results;
- Exchange cable documentation;
- Straight line diagram (The CADLink Straight Line Diagrams are used by designers and constructors to identify works and confirm data in cutover or damage situations. They readily give constructors a clear idea of what is required as well as splicing arrangements), detailing optical distances to joints & the cable number (the numbers that appear directly after the date of manufacture);
- Notice of Intention summary;
- Special route maintenance requirements;
- Compliance with all Federal, State and Local Government environmental requirement;
- Details of significant installation problems encountered;
- Details of defective materials and confirmation of prior approvals for non-conforming/non-standard materials used.

3.3.31. Job Completion

Manholes, pits and conduits are to be left in a clean and orderly condition.

3.4. Commissioning

3.4.1. Completed Cable Route Plans

For all completed optical fibre cable installations, a detailed route plan “as built” must be provided to the long term maintainer, at the time of handover / commissioning.

As per Schedule 3 “Commissioning and Acceptance” of the Integrated Deed, where specified, GPS coordinates to datum GDA94 are to be included on ‘as-built ‘ drawings, as per “As - built Requirements for Optical Fibre Installation”.

All GPS entries in TPNI are to be recorded using labels next to the network object.

Information from the field may be supplied as either Latitude/Longitude & Datum (GDA94), or Map Grid Co-ordinates (MGA Easting & Northing) along with Zone & Datum/ Projection, however GDA94 to 4 decimal places is the preferred datum for TPNI although if supplied as MGA it is not necessary to convert. Refer to Telstra Publication 011844W06 “Entering Optical Fibre into TPNI” Section 3.6.

Cable route plans shall be to the smallest convenient scale, consistent with legibility, and containing at least the information as shown in Table 25.

Item No	External Plant Feature/Attribute	Need for that Feature
1	LOCATION OF THE CABLE Deviations around objects Offsets from: roadway boundary/property boundary/ railway lines. Fence lines/road centre-lines. Approximate depth of cover.	Key feature of the completed plan. Needed for fault finding and as an aid for planning additional Telstra installations. Required for locations for other utilities & property owners. For cross-country and remote areas offsets from Fence line/Road centre lines may be needed to be shown to locate the cable.
2	TYPE & SIZE OF CABLE Sheath Code, Fibre Count - as per cable designation. Manufacturer Batch number/Cable Number (from sheath)	Fundamental data required for maintenance purposes and for Telstra Operations. Needed to positively identify cables in fault conditions. Also used to separate cables
3	CABLE DESIGNATION TRAC Code	Telstra Operations requirement
4	MARKER POSTS & TRANSPONDER PEGS Notation required if no posts, pegs or tape installed. Offset to Marker Post. Post & peg location stored in TPNI Design	Fundamental Data.
5a	OTHER UTILITIES PLANT Included as required by the Design Engineer or Project Supervisor. Entered as reference points in TPNI	A valuable additional aid to locating the cable/plant. For example:- electricity pylons going cross-country.
5b	TOPOGRAPHICAL INFORMATION Included as required by the Design Engineer or Project Supervisor Entered as reference points in TPNI	A valuable additional aid to locating the cable/plant.
5c	REFERENCE POINTS eg Survey/GPS data, to be included as required by the Design Engineer or Project Supervisor Entered as reference points in TPNI	A valuable additional aid to locating the cable/plant.
6	DUCT OCCUPANCY Size, Type, Direction & Subduct if used	
7	JOINT (SPLICE) LOCATIONS (Surface) Distance from designated exchange/regenerator datum points. Joint Numbers	Fundamental data
8	SPECIFIC INSTALLATION PROBLEMS Location of features such as expansive soil and heavy rock etc	
9	PITS & MANHOLES Recorded with offsets, as per (1) above.	Fundamental data
10	REGENERATOR SECTION LENGTH Obtainable from surface distances	
11	REGENERATOR LOCATION Recorded with offsets, as per (1) above.	
12	EXCHANGE LOCATIONS	Fundamental data

Item No	External Plant Feature/Attribute	Need for that Feature
13	NORTH POINT & SCALE	
14	BUILDING/REGENERATOR COMPOUND INFORMATION Currently not stored in TPNI. A home for this information is not yet agreed upon	

Table 25 - Cable Route Plans - Information

Additional Information

The plan should be combined with the overall key plans and a schematic diagram showing transmission path details and cable fibre groups.

The plan may include more than one repeater section.

Preferred sheet size 4 x A4, folded and bound in book form.

3.4.2. Test & Commissioning Equipment

All test equipment utilised for optical fibre cable acceptance and commissioning acceptance shall preferably be that available under Telstra Product Sourcing Agreements.

3.4.2.1. Stabilised Light Source and Power Meter

Stabilised Light Source and Power meter equipment used shall comply with the requirements as detailed in IEC 61280-4-2 & ISO/IEC 14763-3. The calibration requirements are as defined in IEC 61315.

3.4.2.2. Optical Time Domain Reflectometer (OTDR)

Either “Mini” or “Full Featured” OTDR instruments, immune to Polarisation noise and conforming to the Telcordia GR-196-CORE “Generic Requirements for Optical Time Domain Reflectometer (OTDR) – Type Equipment”, are to be used for all OTDR measurements.

The OTDR must be capable of storing the traces on an electronic medium (e.g. floppy disk or USB stick) for transportation/submission; allow retrieval and reading of traces. All traces are to be stored and submitted preferably in a format compatible with Telcordia standard SR4731- Issue 2 (SOR). . Other preferred trace formats are the ones compatible with Nettest’s Networks OTDR 3.0 emulation software or GR 196/SR-4731 Issue 1 (SOR) compatible file format.

The OTDR testing is to be carried out at 1550nm and 1625 / 1650 nm wavelengths. The 1625 / 1650 nm OTDR trace is primarily used to identify pressure points, macro bends and imperfections in cable installations.

3.4.2.3. Chromatic Dispersion (CD) Test Equipment: (CD tester)

When CD testing is required, equipment based on “Phase shift or differential phase shift method” as specified in IEC 60793-1-42, shall be used.

CHROMOS 11 or FD440 from PE Fiberoptics or similar type equipment is recommended.

3.4.2.4. Polarisation Mode Dispersion (PMD) Test Equipment: (PMD tester)

When PMD measurement is required, an instrument based on “Interferometric method” as recommended in ITU-T G650.2, is to be used. The wavelength range for PMD measurement is typically C band. The lowest measurable PMD of the instrument has to be at least 0.06 ps and the dynamic range of the instrument shall be > 40 dB. “Nexus” PMD instrument from PE Fiberoptics is one of the models that can meet the above requirements and is preferred for the purpose of PMD measurements in Telstra network. Measured PMD for the fibre is to be provided as the “cable section” PMD value and PMD value (ps) per √ km. In addition, the PMD delay graph from the analyser is to be provided in a PDF file format for records.

3.4.2.5. Visible Light Source

A Visible light source is used to physically identify fibres and is great way of seeing bad splices, high loses etc as you will see that point glow red. Only approved VFL’s are allowed to be used on Telstra fibres/plant. VFL’s with laser power ratings greater than 3R MUST NOT BE USED.

3.4.3. Testing

3.4.3.1. General

The OTDR operator must be experienced in the use of high performance OTDR’s and shall have attended an approved Telstra or Nationally accredited OTDR training course and also have knowledge on use of the Telstra Fibre Workbook. Usage of CD and PMD equipment require special skills and the operator must be trained in using the equipment.

To ensure transmission system link integrity and the implementation of a high quality network it is essential that optical fibre cable acceptance testing be carried out after all cable installation.

Testing of unterminated fibres is to be performed by splicing temporary pigtails to the fibres or by using a Bare Fibre Adapter 49400178.
Terminated fibres, refers to fibres terminated with connectors on patch panels at an ODF, and/or at equipment.

3.4.3.2. Recording of Test Results

It is the responsibility of the optical fibre testing groups to ensure that all relevant information pertaining to the commissioning and cable acceptance test results / records are made available, in a Telstra preferred format, for ease of entry into the Telstra database records.

All optic fibre Acceptance and Commissioning Test results shall be recorded in the standard Telstra approved Excel Workbook, in accordance with Telstra Work Instruction 016390W35 “Data Services, Capturing & Recording Test Results into Multiman”.

3.4.3.3. Fibre Testing

Two stages of testing are required on any installed fibre/ cable as detailed below:

- "Cable Acceptance Measurements" (Refer 3.4.3.5):
  - - This involves OTDR measurements on the installed fibres, at 1550nm and 1625 /1650 nm, to check the integrity of the material supplied and the workmanship of the contractor in installation of the cable.
- "Link Commissioning Acceptance Measurements" (Refer 3.4.3.7):
  - This involves insertion loss measurement of the link using optical source and power meter at 1310nm and 1550nm;
  - - A "link" is created when the fibres are terminated with connectors. Eg when a new cable is commissioned, and all the fibres are terminated on patch panels at the ODF's at two exchange ends, each fibre constitutes a link and requires Link Commissioning Acceptance measurements on each of the terminated fibres.

Test results files shall be identified using the Telstra standard file naming convention specified in this document (Refer 3.4.3.11)

3.4.3.4. Cable Acceptance Criteria

Cable Acceptance testing of SMOF cables is carried out after cable installation has been completed to check the integrity and quality of each fibre in the cable after installation/repair, regardless of whether the fibre has been terminated or not.

Unless otherwise stated, OTDR tests are to be performed on all terminated or unterminated fibres in both directions (2way) at 1550 nm and 1625 / 1650 nm wavelengths. (Except as specified in 3.4.3.5.7 point H)

Two-way averaged Link Loss (LL) and two way averaged splice losses are measured from the OTDR trace results, at 1550nm and 1625 / 1650 nm. Optical Link Length (L) is measured from 1550nm OTDR trace.

Measured LL values shall be checked against theoretically calculated value to confirm the cable performance. Using OTDR reference markers, fibre loss between splices is checked and should not exceed 0.21dB/km at 1550nm (excluding all splice losses).

Individual splice loss values are checked and the bi-directional average splice loss of each splice shall not exceed 0.1 dB at both wavelengths.

Individual through connector loss values are checked and the bi-directional average OTDR loss of each through connector should not exceed 0.3 dB at both wavelengths. Any point loss exceeding 0.1 dB due to "Installation defect" shall be investigated and rectified and "Fibre material irregularity", in the form of point loss of > 0.1 dB, shall be investigated and reported.

Records of OTDR test results and analysis, indicating the splice loss, optical distances of each event and the corresponding physical location of joints shall be presented for upload into Telstra database.

All OTDR tests shall be performed using fibre refractive index set as 1.4682 for both 1550 and 1625 / 1650 nm wavelength.

OTDR Processing time , Range, and Pulse Width Settings should be selected appropriate to the length of fibre to be tested. OTDR Results shall be recorded with sufficient processing time or sample averaging to identify trace events and eliminate trace noise interfering with measurements. Processing times/averages should be selected to complement the OTDR Range, Pulse Width and Wavelength settings.

The measured OTDR Event distances recorded in the Optic Fibre Workbook shall be the OTDR distances from the test location connector/interface point, removing launch drum lengths from the recorded values. *Note:* Due to the limitations of the OTDR, if two splices occur relatively close to each other, it may be impossible to determine the loss performance of each individual splice due to their close proximity, in which case the accumulated loss for both splices can be measured.

3.4.3.5. Cable Acceptance Measurements

OTDR testing shall be performed on all terminated or unterminated fibres in both directions (two-way) at 1550 nm and 1625 / 1650 nm wavelengths (λ).

3.4.3.5.1. Section Link Length

The Section Link Length (L) or the optical OTDR Link Length is measured from the 1550nm OTDR trace.

This is required for the theoretical calculation of OTDR Link loss (LL) and for calculation of Insertion Loss criteria, (in Section 3.4.3.7.).

3.4.3.5.2. OTDR Link Loss

OTDR Link Loss measurements are to be carried out on all fibres to confirm the integrity of the cable link without including the performance of the end connector/pigtails.

Two-way averaged OTDR Link Loss (LL) is measured at 1550nm and 1625 / 1650nm from the bi-directional OTDR traces, as $LL_{\lambda=1550nm}$ & $LL_{\lambda=1625/1650nm}$ respectively.

The measured OTDR Link Loss shall comply with the following criteria,

$LL_{\lambda=1550nm} \leq 0.21L + 0.1N + 0.3$;

$LL_{\lambda=1625/1650nm} \leq 0.25L + 0.1N + 0.3$;

Where L = the optical OTDR link Length in km (measured at 1550nm) &

N = Number of splices excluding pigtail terminations.

If compliance is not achieved, further investigation shall be conducted to understand why compliance is not achieved and any anomalies rectified.

3.4.3.5.3. Irregularity Check

All fibres in each section length shall be checked for any manufacturing irregularities in both directions at 1550 nm wavelength.

Irregularities (point losses) in length or at a joint shall not exceed 0.10 dB (average). If any material defect is noticed on the fibre, Telstra Project Manager is to be advised of the defect.

3.4.3.5.4. Point Loss

Any localised point loss found shall be measured in both directions at both 1550 nm and 1625 / 1650 nm wavelengths, and the distance and magnitude recorded.

The maximum two-way (average) point loss measurement, in length or within a joint/termination module, at both wavelengths shall not exceed 0.1 dB.

Any point loss due to installation that exceeds 0.1 dB shall be removed.

3.4.3.5.5. Splice loss/ Joint location

The optical distance to all splices (joints) together with the magnitude of each splice loss shall be measured on all fibres from both directions at both 1550 nm and 1625 / 1650 nm wavelengths.

The maximum two-way (average) splice loss of any splice shall not exceed 0.10 dB.

Any splice loss that exceeds the above criteria shall be re-spliced. If the splice does not improve after two attempts at re-splicing and the tests at both wavelengths have confirmed that the splice loss is not consistent with a high point loss, then the splice shall be accepted but reported as a high splice loss. All splice loss/joint measurements shall be recorded and any high splice loss value shall be appropriately marked (eg circled, highlighted).

Fibre splices with air bubbles or high reflectance (reflective spikes) are considered as faults and have the potential to fail. They shall be respliced to correct the fault.

3.4.3.5.6. Through Connector loss

Individual through connector loss values are checked and the bi-directional average OTDR loss of each through connector should not exceed 0.3 dB max at both wavelengths. Now we are having significant quantities of grade A connectors in the network a figure of 0.15dB max per through connector would be expected.

3.4.3.5.7. Testing requirements for various Installation scenarios are defined below

Measurement requirements for various installation scenarios are as defined below:

A. For New Optical Fibre Cable Installation with unterminated fibres:

(When fibres are left in the exchange splice tray or in the outside joint/FAP);

- "Cable Acceptance Measurements", only is required on all fibres.
  (*Note:* For new cable installations, all fibres are required to be terminated on the exchange ODF as defined in 3.1.17).

B. For New Optical Fibre Cable Installation with fibres terminated on the ODF

- "Cable Acceptance Measurements", and;
- "Link Commissioning Acceptance Measurements", are required

C. When adding pigtails only for a fibre which has already undergone Cable Acceptance Measurements:

(E.g. terminating the fibre from splice tray to the ODF patch panel);

- "Link Commissioning Acceptance Measurements" only is required.
  (If optical Link Length and OTDR link loss are not available from Telstra records, for Link Commissioning Acceptance Calculations, two way OTDR Link Loss and Link Length are measured using 1550nm OTDR test).

D. When a new "Link" is created using fibres which have already undergone Cable Acceptance Measurements, by adding splices at one or many exchanges:

(Including cases where the link is created by using a combination of splice and patch);

(Where the "Link" is defined as, the optical path between the two end connectors which are to be plugged into the transmission equipment without the attenuators that may be necessary for system commissioning).

Two way OTDR test at 1550nm is carried out on the "Link" , all new splices and through connectors shall be checked , as specified in section 3.4.3.4 . OTDR traces for the link are to be submitted for Telstra records;

- Optical link length "L" and two way averaged OTDR Link Loss "LL" are measured at 1550 nm for the Link, for the purpose of "Link Commissioning Acceptance" calculations;

- "Link Commissioning Acceptance measurements" shall be done for the Link, as specified in section 3.4.3.7.

E. When a new "Link" is created for purpose of commissioning of transmission systems by adding only patches at one or many exchanges using fibres which have already undergone Cable Acceptance and Link Commissioning tests.

- A simplified "Link Commissioning Acceptance" is done by measuring the insertion loss (IL) of the link - one way measurement only at the transmission wavelength, with a light source and a power meter. For this, if stabilised light source is not available at the transmission wavelength, then the transmission equipment itself is used as a light source, as described in TM00045 A01"Generic Optical Link Commissioning & System Commissioning Procedure". The measured link loss value is checked against the theoretically estimated value using Telstra DBoR Commissioning records for loss of individual cable sections or using calculations shown in section 3.4.3.7;

- When the measured link loss value is greater than the estimated value by more than 1 dB, detailed investigation and Link Commissioning procedure as described in Clause (D) is to be followed. The measured Link Loss value is entered into the system test and commissioning sheet.

F. When a new "Link" is created for the purpose of commissioning of transmission systems by adding splices and patches at one or many exchanges using fibres which have already undergone Cable Acceptance and Link Commissioning tests, the following test procedure apply:

- Testing as per Clause (D) can be carried out for the full end to end link or optionally, the following alternate test procedure can be adopted;

- For the section of the cable involving splicing only, testing as per Clause D is carried out, which is to be followed by testing as per Clause (E) for the end to end full link.

G. When a repair work is done by adding a new /replacement fibre cable within an existing section:

- two way OTDR testing at 1550nm shall be done - to check the quality of the new cable installation (Quality of Fibre cable material and installation quality), as follows:
    - Using OTDR reference markers between newly installed cable ends, fibre loss is checked and should not exceed 0.21dB/km (excluding the splice loss).
    - All splices for the new installed section should be ≤ 0.1 dB;
    - Fibre irregularity check, point loss and splice loss checks as defined, in 3.4.3.5, are required for the newly installed cable sections;
    - Two way splice loss (at 1550 nm) and updated cable and joint location details, are to be provided for input to MULTIMAN database;

Then, Link Commissioning Acceptance measurements are done as defined, refer to 3.4.3.7.

- During planned cable replacement, and urgent cable restoration operations, where time does not allow complete OTDR testing (Acceptance testing) and Insertion Loss measurements (Link Commission Acceptance Measurements), ONE WAY OTDR testing at 1625 / 1650 nm, is recommended on all the fibres to check the repair joints and cable sections and to record fibre damage and high losses at other locations in the cable. Where the fibres are connected to live transmission equipment, this ONE WAY testing through the repair may be performed from the closest accessible termination /patch location using an OTDR with a “LIVE” testing port (filtered port).Alternatively an approved discrete Band pass filter, in circuit with the OTDR may be used. See Sect 3.4.3.10 for details of “Live“ fibre testing with a filter.

- When all the fibres in the cable are not available for testing, a sample of the fibres is to be tested. i.e. testing of a few sample fibres – at least one fibre per tube, to confirm/prove that the splicing and repair operations are being carried out in conformity to the standards specified in this document.

- Outside the repaired section, All high losses found should be reported to the Contract Manager, so that the Transport Group, (Platform Operations, Network Services) are alerted.

- Faults at a single location exceeding 3 dB (at 1625 /1650 nm) must be investigated, reported and scheduled to be fixed.)

- Point losses of > 2 dB but <3 dB at 1625 / 1650 nm are to be identified, and reported.

- When spare fibres are available and accessible at both ends, two-way OTDR testing on those spare fibres is to be carried out as part of the restoration work and Link Commissioning Acceptance measurements are done as defined, refer to 3.4.3.7.

H. When an existing Distribution / CAN fibre cable is extended by adding an extension cable (e.g. extension from existing FAP):

- Fibres Terminated at both ends on completion of installation.

- Fibre Acceptance and Link Commissioning Acceptance measurements are done as defined, refer to 3.4.3.7, for all terminated fibres of the extended cable.

- Fibres Terminated at ONE end only on completion of installation.
  - One way OTDR testing at 1550nm & 1625 / 1650nm shall be done to check the quality of ALL NEW splices done to extend the existing link. Any splices that are out of limits shall be 2 way tested and repaired if required.

- UN- Terminated Fibres with intermediate splices on completion of installation. (Untested fibres to be tested when they are put into service).
  - One way OTDR testing at 1550nm & 1625 / 1650 nm shall be done to check the quality of Material, Installation and ALL NEW splices done to extend the existing link. Any splices out of limits shall be 2 way tested and repaired if required

- Fibre loss, irregularity check, point loss and splice loss checks shall be done, refer to, 3.4.3.4 ,for the newly installed cable sections;

- Two-way splice loss (at 1550 nm) and updated cable and joint location details are to be provided for input to Multiman database for all terminated fibres.

- OTDR results shall be submitted with the as built pack for storage.

Notes:
- If fibres are not accessible on a splice tray, to enable testing, then testing is required when the fibres are placed into service
- If the new installation spans multiple cable sections it is recommended that all available fibres be through spliced at the NEW intermediate joints and tested as per the applicable point above.

I. When a new lead-in cable of less than 800m is installed from FAP to the customer premises, with 12 fibres or less, and the number of splices are no more than 2 including the FAP and the customer premises, the following testing is done for Cable Acceptance:

- One way OTDR testing at 1550nm from Customer premises shall be done, as follows:

  - The quality of the new lead-in cable installation and the splices from the customer end to the FAP are checked from the OTDR results, to confirm that there is no macro bends /point loss of greater than 0.1 dB in the newly installed cable. One-way splice loss of all new splices in the lead-in extension section should be £ 0.2 dB (higher allowance is given here, taking into account possible Mode Field Diameter mismatch between fibres and testing is one-way only) and reflection from the new splice should be better than 40dB;

  - Optical link length L and the one-way Link Loss (LL) are measured for the entire link from the 1550nm OTDR trace for Link Commissioning Acceptance calculation;

  - Updated cable and joint location details are to be provided for input to Multiman database.

Then, a simplified “Link commissioning acceptance measurement”, as described in Clause (E) is carried out.

Note: When a new customer wideband link is created by adding additional splices or patches at intermediate exchanges, two-way OTDR testing is to be done to check the quality of the connector/splices, as defined in Clause D above.

J. Commissioning of Tie Cables;

- Terminated Tie cables (i.e. internal building cables, terminated but with no intermediate joint) shall be tested for Insertion Loss at 1310 and 1550 nm. The two-way (average) loss measured in both directions and at both 1310 nm and 1550 nm wavelengths shall not exceed 1.5 dB. If the loss value is exceeded, then a more comprehensive evaluation of each individual connector/pigtail at either end needs to be undertaken to determine the cause of the high loss;

- If the installed tie cable is to be left in the splice tray for later connectorisation or usage, then the cable acceptance measurement, as defined in 3.4.3.5, is to be carried out;

- For NGN TIE cables, which run between intermediate ODF to the NGN equipment rack, all fibres of the cable may not be terminated initially. For these NGN TIE cables, Insertion loss testing is done on terminated fibres only as and when they get terminated. They should comply with the criteria defined in the first dot point of this clause

For DBOR entry, the length of the TIE cable is to be derived from the cable sheath markings, at the start and end of the cable run.

3.4.3.5.8. Parameters for Measuring Losses Using an OTDR

Configure the following OTDR parameter settings to record signature traces for accurate analysis:

- wavelength
- range
- pulse width
- averaging time

Range
Range settings should be selected to display at least the maximum length of the fibre under test. Selecting a range setting less than the total length of the fibre may result in ghost reflections on the displayed trace.

The following table provides suggest settings which should cover a range of OTDR's available at this time.

Total length of test fibre (RANGE.)	***Wavelength (nm)***	***Pulse Width OTDR's vary , generally one or two settings in the pule width rangewill be available on most OTDR's***	***Aqusition (Test) time Test/Acquisition time should be selected to obtain traces with a minimum od noise distortion***
0 – 500m	*1310 ,1550, 1625/1650*	1ns – 5ns	5-10 Sec
500m – 1000m	*1310 ,1550, 1625/1650*	3ns – 10ns	5-10 Sec
1000 – 5000m	*1310, 1550,1625/1650*	5ns – 50ns	10-20Sec
5 km- 50km	*1310*	20ns-500ns	30-60Sec
	1550, 1625/1650	10ns-200ns	20-60Sec
50km-80km	*1310*	1us-5us	1min-3min
	1550, 1625/1650	200ns-1000ns (1us)	60 Sec-2min
80km-120km	*1310*	Beyond the range of most	OTDR's
	1550, 1625/1650	500ns- 10,000ns (10us)	1min-5min
125km-250km	*1550,1625/1650*	1us- 20us	1min-5min

3.4.3.6. Link Commissioning Acceptance Criteria

These measurements apply to terminated fibres only in SMOF cables, and shall only be applied to fibre links, which have met the Cable Acceptance criteria above.

Link Commissioning Acceptance measurements determine whether the transmission system power budget for each fibre link will be met and whether the cabled fibres have been satisfactorily installed.

All test results are to be recorded. If the test criteria are exceeded, even after a number of re-measurements, the performance of the end connector/pigtail is to be examined and replaced if necessary. After this measurement is required again, and if the fibre still exceeds the insertion loss criteria, then the value shall be appropriately marked.

3.4.3.7. Link Commissioning Acceptance Measurements

3.4.3.7.1. Insertion Loss

This measurement is performed on terminated fibres only and provides the overall end to end power budget level of the entire link.

Insertion Loss (IL) for each fibre shall be measured in both directions using stabilised light source and power meter, at both 1310 nm and 1550 nm wavelengths. For specific requirements 1625nm/1650nm insertion loss may also be requested

Note: When only a single person is available to carry out the IL testing for a link, it is highly recommended that consideration should be given for use of a suitable automatic two-way test equipment, which has built-in power meter and light source in one unit (to avoid repeated back and forth travel between sites).

Two- way averaged IL ($IL_{\lambda=1310nm}$, $IL_{\lambda=1550nm}$ & $IL_{\lambda=1625/1650nm}$) for the specified test wavelengths shall be calculated and checked against the following criteria:

For cables with a manufacturing date of 01/2006 or later date:

$IL_{\lambda=1310nm} \leq 0.35L + 0.1N + 0.3C + 0.3;$

$IL_{\lambda=1550nm} \leq 0.21L + 0.1N + 0.3C + 0.3;$

$IL_{\lambda=1625nm} \leq 0.25L + 0.1N + 0.3C + 0.3;$

For cables with manufacturing date prior to 01/2006:

$IL_{\lambda=1310nm} \leq 0.37L + 0.1N + 0.5C + 0.3;$

$IL_{\lambda=1550nm} \leq 0.22L + 0.1N + 0.5C + 0.3;$

$IL_{\lambda=1625nm} \leq 0.27L + 0.1N + 0.5C + 0.3;$

Where $IL_{\lambda=1310nm}$ is the measured Insertion Loss in dB (at 1310 nm):

$IL_{\lambda=1550nm}$ is the measured Insertion Loss in dB (at 1550 nm);

$IL_{\lambda=1625nm}$ is the measured Insertion Loss in dB (at 1625/1650 nm);

L is the optical section Length in km (from 1550 nm OTDR testing);

N is the Number of splices including pigtail terminations;

C = total number of through Connectors.

If compliance is not achieved, further investigation shall be conducted to understand why compliance is not achieved and any anomalies rectified.

If the Link Length (L) from cable acceptance measurement is not available, they are measured at 1550nm using OTDR first.

3.4.3.7.2. Connector/Pigtail Loss

These measurements are performed to determine the overall performance of the individual through connector / pigtail combination situated at either end of the fibre link.

For each fibre, the difference between the average Insertion Loss (IL $_{\lambda=1550nm}$) minus the OTDR average Link Loss (LL $_{\lambda=1550nm}$) shall be calculated at 1550nm, and it shall not exceed 1.0 dB. (If the IL value is not available from cable acceptance measurement, it is measured again using a 1550 nm OTDR).

3.4.3.7.3. Return Loss

This measurement is carried out on fibre links which support analogue transmission systems and all metro SDH or Transmission systems operating at minimum 10Gbit/s TDM in single wavelength or in WDM configuration.

The return loss for each individual event along the fibre link shall be greater than 50 dB.

3.4.3.8. Specialised Testing Requirements for 10Gbit/s Transmission Systems

Chromatic Dispersion (CD) and Polarisation Mode Dispersion (PMD) measurements are legacy requirements. The introduction of Electronic Dispersion Compensation and Coherent technology in new DWDM systems effectively eliminates the need for these measurements. If CD & PMD measurements are required, the following information applies.

CD and PMD measurements on fibres are needed before introduction of optical transmission systems at 10Gbit/s and above, to verify whether the fibres meet the equipment specification or to prepare system design (in DWDM systems). Based on the input from the current transmission equipment vendors, the following guidelines, see Table 26 are developed to decide when PMD and CD testing is needed.

System/Link Description	PMD Testing requirement	CD Testing requirement
Intercapital >=10 Gbit/s (single wavelength or multiple wavelength/DWDM) systems	**Required**	**Required**
Regional >=10 Gbit/s (single wavelength or multiple wavelength/DWDM) systems with one or many optical amplifiers	**Required**	**Required**
Metro DWDM Links (>=10 Gbit/s Multi-wavelength systems in the IEN)	**Not Required**	**Required**
>=10Gbit SDH or Ethernet links □□80kms (Single wavelength systems in IEN or customer side links)	**Not Required**	**Not Required**
>=10Gbit SDH or Ethernet links > 80kms (Single Wavelength systems IEN or Customer side links)	**Not Required**	**Required**
Wavelength Service (WS) Links. >=10Gbit/s multi-wavelength systems in the Access network.	**Not Required**	**Not Required**

Table 26 CD and PMD Testing Guidelines

CD and PMD testing is not part of the routine optical fibre cable acceptance testing requirement. CD and PMD testing is only required as part of the "Link commissioning" requirement for fibres that carry links as described in Table 24. CD and PMD testing will be requested for these systems as part of the system design / system commissioning requirements.

3.4.3.8.1. CD Testing

Normally, the CD measurement on fibre is to be carried out in C and L band. CD value of the fibre link and the CD/km value are to be provided in a tabulated format from 1530 to 1625nm in steps of 5 nm unless CD at specific wavelengths is requested. Also, results of CD curve covering C & L band, is to be provided in a PDF file format.

3.4.3.8.2. PMD Testing

The wavelength range for PMD measurement is typically C band. Measured PMD is to be provided as the section PMD value and PMD value per √ km. In addition, the PMD delay graph from the analyser is to be provided in a PDF file format for records.

3.4.3.9. Installation Problems Identified during Testing

Details of any significant problems/abnormalities experienced during installation which may affect the short or long term performance of the cable should be noted on drawings.

3.4.3.10. Filtered (1625/1650NM) OTDR Testing on "Live" Fibres

THIS TEST PROCEEDURE IS NOT APPROVED FOR MONITORING LIVE IN-SERVICE FIBRES WITH TRAFFIC !

This measurements procedure may be used to perform OTDR testing ONE WAY on a fibre where the remote end is inaccessible at the testing time, AND the fibre has some light transmitted from the remote end. It is to be used when the service has been interrupted by damage or scheduled maintenance and the fibre has a connectorised break point at an accessible location where testing can be performed, i.e. Exchange or repeater building etc.

Only an approved OTDR with a filtered "LIVE" test port, OR a standard OTDR with a test wavelength matching an approved In Line Band Pass Filter may be used.

Extreme care should be taken to ensure the minimum test parameters are used. OTDR Pulse Width and Range should be selected at the minimum levels required to observe the location of significance for a repair OR remote end for a full link fibre check.

HIGH POWER SETTINGS SHOULD NOT BE USED TO AVOID DAMAGE TO THE TRANSMISSION EQUIPMENT AT THE REMOTE END.

OTDR test parameters should be set low and increased to the optimum required to evaluate the events of interest.

Current OTDRs with filtered "LIVE" test ports use 1625/1650nm wavelength to perform this test.

An approved, discrete component 1625/1650nm wavelength Band Pass filter is available to be used in circuit on the Output port of a standard OTDR with the functionality to test at 1625/1650nm Wavelength.

Using either of these two test configurations, the in circuit filter should block the incoming light on the fibre under test, allowing the OTDR to test at a wavelength outside the transmission range of the system.

This 1625/1650nm method is suitable for testing fibres with transmission systems operating in the "O" to "C" Bands. Fibres used for CWDM and DWDM systems operating at wavelengths into the "L" Band, should only be tested using this method if the OTDR has a "LIVE" test port operating at 1650nm, and the transmission system wavelengths do not extend into the "U" Band.

BAND	WAVELENGTH
O	1260NM to 1360NM
E	1360NM to1460NM
S	1460NM to1530NM
C	1530NM to 1565NM
L	1565 to 1625NM
U	1625 to 1675NM

Table 27 Wavelength Table.

[For information on the currently approved "In Line Band Pass Filter" , Contact Richard Moretti, Deployment Solution Expert, Fixed Delivery, Program Management Office, Telstra Operations 03 8649 4334]

3.4.3.11. Test Result File Naming Convention

File names for test results should conform to the follow standard naming convention.
OTDR Traces:
LOC1.LOC2.CCCCXXXX.FXXX.WWWW.SOR or
LOC1.LOC2.CCCCXXXX.FXXX_WWWW.SOR

Example:- **CBNC.BWKS.CBNC3001.F001.1625.SOR** or
CBNC.BWKS.CBNC3001.F001_1625.SOR

Excel Workbook, Photo Audit document and EXCEL CSV from EXFO FOT-933 LTS:
SPSPSPSP.WWW.LOC1.LOC2.CCCCXXXX.FXXX&YYY.xlsx
SPSPSPSP.WWW.LOC1.LOC2.CCCCXXXX.FXXX-YYY.xlsx (for a continuous range from XXX to YYY)
SPSPSPSP.WWW.LOC1.LOC2.CCCCXXXX.FXXX&YYY.doc
SPSPSPSP.WWW.LOC1.LOC2.CCCCXXXX.FXXX-YYY.csv (for a continuous range from XXX to YYY)

Examples:-
Excel workbook:-
10011001.001.CBNC.BWKS.CBNC3001.F011&015.xlsx
10011001.001.CBNC.BWKS.CBNC3001.F011-025.xlsx (for a continuous range from XXX to YYY)

Photo Audit doc:-
10011001.001.CBNC.BWKS.CBNC3001.F011&015.doc or docx

EXFO FOT-933 LTS:-
10011001.001.CBNC.BWKS.CBNC3001.F011-015.csv

JPG Screen shot file:
SPSPSPSP.WWW.LOC1.CCCCXXXX.FXXX.JPG
Example:- **10011001.001.CBNC.CBNC3001.F001.JPG**

CODE LEGEND
SPSPSPSP = Separable Portion Number
WWW = Work Authority Number

LOC1 = **TEST "FROM" LOCATION** Exchange/Site 4Alpha NODE Code
LOC2 = **TEST "TO" LOCATION** Exchange/Site 4Alpha NODE Code
NOTE: If Node Code is not known and the test location is located in the Telstra Exchange Building identified by the ESA for the location the ESA CODE should be used.

CCCCXXXX = Cable number This should be the SHEATH ID - 4ALPHA&4NUMERIC (As identified at the test FROM Location Exchange/Site (because it maybe a different ID at the LOC2 location)
Example:- **LOC13003"** as it appears at the TEST **FROM** Location Exchange/Site.

FXXX = First **SHEATH** Fibre number To avoid confusion with position number, or Group number in the CPG. &YYY= Second SHEATH Fibre number
or
FXXX-YYY where FXXX=First SHEATH Fibre number , -YYY=Last SHEATH fibre in a continuous range
WWWW = Wavelength in nm
SOR = File extension type.

Testing a Cable section between two external FAP's

The variation to the standard file naming convention which would require additional filename information is when testing a cable section between two external FAP's.

To ensure uniform filenaming conventions, this naming format should also be used when testing from an Exchange to an external FAP in the same, or a different ESA area. (The A Fap would be the exchange "YY",or may be a Node if testing from a repeater)

This information should only be required for OTDR trace names as insertion loss is not required for intermediate cable sections.

For this filename template to provide a unique filename the FAP ID at each end of the cable section under test should be included.

[A Esa].[A Fap].[B Esa].[B Fap].[SheathCode ID].[FibreNo].[Wavelength].SOR

Where:-

The "A" and "B" Esa's would be the ESA locations for each test FAP.

Note 1:- Cable may cross the ESA Boundary resulting in different ESA's at each test FAP.

Note 2:- Both ESA's and FAP's must be included in the filename as this determines the direction of test from the Test Location FAP .

The "A" and "B" Fap's being the Fap's at each end of the cable section being tested.

SheathCode ID and Fibre No at the test end FAP.

Note 3:- This should be the Sheath code that applies at the Testing point FAP as cable sheath ID's may change at the second testing FAP location.

Note 4:- It should also be considered that the FIBRE NUMBER may be different each test location,

Example 1:- LOC1.AA.LOC2.BB.CABL1001.F001.SOR

Example 2:- Testing from both ends across the exchange ESA boundary where the fibre number changes due to cable inter connections.

RAA.BWKS.RAD.CBNC3001.F011.SOR

test file 2 = BWKS.RAD.CBNC.RAA.BWKS3005.F023.SOR

Example 3:- LOC1.YY.LOC2.BB.CABL1001.F001.SOR

3.4.4. Fibre Maintenance Related Issues

3.4.4.1. Fibre Sections Showing System Power Budget Margin Problem

Severe degradation in fibre transmission characteristics can lead to a reduced system power margin, triggering transmission performance errors. Continuous or intermittent errors or Alarms observed in the Global Operations Centre (GOC) on any Transmission system may lead to investigations on all network elements on the system, including the optical fibre. Checking through EMOS or AGC voltage readings, the available power budget margins on the transmission system can be estimated. Subsequent investigation on the fibre may lead to information on fibre transmission degradation if any, in the form of high point loss or high attenuation coefficient.

3.4.4.2. Fibres Showing High Point Loss

For fibres showing High Point (H.P) loss due to a mechanical stress or reactive soil problem, depending on the magnitude of H.P loss, monitoring of fibre performance or immediate repair operation is required.

As indicated in 3.4.3.3 (E), any point loss of > 3 dB identified by OTDR testing at 1625 / 1650 nm, must be investigated and repaired. Point losses of > 2 dB but <3 dB at 1625 / 1650 nm are to be identified, and reported to the Contract Manager, so that the Transport Group, (Platform Operations, Network Services) are alerted.

If only one of the fibres in the cable is affected by H.P. loss, while the rest of the fibres are behaving near normal, repair work may be postponed and monitoring may be implemented to see whether any degradation is observed on other fibres, and to analyse the rate of degradation on the affected fibre.

For suspected reactive soil areas, even after repair operations, some type of monitoring may be needed to assess any likely future problems.

3.4.4.3. Maintenance Practices to improve the cable repair time

Irrespective of all precautions and care, cable cuts due to third party and other natural causes are inevitable. To minimise the impact of cable cut, restoration at the earliest opportunity would improve network availability.

After significant flooding in an area, major / significant Fibre routes should be surveyed (by plane / helicopter / drone or other means) to ascertain the integrity and security of the cable. Defective routes should be re-instated in a timely manner before any traffic affecting incident occurs. Route survey is required every 12 – 24 months on flood prone areas or after significant environmental events in the area.

When cable cut occurs due to flood or other events, the damaged cable is to be reinstated at the earliest opportunity to get the transmission system links restored. It is recommended that the link is reinstated with a like for like or a temporary patch to be followed up by an Incident report to the Planning area, with a recommended permanent or alternate solution, to eliminate the repeat occurrence of the same type of failure on the section. The Planner has to consider the recommendation and take appropriate action to eliminate future outages of the same nature at that location. Any improvements implemented to provide more resiliency, would be considered as CAPEX which may help the value proposition to fund the replacement.

Costs would be approved by the appropriate SD5 Delegate linked to the Planning Brief in PBR Register. A cost variation would be submitted by Network Delivery for approval in PBR. Costs estimates would generally be negotiated first before finalising Brief.

3.4.5. Cable Data

There are three primary databases of record (DBoRs) used to administer the various aspects of an Optical Fibre Cable network, namely TPNI, MULTIMAN and TRAC. It is a requirement that contractors will source, edit and update various Optical Fibre data elements contained within each of these DBoRs. Refer to 3.4.5.1, 3.4.5.2 and 3.4.5.4, for a summary of these data elements.

Distribution frame inventory items are to be entered into the MITS DBoR, refer to 3.3.22.2.

For entry of contract details into the databases refer to Telstra Publication 013310 “Contract Identification - Contractor Database Requirements”.

3.4.5.1. TPNI Data Elements

- FAP and BLDG Codes;
- Exchange Codes and Exchange Names;
- ESA Codes and ESA Names;
- Sheath Code and Sheath Section Code;
- Optical Fibre Termination Points;
- Geographic location of Termination Points;
- Geographic Path of Optical Fibre Cable Sheath Sections.

3.4.5.2. MULTIMAN Data Elements

- Level 4 Project Number (BUILD) e.g. SP(and WO) number, or Project number, refer to 3.4.5.3;
- All Optical Fibre Cable Termination Points;
- FAP and BLDG Codes;
- External cable Sheath Code, Sheath Section Code;
- Optical Fibre Tie Cables;:
  - Sheath code and section code (see *Note 1*);
  - Equipment at both ends tie cable connects to;
- Optical Fibres, Optical Connections;
- Insertion Loss measured at both 1310nm and 1550nm (A-B, B-A, Average)*;
- OTDR Link Loss measured at 1550nm (A-B, B-A)*; (* see *Note 2*):
  - OTDR electrical distances to all splices A-B and B-A, including FAP and address details;
  - Cable batch number, cable size and type, and survey (as built) distances.
- OFDP Subrack Location;
- OFDP Optical Fibre Terminations;
- OFTU Optical Fibre Terminations;
- Line System Code.

Note1: The external cable sheath code is to be recorded in the test results where an OTDR test is conducted on a coded external optical fibre cable that is connected to equipment and then interconnected via a coded optical fibre tie cable to equipment. The internal elements such as interconnect details, tie cable, patch cord and equipment references are to be recorded on the events sheet. Where an OTDR test is conducted on an internal tie cable that does not connect to external cable, the optical fibre tie cable sheath code is to be recorded in the test results.

Note 2: If an existing fibre is not in use and no test records exist, tests are required. If an existing fibre is not in use and test records exist and the fibre was terminated at both ends when previously tested, no testing is required. If an existing fibre is not in use and test records exist, and the fibre was not terminated at both ends when previously tested, testing is required after termination. If a fibre is in use and no test records exist, if an additional service is installed on the existing system, testing cannot be performed without a break of service, no testing required due to service interruption. If a system is upgraded (Optomux to VCTS) to create additional capability, and the fibres need to be reterminated in different racks and require new pigtails, testing is required (test records to show new rack location). If a system is upgraded to create additional capability, and the fibres do not need to be reterminated, no testing is required.

3.4.5.3. MULTIMAN Project Numbers

Multiman's Project Number field is to be used to record Contract Identification Number's (CIN) for cable section identities in the network. The CIN is to be recorded against each cable section or spur as it is introduced into the network. This CIN will remain against the cable section for its life in the network. CIN's that change the utilisation of the cable section are to be recorded and tracked in TRAC. The sequence numbers for each CIN used in TRAC are to be the same as the sequence numbers used in Multiman to allow for cross-referencing.

The CIN should now be in this format below.

SPxxxxxxxx-yyyy where "SP = Separable Portion", "xxxxxxxx = The Separable Portion Number" and "yyyy = Contractor's sequence number 0001 to 9999" (to allow Contractors to identify and have multiple authorities on each SP).

The Separable Portion\ IPaC Work Order work should now be in this format below.

WOxxxxxx-001A where "WO = Work Order", "xxxxxx = The Separable Portion Number", "001 = The Work Order number" and "A" is the Contractor's identification designation where the range is "A-Z."

3.4.5.4. TRAC Data Elements

- Line System Code;
- Multiplex Link Code;
- Measured Insertion Loss at Commissioning;
- Sheath Code, Sheath Section Code;
- Cable Pair Group Code (IEN only);
- Cable Pair Group Position;
- Optical Fibre Tie Cables:
  - - Sheath code
  - - Cable pair group.

3.4.6. Long Term Maintenance

The Superintendent shall be provided with, at the time of hand over, all necessary information and details which are essential to enable the superintendent to operate and maintain the network in an effective and efficient manner.

3.4.7. Inspection

The owner or his representative may request joint inspection of all or any part of the installation at a negotiated time to suit all parties. The installer has a duty to draw attention to, and inspect where necessary, with the owner, any unusual, novel or critical aspects of the installation which requires operational or maintenance attention.

A handover procedure will take place when the entire work, or sections of work are complete and the owner is requested by the installer to accept the work. In some circumstances it may be the owner who initiates a handover request for part of the work. At handover the installer shall provide to the owner a Commissioning Pack which includes, at least the following:

- All relevant project design documentation, updated plans, equipment spares, test records and maintenance requirements or plan as appropriate;

- A Handover Checklist which verifies that critical acceptance criteria have been met.

To formalise the handover procedure and agreement, a formal acceptance certificate should be completed and signed and copies kept by both parties. As conditional acceptance is permissible, the Handover Checklist should be used to identify potential issues subject to a conditional acceptance.

3.4.8. Quality Control System

With optical fibre cable, it is not possible by Inspection and Test procedure alone after the cable installation is complete to determine if critical quality standards have been met. The handover procedure should be supported by the installers project based quality control system. The installer must be able to provide the documented evidence of the quality processes applied to all phases of the project including the design, planning, installation, testing and suggested maintenance. This will provide the necessary confidence to the customer that it should not be necessary for the complete cable route to be inspected as part of the final handover procedure.

3.5. Cutover

Nil

3.6. Recovery

3.6.1. Removing Cables from Ducts

When it is necessary to remove an existing copper cable from a conduit or pipe which houses both optical fibre & copper cables, to ensure that no damage occurs to other cables in the conduit or pipe, the tension applied to the copper cable shall not be greater than that specified for any of the installed optical fibre cables. It should be noted that the allowable tensile strength of optical fibre cables has improved with time. Therefore to safely remove the copper cable the removal tension applied to the copper cable shall not exceed the hauling tension that would be applied to the installation of any of the optical fibre cable present in that duct.

Use the same guidelines as specified above for limiting the hauling or removing tension. If however the cable cannot be safely removed then it shall either be not recovered or left insitu until traffic has been cutover from the optical fibre cable/s. If this removal was due to space problems then it may be necessary to provide an alternative or new pipe or conduit.

3.6.2. Cable Drums

All Metal and Timber cable drums remain the property of the Vendor and must be returned as soon as possible after use. Contact CEVA to arrange pickup of the drums, so that they can be returned to the Vendor.

Excess cable, for disposal, shall remain on the drums for return to the Vendor. No charge is levied for this service.

04 References

Document number	Title
000 511	Numbering, Labelling and Data Entry of Network Inventory
000531	Optical Fibre and Laser Safety
004 527 A19	Standard Identification Scheme for Transmission Paths- Optic Fibre Cable Sheaths
005747	Network Deployment Rules
008532A36	Recording Fibre to the Premises (FTTP) in NPAMS
009 959	Material Management Process Overview
010256W06	Underground Joint Closures – Use of Denso Termiteshield Tape
011844W06	Entering Optical Fibre into TPNI
011844W41	Fibre to the Premises (FTTP) - Plan Symbols Definitions
013 310	Contract Identification – Contractor Database Requirements
015526A14	Access Network Design Fibre to the Premises (FTTP) ODN Design Specifications
016390W35	Data Services, Capturing & Recording Test Results into Multiman
016390W37	Access Network Design Fibre to the Premises (FTTP) ODN Design Specifications
016390W38	Data Services, Building FTTP (GPON) into TRAC
016390W40	Data Services, MITS - FTTP Build
017833	External Plant Construction Specification - Fibre to the Premises (FTTP)
017833A04	Telstra FTTP Optical Network Terminals - Technical Specifications
017833A05	Fibre to the Premises (FTTP) ODN Material List - Serial 914 Items Only
017833W01	Fibre to the Premises (FTTP) ODN - Lead-in Cable Installation Instructions
017833W02	Fibre to the Premises (FTTP) ODN - External FDH Installation Instructions
017833W03	Fibre to the Premises (FTTP) ODN - Splitter Installation - External & Internal FDH
017833W04	Fibre to the Premises (FTTP) ODN - DLM Closure Installation Instructions

Document number	Title
017833W05	Fibre to the Premises (FTTP) ODN - LM Closure Installation Instructions
018050W01	Installation of Corning MAX Closures – Including NGN Network
018334	Fibre Interface Inspection and Cleaning – Requirements for Telstra Networks
018390W38	Data Services, Building FTTP (GPON) into TRAC
018390W40	Data Services, MITS - FTTP Build
Bellcore TR-TSY-000887	Generic Criteria for Optical Power Meters
CN1279	Optical Fibre Duct
G70381-K0006-U019-1-76	Telstra CAN Requirements for the Installation of Corning MAX Closures
ISO9001	Quality systems - Model for quality assurance in design, development, production, installation and servicing
TM00042	Conduit Route Installation
TM00043	Copper Cable
TM00044A01	Optical Fibre Cable Hauling Winch Compliance
TM00044A02	Optical Fibre Cable Plough Compliance
TM00045A01	Generic Optical Link Commissioning & System Commissioning Procedure
TM00138A01	Common Station Facilities - Optical Fibre Ducting
TM00183	Optical Distribution Frame – Technical Requirements
TM00183-A02	Optical Distribution Frame – Standard OFDF
TM00183– A03	ODF -Tyco BAN OFDM's
TM00183 A04	ODF – Optical Fibre Tie Cables
TM00183-A01	Optical Distribution Frame – High Density Optical Distribution Frames
TM00183A10	ODF- High Density Optical Distribution Frames WBT V3
005747-A076	005747 – Wideband Network Deployment Rules, Deployment Standard.

05 Definitions

Term	Definition
ACIF	Australian Communications Industry Forum
AC	Alternating Current
AS	Australian Standard
ASC / SC-APC / Angled SC	The terms are interchangeable, and refer to a Standard Connector that is Physical contact and angled.
ASN	Application Service Node
BAN	Business Access Network
CAN	Customer Access Network
CBD	Central Business District
CCM	Customer Cabling Manual
CD	Chromatic Dispersion
CIN	Contract Identification Number
COFTU	Customer Optical Fibre Termination Unit
CPR	Cable Plant Records
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DBoRs	Database of Records
DA	Distribution Area
DF	Distribution Frame
DI	Deliverable Item
DPR	Defect Performance Reporting
DSPN	Digital Service Protection Network
DWDM	Dense Wavelength Division Multiplexing
EAP	Ethernet Aggregation Point
ESA	Exchange Service Area
FAP	Fibre Access Point
FIST	Fibre Infrastructure System Technology
FIST- GCO	FIST - Generic Closure Organizer

Term	Definition
FRP	Fibre Reinforced Plastic
FTTP	Fibre to the Premises
GOC	Global Operations Centre
GPON	Gigabit Passive Optical Network
HP	High Point
HS	High Strength
HDODF	High Density Optical Distribution Frame
IEN	Inter Exchange Network
IL	Insertion Loss
IRIM	Integrated RIM
IPA	Iso-Propyl Alcohol
ISO	International Standards Organisation
LAN	Local Access Network
LAS	Local Access Switch
LL	Link Loss
LSZH	Low Smoke Zero Halogen
LTH	Local Transmission Hub
MITS	Module Inventory and Tracking System
MTH	Main Transmission Hub
MULTIMAN	Multiplexed Manager
NATA	National Association of Testing Authorities
NGN	Next Generation Network
NNACS	National Notification & Compliance System (on-line database)
NPAMS	Network Plant Assignment and Management System
OFDF	Optical Fibre Distribution Frame
OFDM	Optical Fibre Distribution Module
ODF	Optical Distribution Frame

Term	Definition
ODFP	Optical Distribution Fibre Panel
ODFT	Optical Distribution Fibre Tray
OFTU	Optical Fibre Termination Unit
OLTE	Optical Line Terminal Equipment
OTDR	Optical Time Domain Reflectometer
PMD	Polarisation Mode Dispersion
PSA	Product Sourcing Agreement
PVC	Poly Vinyl Chloride
RAU	Remote Access Unit
RAX	Remote Automatic Exchange
RCM	Remote Customer Multiplexer
RIM	Remote Integrated Multiplexer
RSS	Remote Switching Stage
RSU	Remote Subscriber Unit
SDH	Synchronous Digital Hierarchy
SMOF	Single Mode Optical Fibre
SOSA	Splice Only Sub - Assembly
SS	Stainless Steel
TAP	Transport Access Port
TDM	Time Division Multiplexing
TITAB	Telecommunications Industry Training Advisory Board
TNS	Transport Network Switch
TPNI	Telstra Physical Network Inventory
TRAC	Transmission Recording and Control (System)
UCN	Universal Closure New
UCNP	Universal Closure New with Ports
UCNCP	Universal Closure New Canister with Ports

Term	Definition
W&B	Warren & Brown
WDM	Wavelength division Multiplexing
WUC	Works Under Contract

06 Attachments

Document number	Title
TM00044 A01	Optic Fibre Cable Hauling Winch Compliance
TM00044 A02.	Optic fibre Cable Plough Compliance
TM00044 F01	Hauling Detail Sheet, (copy attached at end of this document)
TM00044 F02	Ramon Fibre testing specifications, (copy attached at end of this document)

07 Document control sheet

Who to reach out to if you have any queries, questions, changes or concerns.

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If you have a suggestion for improving this document, please contact the person listed above.

Issue number	Issue date	Details on the change
1	24 June 1999	Document Creation
2	24 Nov. 2000	Revision to update specifications
3	15 February 2002	Extensive revision to update layout and specifications, including: - adding information from Addenda 0048 and 0060, and revised details on splice closures , the UCNCP closure, splice trays, splice protectors, cable hauling, dual cable ploughing, cable markers and other. -added details on Customer Terminations, Access Joints and Lead-ins -revised Material details -revised Installation in Pipe/Conduit details -revised Testing details -revised Cable Data specifications

Issue number	Issue date	Details on the change
		Revised Attachments 1 and 2.
4	13 May 2002	Updated Colour Code.
5	2 Dec. 2002	Revised: - sections 4.3.2, 4.3.6.1, 4.3.6.2, 4.3.6.5, 4.3.7.2, 4.3.12, 4.4.8, 4.5.5.4, 4.5.10.2, 4.5.13.2, 4.5.13.4, 4.5.13.6, 4.5.13.11(prev. 4.5.13.10), 4.5.13.13 (prev. 4.5.13.12), 4.5.19.2, 4.5.19.6, 4.5.20.3, 4.5.20.9, 4.5.23.1, 4.5.23.2, 4.5.23.3, 4.5.23.4, 4.5.28, 4.6.3.2, 4.6.3.3, 4.6.3.5, 4.6.5.2. - tables 4 (4.3.6.3), 8 (4.4.9), 10 (4.4.11), 12 (4.4.15), 16 (4.5.13.7) - figure 8 (4.5.22) Added: - sections 4.4.14.2 HDODF 4.5.5.7 Shared Trench with Power Cables 4.5.13.10 Hauling Detail Sheet 4.6.3.7 Acceptance Testing of Optical Fibre Lead-in cables 7.3 Attachment 3, TM00044-F01 Hauling Detail Sheet - tables 7A Preferred Splice Protectors 16A (4.5.13.10) CPAS Contractor Contact List 18 (4.5.28) Cable Tagging Minimum Requirements - figure 10A (4.5.23.2) OFDF Layout
6	21 July, 2004	Reformat to updated template Amendments to Section/Sub-section: 3.3.3.1 Subducting. Revised guidelines for Installing Subduct in a congested duct route. 3.3.7.2 Termination Requirements. Revised to conform with TM00183 3.3.7.3 OFDF Rack Capacity. 2nd para. revised 3.3.8.3 Larger Exchanges . Revised back to : > 480 fibres (conforms with TM00183) 3.3.8.3 Smaller Exchanges. Revised back to : < 480 fibres (as above) 3.4.16 Marker Posts and Signs. Revised comments in Table 13 for S448/00062 3.5.1 Labelling of Plant . Revised text 3.5.2 Recording of Plant. Revised text 3.5.13.13 Housing Cable. Various revisions to text 3.5.16 Tie Cable Installation. 1st Para. revised 3.5.23.2 –5 Splice tray /Loose tube layout, and Splice Tray, Patch Panel and Pigtail labelling. Revised and Additional text to clarify specifications. Includes details contained in TRMR 136 3.5.28 Cable Identification

Issue number	Issue date	Details on the change
		Deleted note following Cable Section Identifier. 3.6.3. Testing. Revision of complete section to include details issued in TRMR 124 Issue 2 3.6.5.2 MULTIMAN Data Elements Added details to: OTDR Link Loss measured at 1550nm (A-B,B-A)
7	1 September 2005	This issue has been reformatted with an updated template. As a result of reformatting and because of revision of text, the section and sub-section numbering, and the table and figure numbers, may have changed. Amendments to specifications include: 3.1.15 Renamed to Network Cable Sizes and Architecture, with Sub sections 3.1.14.1 to 3.1.15.4 created: 3.1.15.1 General. (Prev. 3.3.4.) revised as Table 3, and to include 312 fibre cable 3.1.15.2 Cable Types and Application. New sub section to include brief descriptions and application of available SMOF cables including Internal Riser and FTTP Lead-in cables. Includes details from previous sub- sections 3.4.7.5 to 7. 3.1.15.3. Haul Lengths. Previous section 3.3.5. 3.1.15.4. Standard Cable Drum Lengths. New Table 4 added with standard drum lengths for all SMOF cables. 3.1.16 Jointing and Housing of Cables (prev 3.3.6.). UCNCP Closures (prev. 3.3.6.3.). Revised to include 312 fibre cable for 9-28 closure. Table 6 revised to include splice tray configurations for 312 fibre cable. 3.1.17. Exchange Termination (prev. 3.3.7.). 3.1.17.2. Termination Requirements (prev 3.3.7.2.). Revised to refer to 2.4mm patchcords. 3.1.21 Customer Terminations. Text added. 3.2.6. Optical Fibre Cable. 3.2.6.1. General. Revised to include description of Pirelli KleencoreTM cable. 3.2.6.2. Serial / Item Code (prev 3.4.7.8.) Revised to include 312 Fibre cable. 3.2.6.3. Cable Design Construction (prev. 3.4.7.2.). Sub-section renamed and revised to include Table 6 containing new descriptions of SMOF cables, and to include FTTP Lead-in and Internal riser cables. 3.2.6.4. Colour Code for Optical Fibres and Loose Tubes (prev. 3.4.7.3.). Table 10 (prev. Table 6a) revised to include loose tubes 25 and 26 as in 312F cable. 0. Cable Marking (prev. 3.4.7.4.). Revised information for markings on Pirelli KleencoreTM cables. 3.2.13 included with details of CLETOP products. 3.2.18 Table 15 - Cable Identification Tag and Accessories included. 3.2.19 Table 16 - Conduit Sealing Plugs and Devices included. 3.2.20 Table 17 - Bracket Sets for In-line Closures included. 3.3.7. River and Waterway Crossings. Amended to include further specifications regarding: installation by plough or trenching where no permanent water present: manholes and 30m loops of cable to be installed at each side of major crossings: and, all waterway crossing conduits to be sealed. 3.3.11.6 Ropes for hauling Optical Fibre Cables. Revised with more specific guidelines of approved ropes for mechanical hauling of optical fibre cables. 3.3.5.1. Optical Fibre Cable Mechanical Performance Data. Table 18 - Optical Fibre Cable Mechanical Performance Data(prev. table 16) revised with new specifications (OD, MBR etc.) for: Pirelli KleencoreTM type cables, including 312f Standard cable : and, FTTP Lead-in and Internal Riser cables. 3.3.11.11 Table 22 - CPAS Contractor Contact List (prev. Table 16A) revised. 3.3.11.12 and 3.3.11.13 Overhauling. Revised
7 (cont.)	1 September 2005	3.3.12. Housing Cable in Manholes, Pits, Tunnels, Exchange Cable Chambers and Exchange Buildings. Amended to include specification

Issue number	Issue date	Details on the change
		for installation of 30m loops of cable where manholes are placed at either side of waterway/river crossings. Revised details for housing loops of cable in manholes and pits including Figure 2 - In-Line Closure and Cable Housed in Manhole and Figure 3 - Single ended Closure and Cable Housed In Manhole. 3.3.14 Sealing Ducts and cable Entries. Revised to include further specifications for sealing ducts into buildings and other Network facilities. 3.3.16 Aerial Cable. Added specifications. 3.3.18.3Openable Closures. Revised with reference to pressure testing. 3.3.19. Joint Closure Placement and Housing. Additional information referring to new closure mounting Bracket Sets. 3.5.21.4.Cleaning Optical Connectors, and 3.5.21.9. and 3.3.22.10. Revised to include specifications for CLETOP dry cleaning products. Section 3.5.23.12 SiteLight Junior/SDH Coupler Housing. This section removed. Refer to other appropriate Technical Specifications (TM's). 3.3.26 Cable Identification and Labelling. Revised to include details of the standard cable labelling system. 3.4.1 Completed Cable Route Plans. Revised to include further reference to inclusion of GPS co-ordinates on 'as-built' drawings
8	1 June, 2006	Amendments include reformatting, deletions and inclusions which has changed some section numbers. Specific amendments have been made to the following sections (numbering as per this updated issue): 3.3.3.1. Specifies that only one cable is permitted in a subduct. 3.3.4.1. 288 fibre cable deleted. 3.3.4.2 60 fibre Aerial Cable included and "Pirelli" changed to "Prysmian" cable, and 312 fibre Underwater Cable included. 3.3.4.4. 288 fibre Standard cable deleted, and 60 fibre Aerial Cable included 3.3.5.2, 3.3.5.3, and Table 6. Reference to 288 fibre cable is retained only for when joints are installed on existing 288 fibre cable. 3.3.6.2. Exchange termination requirements changed to 100% patching except for Intercapital and Regional DWDM systems. 3.3.6.3. OFDF capacity specifications revised, and termination of 312fibre cables included. 3.3.10. 100% patching specified. 3.4.7.2. 288 fibre cable deleted. 3.4.7.3. Table 9 revised to delete 288 fibre Standard cable and include 60 fibre Aerial and 312 fibre Underwater cables. 3.4.7.5. "Pirelli" replaced with "Prysmian' marking on cable. 3.5.5.5. Reference to use of split pipe in reactive soil areas included. 3.5.11.7. Table 24 revised to delete 288 fibre Standard cable, revise MBR's for 6-60 and 120 fibre and include 312 fibre Underwater cables, and include 60 fibre Aerial cable. 3.5.11.9. Revised to specify that overhauling in subduct is not permitted. 3.5.19.3. Reference to housing unspliced fibres deleted. 3.5.22.10. Text added to refer to where splicing is only allowed to bypass a patch panel. 3.6.2.3. Revised OTDR specifications.

Issue number	Issue date	Details on the change
		3.6.2.4. New section included 'Chromatic Dispersion Test Equipment' 3.6.2.5. New section included 'Polarisation Mode Dispersion test equipment' 3.6.3.1. Revised to refer to CD and PMD testing. 3.6.3.2. 'A' revised to refer to fully terminating fibres at an OFDF. 'D' Revised specifications for testing after repair or cable extension work. 3.6.3.3. Revised to delete reference to 1310 nm wavelength and include 1625 / 1650 nm wavelength Cable Acceptance testing criteria. 3.6.3.4. Revised to delete 1310 nm and include 1625 / 1650 nm wavelength Cable Acceptance testing measurements. 3.6.3.7. Revised Insertion Loss, Connector/Pigtail Loss and Return Loss Commissioning Acceptance measurement specifications. 3.6.4. New section specifying specialised testing requirements for 10 Gbit/s transmission systems.
9	20 February, 2008	Change of Document Title to Optical Fibre cable - Outside Plant Amendments have been made, include reformatting, deletions and inclusions which have changed some section numbers. Detailed ODF Installation specifications have been removed- refer to TM00183 and attachments. Specific amendments have been made to the following sections (numbering as per this updated issue): 3.1.15. Inclusion of 624f Standard cable; 3.1.16.1 & 2 Revised to refer to UCNP 9-30 Closures for jointing 624f cables; 3.1.16.3 Specs. added for UCNCP Max Closures; 3.1.16.4 Revised to specify use of the UCNCP MAX closure as a FAP; 3.1.17.2 Revised specifications and to include 2.0mm with 2.4mm pigtails and patchcords as the standard; 3.1.17.3 Revised rack capacity specifications for termination of cables to 624f; 3.2.7.2 & 3 624f Standard cable included; 3.2.7.4 Table 9 revised to included Fibre and Tube details for 624f cable; 3.2.8 Revised to refer to UCNCP MAX closures; 3.2.9 Table 11 revised to include UCNCP MAX Closure details; 3.2.10 Table 12 revised to include UCNCP MAX Splice Tray details; 3.2.14 Table 14 revised to include S353/ 00254 connector cleaning kit 3.3.5.1 Table 21 624 Standard Cable, and 72 and 144 F Tie Cable included , and all data revised; 3.3.18.4 Title revised to indicate UCNCP VIP obsolete for new installations; 3.3.18.5 Section added for UCNCP MAX Closure splice tray sequence protocol; 3.3.18.6 Section added for UCNCP MAX Closure cable entry protocol; 3.3.19 Revised to include details of W&B Protective Barriers for UCN/UCNP closures; 3.3.20.4 Revised to refer to 1200mm fibre length in UCNCP closures; 3.3.20.3 Revised to refer to 624f termination in splice subracks 3.3.20.6 Revised to include splice loss at 1625nm;

Issue number	Issue date	Details on the change
		3.3.20.9 Revised to include labelling codes used to describe the fibre network, and labelling requirements for UCNCP MAX splice trays; 3.3.22 Inspection criteria examples text revised and Inspection criteria image examples added; 3.3.23 Revised to refer to TM00183 and attachments for specifications for ODF terminations; 3.3.23.1 Figure 10 and associated notes revised to clarify subrack numbering sequence; 3.3.23.5 Revised to delete adding of fibre sheath code to pigtail labels; 3.4.1 Revised to include further details on GPS coordinate recording requirements. 3.4.3 and subsections. Testing specifications revised
10	4 September 2009	3.1.16.3 & 4. Now refer to 018050W01 “Installation of Corning MAX Closures; 3.1.16.4. Minimum cable pit size change for UCNCP closures; 3.1.22. Added 96 fibre termination Cabinet details; 3.2.1. 3.2.15. Table 15 Added additional material; 3.3.6. Addition information added for 24 Fibre Joint; 3.3.9.2. Mandatory sequential marker post numbering requirements; 3.3.12. Added specific requirements for excess cable details; 3.3.21. Fibre cleaning details are now referred to 018334; 3.4.3.3. Some changes to fibre testing section linked to TM00045 A01; 3.4.5.3. reworded to align with 013310;
11	September 23, 2010	3.3.6.2 Depth of directly buried cable changed to a minimum depth of 900 mm. Depth of directly buried cable changed to a minimum depth of 900 mm.
12	May 11 , 2012	3.1.4.2 Added guideline reference examples 3.1.25 Added Environmental section. 3.3.5.1 Updated table 18 3.3.10 Added environmental wording to reinstatement section. 3.3.11.4 Updated Hauling rope wording. 3.3.12 Updated section to reflect no fibre loops in Exchanges. 3.3.18 Updated wording to Joint / Closure assembly. 3.4.3.5 Rearranged dot points and clarified testing. 3.4.3.3 Corrected dot point lettering and wording for fibre testing. 3.4.3.4 Updated Cable acceptance criteria and specs. 3.4.3.5.5 Added air bubble sentence.
13	9 Sept 2014	3.1.26 Hauling in existing conduits. 3.3.7 Updated for resiliency. 3.4.4.3 Updated for resiliency.
14	7 July 2015	3.4.3.5.7 Sect G Testing requirements for Cable repairs and in-service testing. 3.4.3.10 Filtered (1625NM) OTDR Testing on “Live” Fibres

Issue number	Issue date	Details on the change
15	13 May 2016	3.1.17.2 , Remove Bandwidth restriction, Remove inclusions and specify exception for Amplified DWDM sections, Note SC-APC for DWDM 3.1.21 Add section reference to conditions for DWDM, revise 50dB ORL statement. 3.3.22.10 Delete statement & add reference for direct splicing conditions 3.4.3.5.7.E. F & I Remove bandwidth restriction & add reference to DWDM patching conditions 3.3.3.7.3 reword 3.4.3.8 Statement excluding CD/PMD testing for current technology. 3.4.3.3 Add reference to 3.4.3.11 for filenaming 3.4.3.11 New section for Filenaming Convention Update 3.3.12 as per TRMR221
16	23 Nov 2016	3.1.13 Updated duct occupancy matrix. 3.1.22 & 3.2.15 Updated COFTU serial and item numbers. 3.1.27. Clarification on Straight Line Drawings. 3.2.8 Update on Channel Openable Joints material table.
17	11 May 2017	3.3.4 Updated Dial before you dig details. 3.3.15 Updated the sealing ducts and conduits details. 3.4.3.11 addition of file naming details for fap to fap
18	4 Oct 2017	3.4.3.5.7 Paragraph H, updated unterminated fibre heading. 3.4.3.5.8 Parameters for Measuring Losses Using an OTDR 3.1.4.2 Wideband Design deployment Standards listed. 3.2.7 Splice protectors section updated
19	22 Oct 2019	Revised Template.
20	24 Apr 2021	Converted to InfraCo template. Updated document contact details.
20.1	23 Feb 2023	3.1.25 Update the link to the latest Telstra Environment web site.

08 Attachments

8.1. ATTACHMENT 3. TM00044-F01

Telstra	HAULING DETAIL SHEET	*Contractor Name:*	SHEET____OF____
Exchange:	**Project Address:**	**Supervisor:**	**Tel Number:**
DA/CCP:	**Work Order No:**	**Start Date:**	**Completion date:**
Identify Section/s to be Hauled:			
New Cable		**Existing Cable(s)**	

Distance Hauled	Cable Size	Air Or Filled	Cable No.	Pressure After Haul	Pressure 24Hrs After Haul	Existing Cable Number	Pressure Prior To Haul	Pressure After Haul	Pressure 24 Hrs After Haul

Note: Shaded areas to be completed and sent electronically to the CPAS contractor 24 hrs prior to hauling.
For assistance when completing this form, or to obtain monitoring centre E.Mail addresses, call the National CPAS information number: **1300 556 727**

8.2. Attachment 4 TM00044-F02 Ciena DWDM Fibre Testing Requirements

Summary
This document describes the fibre pre-testing requirements for DWDM System design. The final measurements shall be used by the vendor for system simulation and configuration data production.

This document does not replace TM00044 for commissioning fibres.

To detail additional fibre testing and/or reporting requirements for amplified Ciena 6500 DWDM systems.

Important: This document does not replace the mandatory practices set out in *TM00044 Optical Fibre Cable - Outside Plant Technical Requirements*. All requirements outlined in this document are in addition to *TM00044*.

Audience
Experienced Fibre Commissioners, Designers, Planners, Project Managers.

General
A DWDM System is made up of CIENA Network Elements installed at multiple sites connected by Optical Fibre Links. An “Optical Fibre Link” is defined as the complete optical fibre path between an optical transmitter and an optical receiver, excluding any inline attenuators or couplers. It can be made up of a number of Optical Fibre Sections.

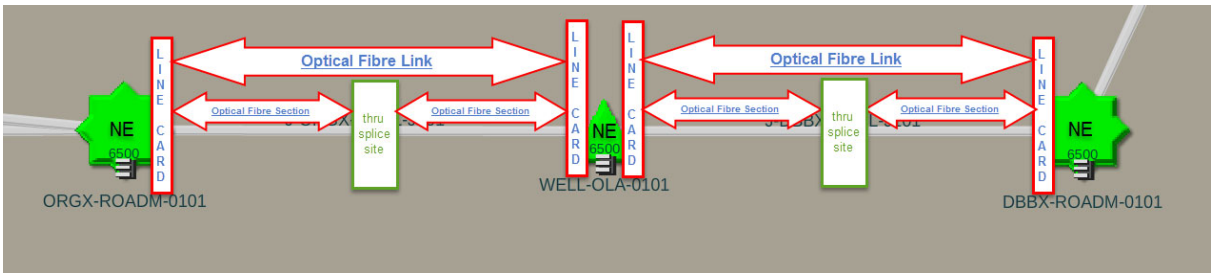

Figure 10. Example DWDM System - Optical Fibre Links and Sections

The DWDM System Designer requires certain fibre characterisation information for ALL the links in the system in order to determine the exact equipment types and configurations to install. The information is required as early as possible in the project timeline so as to confirm material ordering and project delivery. Therefore, to assist with system design a preliminary investigation of candidate fibres that could be used for the links is usually requested by the Planner early in the delivery process.

There are 2 types of DWDM amplified links.

- EDFA (Erbium Doped Amplifier)
- RAMAN (RAMAN Amplifier)

RAMAN requires more detailed information and analysis than standard EDFA links. The scope of works for preliminary fibre investigation should detail which type of testing is required.

Testing Requirements
IMPORTANT: *The following tests are used to decide on fibre suitability for the DWDM system only. Standard fibre Acceptance, Commissioning and fibre workbook reporting as per TM00044 must be performed on all links once the final fibres are chosen.*

General

The Designer will provide details for all fibres to be tested. In general, a full exchange-to-exchange path will be pre-built in DBoRs by the Designer as a preliminary baseline for the fibre link. This enables the details of all the relevant fibre sections in the link to be extracted from the DBoR and included in the Design. Additional spare fibres to be tested on the sections will be detailed in the Design.

Fibre Suitability Testing

The following section details the scope of testing to be performed. The minimum Basic fibre suitability requirements for DWDM systems will be evaluated by the field operator according to the guidelines for fibre loss and point loss. Any additional analysis to determine suitability for RAMAN systems must be performed by the relevant Design/Planning delegate.

In consultation with the relevant design/planning experts, final fibre selection for the system may also be determined during the suitability testing. If this is the case, standard final testing and recording as per TM00044 also applies.

Fibre Suitability Testing Guidelines

1. **IMPORTANT:** A Launch Lead of at least 30m **MUST** be used for all traces.
2. **Setup the OTDR Trace parameters using the guidelines in Appendix A** (Extract from *TM00044 3.4.3.5.8, Parameters for Measuring Losses Using an OTDR*).

   Set Range >= Max length of fibre under test;

   Set Pulse Width = narrowest possible for fibre distance;

   Set Acquisition Time = long enough to deliver trace with minimum noise distortion.

3. **Perform OTDR Traces using the principles in *Clause D of TM00044 Section 3.4.5.7*.**

   - In summary, perform both way OTDR Link Loss testing at 1550nm & 1625nm on the full baseline Exchange-to-Exchange path.

   And

   - perform both way OTDR Link Loss testing at 1550nm & 1625nm on spare fibres as detailed in the Design, per CPG section.

Note: If spare fibres on CPG sections have already been spliced through, it is permitted to test from beginning to end of the spliced path. Ie. it is not necessary to break fibres at splice through points.

4. **If Testing for RAMAN Systems, Perform Additional OTDR traces.**

   Perform Unidirectional traces on the fibres looking out from the RAMAN Equipment Sites as per the table below. Any spare fibres marked for testing at pass-through sites within 25km of the RAMAN site that have not yet been spliced through, must either be temporarily spliced through or traced individually.

Pulse Width	Range	Wavelength	Launch Lead
10ns	Min. 5km	1550nm	Min. 30m
100ns	Min. 25km	1550nm	Min. 30m
1000ns	Min. 25km	1550nm	Min. 30m

Table 28. RAMAN OTDR Trace Settings

5. **Save All Traces as per *TM00044* naming convention format.**

   Note: For traces taken in accordance with Step 4 above, distinguish from other files by adding the pulse width after the wavelength. Eg. CBNC.BWKS.CBNC3001.F001.1550.100ns.SOR

6. **Establish a Fibre Workbook.**

   - Record OTDR Link Loss results in the *Insertion Loss worksheet*
   - Record the location of all events in the *Line Diagram worksheet* as per standard Fibre Workbook practices.(Note: This includes events not visible in the OTDR trace)
   - Create a *1550nm Splice Sheet* using the "Add Splice Sheet" menu item
   - Record all event loss values on the *1550nm Splice Sheet*
   - For RAMAN - Create a "*100ns" 1550nm Splice Sheet* using the "Add Splice Sheet" menu item
   - For RAMAN - Record all event loss values up to 25km on the *"100nm" Splice worksheet*

7. **Populate the CIENA DWDM Basic Fibre Testing Results Workbook supplied with the Design.**

   Basic Fibre Suitability for DWDM Systems should be assessed according to the following Criteria.

   Note: Fibre Attenuation, dB/km (ie. slope of OTDR trace between events) can be verified by placing the OTDR reference markers between events. Attenuation per km reveals how degraded the fibre might be.

   Suitable
   a) OTDR Fibre Attenuation, <= 0.23 dB/km (@1550nm).
   b) No point loss exceeds 1.0dB.

   Possibly Suitable
   a) OTDR Fibre Attenuation @ 1550nm in the range, > 0.23 dB/km to 0.27dB/km.
   b) Point losses in the range >1.0dB - 2.0dB.

   Faulty
   a) Fibres that do not meet the criteria above

8. **Provide all results to the Designer and Project Manager.**
   ***Note**: Fibres for use in RAMAN Systems may require further specialist analysis of the data.*

09 Appendix A

The following table provides suggested settings which should cover a range of OTDR's available at this time. (Extract from TM00044 Iss18)

Total length of test fibre (RANGE.)	***Wavelength (nm)***	***Pulse Width OTDR's vary , generally one or two settings in the pule width rangewill be available on most OTDR's***	***Aqusition (Test) time Test/Acquisition time should be selected to obtain traces with a minimum od noise distortion***
0 – 500m	*1310 ,1550, 1625*	1ns – 5ns	5-10 Sec
500m – 1000m	*1310 ,1550, 1625*	3ns – 10ns	5-10 Sec
1000 – 5000m	*1310, 1550,1625*	5ns – 50ns	10-20Sec
5 km- 50km	*1310*	20ns-500ns	30-60Sec
	1550, 1625	10ns-200ns	20-60Sec
50km-80km	*1310*	1us-5us	1min-3min
	1550, 1625	200ns-1000ns (1us)	60 Sec-2min
80km-120km	*1310*	Beyond the range of most	OTDR's
	1550, 1625	500ns- 10,000ns (10us)	1min-5min
125km-250km	*1550,1625*	1us- 20us	1min-5min

010References

Document number	Title
TAF0001-694230	TM00044 Optical Fibre Technical Manual
AWO-2751	Fibre Workbook Software
BUY-2885	Ciena Transport Raman Solution DD

011Definitions

Term	Definition
LL	Link Loss measured using OTDR @ 1550nm & 1625nm
IL	Insertion Loss measured using fixed light sources and optical power meter
SRA	Singe Raman Amplifier
ROADM	Reconfigurable Optical Add/drop Multiplexor
OLA	Optical Line Amplifier
ESAM	Enhanced Service Access Module
ORL	Optical Return Loss
XLA	Switchable Line Amplifier

012Links

Document number	Title
TM00044	http://func3.collab.in.telstra.com.au/rep/func/0000089/Controlled Standard Documents/TM00044.pdf
Fibre Workbook Software	http://objects.in.telstra.com.au/documents/AWO-2751
BWQ-0010	Ciena DWDM Fibre Testing Results Workbook (project specific spreadsheet will be supplied in the project ECB)