PUBLIC

Telecommunications Installation

Telecommunications

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Document owner

Name	Title	Date
Kathryn Shoolman	Manager Internal Plant Design	17/08/2018

Document Author

Name	Title	Date
John Berti	Manager Standards & Specifications	17/08/2018

Document Endorsers

Name	Title	Date
NA	NA	NA

Approval Authority

Name	Title	Date
Joseph De Luca	Manager External Plant	17/08/2018

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This document is reviewed periodically and new editions are published. It is important that readers use only the current document published on VicTrack's document management system portal.

This document is not, nor should it be relied on as a substitute for, professional engineering design expertise or any other professional advice.

Nothing in this document diminishes the responsibility of designers and constructors for applying the requirements of any applicable law or standard.

Reviews and Amendments

This document should be reviewed every three (3) years by Manager External Plant or amended as appropriate if the nature of operations changes significantly.

Contents

1. Purpose

This specification describes the requirements for the installation of communications external plant for VicTrack.

The scope of External Plant includes, conduits, trunking, cabling, joints, pits, patch panels, MDF's and marker/protection posts.

This can be for new route construction or construction for maintenance purposes.

2. Scope

This specification is applicable to VicTrack staff, contract staff and external third parties who may be responsible for installing communications infrastructure for VicTrack.

This procedure relates to new route construction.

For construction for maintenance purposes refer to ***TS-SP 351 External Plant - Maintenance Specification***

3. Definitions

Term	Description
ALBF	After Last Before First – the time period after the last train one night and the first train the next morning
ARO	Accredited Rail Operator
ARTC	Australian Rail and Transport Corporation leases the interstate standard gauge track from Melbourne to Wodonga and to Serviceton (via Geelong and Ararat) as well as the Maroona to Portland line, and provides access to interstate train operators;
1800 619 111	This is the phone number displayed on VicTrack route marker posts for contact with VicTrack for information on underground communication cables in the Victorian rail corridors.
1800 887 662	This is the phone number of the VicTrack Network Management Centre (NMC).
Cable	VicTrack's fibre optic network and associated infrastructure.
Carrier	A Body licensed under the Telecommunications Act, 1997 (or its replacement), as a general or mobile telecommunications Carrier.
CER	Communications Equipment Room
Clean Fill	Clean fill is sand, crusher dust or dry soil that is completely free of stones, rocks, wood, metal and rubbish or similar.
Conduit	Conduit is used as housing for cable. Underground conduit is PVC and above ground conduit is to be UPVC. A Conduit can also be generically known as a pipe and can be manufactured from materials such as high-density polyethylene (HDPE) or galvanised steel. Within the railway environment these materials require approval for use.
Contractor	Any company, person or persons carrying out construction or installation activities.
CPC	Customer Premises Cabling
CSR	Combined Services Route – contains both telecommunications and signalling conduits and cables
DBYD, 1100	This is the phone number for Dial Before You Dig - a free referral service for information on underground pipes and cables anywhere in Australia from all member Utilities and Authorities. Also: www.1100.com.au
Due Care	Appropriate care as required by the principles of the law of Tort and Contract as well as pursuant to Criminal Statute; along with the requirements for good engineering practices as required by the Act and the Telecommunications Code of Practice. Due care needs to be observed when undertaking construction in accordance with the processes set out in this document.

Term	Description
External Plant	Includes all VicTrack Optical Fibre cables, copper cables, pits, bollards, conduits, trunking, surface ducting route markers, marker tape, termination boxes etc. used to provide the communications services.
Fall Back Plan	Written description of activities to be carried out if haulage and/or outage activities prove unsuccessful.
FTP	Fibre termination panel also called fibre termination shelf, or sub-rack
Fibre termination shelf	also called fibre termination panels, or sub-rack
FOC	Fibre Optic Cable.
Franchisee	A Train or Tram Operator operating under a licence granted by the State. The Franchisees having responsibility for fixed infrastructure include Metro Trains Melbourne (MTM) (metropolitan lines), V/Line (country lines), Australian Rail Track Corporation (ARTC) (interstate corridors) and Yarra Trams.
GI	Galvanised Iron
GIS	A geographic information system (GIS), geographical information system, or geospatial information system is a system designed to capture, store, manipulate, analyse, manage, and present all types of geographically referenced data.
GLT	Ground level troughing – concrete, steel or plastic cable enclosure
Haulage Brief	Written description of what cables will be hauled, from where, to where, and when. This is to give everyone an understanding of the work to be carried out for cable hauling.
High Risk	Areas in which VicTrack Plant is located where VicTrack may require the development of a specific work methodology to protect the integrity of the plant.
HV	High Voltage – voltages above 1000V
IFC	Issued For Construction
Industry Specialist	For the purpose of this document an Industry Specialist shall mean such or as agreed with VicTrack Network Operations and Maintenance Manager. Industry Specialists are experienced design and construction companies capable of understanding protective and relocation works upon the live network without disruption to VicTrack customer traffic and at the same time ensuring there is no asset depreciation of network plant. A person or company having specialist expertise and capability to undertake the above under broad VicTrack direction and with limited supervision.
ITP	Inspection Test Plan
Location, Confirmed	Where the location of the cable has actually been confirmed by exposing it by Potholing.

Term	Description
Location, Nominal	Locations obtained by use of plans, verbal information, marker posts, trench lines, electronic devices or lines between confirmed locations (not to be treated as confirmed location).
Joint	Optical splice closures are also commonly referred as splice joints or joints, and will henceforth be referred as joint.
JSA	Job Safety Analysis – now called SWMS
LV	Low Voltage – voltages 1000V and below
MPa	A Mega Pascal (MPa) is a measure of the compressive strength of concrete. It lets inspectors know how much force can be applied to the concrete before it cracks or fails. One MPa is equal to one million Pascals (Pa), which is equivalent to one million Newtons of force per square meter.
MTM	Metro Trains Melbourne, which has a renewable lease of the metropolitan electrified infrastructure for all the corridors and operates metropolitan passenger services on these corridors;
MOCS	Melbourne One-Call service 1100 (also known as Dial Before You Dig)
NCR	Non Conformance Report
External Plant	Network Infrastructure Services – This is the function within the VicTrack Operations Group that provides damage minimisation principles and information on the location of VicTrack External Plant. VicTrack may delegate some or all of this function to an external company.
NMC	Network Management Centre – This is the area responsible for the integrity and operation of VicTrack's network. It is staffed on a 24-hour 7-day basis.
NPP	Network Protection Plan. A document that sets out the procedures to be followed during the carrying out of Works to ensure satisfactory protection of existing VicTrack External Plant.
Organiser tray	Cable organiser tray
Outage Brief	A written description of what activities have been planned for that particular day/s, who will be responsible for particular activities, start and finish times, fall-back plan, and any other items of information that would be relevant to that piece of work.
PCER	Prefabricated Communications Equipment Room – used by VicTrack – a standalone building
Permit To Work (PTW)	A request to the VicTrack Network Operations Centre for permission to work on, or in the vicinity of, VicTrack telecommunications infrastructure.
PN	Pacific National operate trains on the Victorian rail network

Term	Description
Pothole	See Potholing below.
Potholing	Potholing is a non-destructive digging procedure that uses water lance and vacuum excavation techniques to expose a cable, conduit or marker tape. Manual excavation using hand tools (but not including a pick, crowbar or similar) may also be used. This process is also known as "Exploratory Trenching". At all times while carrying out such activities, Due Care is to be exercised so as not to damage such network External Plant.
PVC	Poly Vinyl Chloride – used to manufacture conduits that are not exposed to the sun
Rodent Resistance Cable	Rodent-Resistant cable is designed specifically for environments that have an increased risk of rodent infestation and disturbance
SC	Standard Connecter
SER	Signalling equipment room – a standalone building
SMOF	Single Mode Optic Fibre
SODF	Small Optical Distribution Frame
SWMS	Safe Work Method Statement
Track Occupation	Absolute Occupation of a defined section of the Access Provider's Network, in order to carry out inspections, repairs, maintenance, up-grade work, improvements, additions or any other works which could interfere with the Access Provider's or an Operator's Services on the Network
Troughing	Troughing is also commonly referred to as trunking, and forms the type enclosure to install cabling within.
ULX	Under Line Crossing
URX	Under Road Crossing
UPVC	Non-plasticised Poly Vinyl Chloride – used to manufacture conduits that may be exposed to the sun
VicTrack	Victorian Rail Track, associated companies or their agents.
VL, V/Line	V/Line - - Operates country rail passenger services. VLP controls the non-electrified country rail infrastructure and is responsible for country train control. VLP provides access to this infrastructure. Country railway stations and some surrounding land are also leased to VLP
Works	For the purpose of this document, the carrying out of any construction or maintenance activities.

Term	Description
ZER	Signalling equipment cabinet that is larger than a location case but smaller than a Signalling Equipment Room

4. Reference Documents

4.1. VicTrack Standards and forms

Item	Standard No	Description
1	CD TS 001	VT Telecommunications Cable Route Drawing Standards
2	TS-FM 002	Hazard & PTW Management Flow Chart
3	TS-FM 045	Permit to Work
4	TS-FM 065	Field Audit & Inspection Form – Design
5	TS-FM 066	Field Audit & Inspection Form - Pre Construction Activities
6	TS-FM 067	Field Audit & Inspection Form - Trenches & Conduits
7	TS-FM 068	Field Audit & Inspection Form - ULX and URX Bores
8	TS-FM 069	Field Audit & Inspection Form – Pits
9	TS-FM 070	Field Audit & Inspection Form - Route Marker & Pit Protection Posts
10	TS-FM 071	Field Audit & Inspection Form - Existing Infrastructure Conduits
11	TS-FM 072	Field Audit & Inspection Form - Existing Infrastructure GST & GLT
12	TS-FM 073	Field Audit & Inspection Form - Site Works
13	TS-FM 074	Field Audit & Inspection Form - AS-Installed Documentation
14	TS-FM 075	Field Audit & Inspection Form - Enabling Works
15	TS-FM 076	Field Audit & Inspection Form - Permits to Work
16	TS-FM 080	Field Audit & Inspection Form - Maintenance Agreement Requirements
17	TS-FM 081	Field Audit & Inspection Form - Compliance with Standards and Specifications
18	TS-FM 082	Field Audit & Inspection Form - Network Records
19	TS-FM 083	Field Audit & Inspection Form - Testing & Attenuation Targets
20	TS-FM 084	Field Audit & Inspection Form - New Cable
21	TS-FM 085	Field Audit & Inspection Form - Route Marking
22	TS-FM 086	Field Audit & Inspection Form - New Conduit
23	TS-FM 087	Field Audit & Inspection Form - Trenching & Boring

Item	Standard No	Description
23	TS-FM 088	Field Audit & Inspection Form - Quality Plan
24	TS-FM 089	Field Audit & Inspection Form - Fibre Optic Cables (Installs)
26	TS-FM 090	Field Audit & Inspection Form - Fibre Optic Cables (Testing)
27	TS-FM 091	Field Audit & Inspection Form - Copper Cables (Installs)
28	TS-FM 092	Field Audit & Inspection Form - Copper Cables (Testing)
29	TS-FM 094	Template for Asset GPS Data
30	TS-FM 097	Cable List
31	TS-FM 099	DMS Drawings for Marker or Protection Posts
32	TS-FM 100	VLine Third Party Access Form - Snapshot
33	TS-FM 101	VLine Site Access Guide - Appendix 1 Rev3
34	TS-FM 102	Aerial Design Route Survey Field Sheet
35	TS-FM 193	Layout and Labelling of FOC Patch Panels
36	TS-SP 049	Permit to Work
37	TS-SP 351	External Plant Maintenance
38	TS-SP-015	Network Protection
39	TS-SP-066	Attachments to Tram Poles
40	TS-ST 028	External Fibre Design document;
41	Various	FOC Manufacturer Specifications.
42	VT-FM 107	VicTrack Safe Work Method Statement 010 (Work Related Driving)
43	VT-MN 001	Rail Safety Manual
44	VT-PO 160	Drug and alcohol policy
45	VT-SP 032	Asbestos (and Hazardous Materials) Management Plan
46	VT-SP 141	Drug and Alcohol Management

4.2. International Standards

1	ITU-T G.652a, b, c and d;	Characteristics of single mode optical fibre
2	ITU-T G.653a and b;	Characteristics of dispersion shifted single mode optical fibre
3	ITU-T G.654a, b and c;	Characteristics of cut off shifted single mode optical fibre
4	ITU-T G.655a, b, c, d and e;	Characteristics of non-zero dispersion shifted single mode optical fibre
5	ITU-T G.656;	Characteristics of a fibre and cable with non-zero dispersion for wideband optical transport
6	ITU-T G.657 Categories A1, A2, B1 and B2	Characteristics of a bending loss insensitive single mode optical fibre and cable for the access network

4.3. Australian Standards

1	AS 4142:	Fibre Ropes
2	AS/NZ 60950.1-2011	Information Technology equipment – Safety – General requirements (IEC 60950.1, Ed 2.0 (2005), MOD)
3	AS/NZ 2211.2-2004	Safety of optical fibre communications systems (OFCS)
4	AS/NZ 2211.1-2004	Safety of laser products, equipment classification, requirements and users guide
5	AS/CA S008-2011	Requirements for authorised cabling products
6	AS/ACIF S009-2006	Customer Premises Cabling Rules
7	AS 60529-2004	Degrees of protection provided by enclosures (IP Code)
8	AS 4799-2000	Installation of underground utility services and pipelines within railway boundaries
9	AS/ACIF S008:2006	Requirements for authorised cabling products
10	AS/ACIF S009:2006	Installation requirements for customer cabling (Wiring Rules)
11	AS 1939–1990	Degrees of protection provided by enclosures for electrical equipment

12	AS/NZS 2211.1:2004	Safety of laser products - Equipment classification, requirements and users guide - IEC 60825-1:2001, MOD- (Labels)
13	AS/NZS 2211.2:2006	Safety of laser products - Safety of optical fibre communication systems (OFCS) -IEC 60825-2 Ed 3.0 -2005 (Labels)
14	Electricity Safety (Installations) Regulations 2009	Authorised Version No. 005 S.R. No. 164/2009. Authorised Version incorporating amendments as at 20 May 2014
15	Electricity Safety (Electric Line Clearance) Regulations 2015	Authorised Version I S.R. No. 67/2015

4.4. Transport operators relevant standards

Each of the transport operators have their own access protocols for the rail corridors that they control:

1	LO-SQE-PRO-014 -	Metro Trains Melbourne has LO-SQE-PRO-014 - Safety and environmental requirements for contractors working on MTM premises - For any update, contact Stephen Haas, MTM, and telephone: 9610 6885
2	TS-FM 100	VLine Third Party Access Form - Snapshot - Refer V/Line website for form
3	TS-FM 101	VLine Site Access Guide - Refer V/Line website for guide
4		ARTC usually provides specific advice with respect to access for each individual project.

5. Responsibilities

Specific responsibilities and accountabilities include the following.

5.1. General Managers

Support and ensure all 3rd parties are compliant with the this standard.

5.2. Managers

Manage and ensure that all parties comply with the installation standard for VicTrack telecommunications infrastructure.

5.3. Supervisors/Team Leaders

Supervise and ensure the compliance of all parties with the installation standard for VicTrack Telecommunications infrastructure.

5.4. Department/Group/individuals

Ensure compliance of all parties to the installation standard of the VicTrack infrastructure.

5.5. Contractors

Comply with all requirements of the installation standard for VicTrack Telecommunications infrastructure.

6. Victorian Rail Industry and the Role of VicTrack

VicTrack owns the train and tram public transport fixed infrastructure and land in Victoria[1].

The rail and station infrastructure, other than telecommunications, is leased through the Director of Public Transport (DPT) to Accredited Rail Operators (ARO's) under long-term Infrastructure Leases and Station Leases.

VicTrack is also a registered Telecommunications Carrier under the Telecommunications Act.

This document, TS-SP-013, is the standard prescribed by VicTrack for installation works within its network.

Cabling within Customer Premises that will be connected to VicTrack's network is to be installed to the requirements of AS/ACIF S009 at a minimum.

The ARO's are private or public companies, which include:

- Metro Trains Melbourne (MTM), which has a renewable lease of the metropolitan electrified infrastructure for all the corridors and operates metropolitan passenger services on these corridors;
- V/Line, which operates country rail passenger services. VL controls the non-electrified country rail infrastructure and is responsible for country train control. VLP provides access to this infrastructure. Country railway stations and some surrounding land are also leased to VL;
- Australian Rail Track Corporation Ltd (ARTC) which leases the interstate standard gauge track from Melbourne to Wodonga and to Serviceton (via Geelong and Ararat) as well as the Maroona to Portland line, and provides access to interstate train operators; and
- Yarra Trams, which operates tram services in the metropolitan area.

In addition to the companies listed above, a number of other companies, such as Pacific National (PN) operate trains on the Victorian rail network.

VicTrack provides telecommunications services directly to MTM, VLP, PN, ARTC, and Yarra Trams and manages other non-transport aspects of the fixed infrastructure, such as property rights.

VicTrack also provides telecommunications services to various state government entities.

Under the Infrastructure Leases, VicTrack has reserved the right to grant access for the installation of telecommunications infrastructure on the rail corridors. In accordance with these provisions, VicTrack must provide the ARO's with a period of notice before exercising its rights to permit the installation of telecommunications infrastructure on the leased land. VicTrack must also ensure that such developments

[1] Apart from most of the infrastructure and land located at Southern Cross Station (formerly Spencer Street Station), which is owned by the Southern Cross Station Authority

do not affect the permanent on-going use of the land by the Tram or Train Operators for railway or tramway operations.

The Contractor has to submit a “VicTrack Permit to Work” application to the relevant VicTrack Project Manager. The Contractor is required to have the “VicTrack Permit to Work” approved by VicTrack, before commencing any works on any VicTrack property.

Where necessary, the Contractor is to apply to the relevant ARO maintenance contractor for permission to work on the corridor.

Note that VicTrack’s approval of the PTW DOES NOT confer any rights to enter the rail corridor.

7. General Installation Requirements for Communications Networks Assets

7.1. Safety

7.1.1. Contractor OHS & Rail Safety

The Contractor must:

i. Comply with all relevant Occupational Health and Safety legislative requirements;
ii. Carry out all works under the Agreement in a safe manner such that no damage or injury is caused to any person or property;
iii. Prepare, and at all times comply with, a Health and Safety Management Plan meeting standards required;
iv. Comply with VicTrack and the ARO's policies and procedures when working on railway property;
v. Comply with the road authority requirements and obtain the necessary approvals for traffic and pedestrian management plans when working on a road reserve;
vi. Comply with Electrical Safety requirements and regulations when undertaking installations which may require attention to Electrical Safety as per Australian Standards list items 14 and 15;
vii. Ensure that all staff working for VicTrack hold current competencies for working in the rail environment with Track Safety Awareness as the minimum level. A Rail Industry Worker card shall be presented when requested by any rail operator. Track Force Coordinator, Hand Signaller and Lookout staff are also required for track and staff protection when working within three metres of the nearest rail. These qualifications can either be gained by the Contractor's direct staff through endorsed training or outsourced to other qualified agencies;
viii. Prior to the commencement of ANY construction or installation work, the Contractor must have a prepared and approved "Work Method Statement", a "Track Protection Plan", and a "Site Safety Plan". These documents are to be submitted to VicTrack AND the relevant ARO(s) for approval. Where the works are off the rail corridor, then the necessary traffic and pedestrian management plans must be submitted. Traffic and pedestrian management plans may also be required on rail property in areas such as station car parks and platforms;
ix. Track protection and or traffic management is the responsibility of the Contractor; and
x. VicTrack may amend or update the requirements set out in this section from time to time and the Contractor must comply with the amended or updated requirements.

7.1.2. VicTrack OHS & Rail Safety

Shift personnel are required to have a clear understanding and commitment to their OHS obligations and responsibilities when fulfilling workplace duties

Shift personnel must ensure that they comply with VicTrack OHS & Rail Safety Worker procedures at all times (***Refer: VT-MN 001 Rail Safety Manual)***.

Personnel should be appropriately dressed to avoid injury to themselves where there are live electrical circuits and/or moving machinery.

Personal Protective Equipment (PPE) is a recognised risk and safety control measure. Shift personnel are required to wear site appropriate PPE when entering into worksites where work activities are to be undertaken. It is a specific requirement for Shift personnel when entering in to the rail corridor to wear appropriate high visibility PPE (***Refer: VT-SP 156 Personal Protective Equipment)***.

Personnel must abide by the VicTrack Drug and Alcohol Policy and Procedure (***Refer: VT-PO 160 Drug and Alcohol Policy*** and ***VT-SP 141 Drug and Alcohol Management),*** available via on "The Loop", Safety @ VicTrack.

Food and drink should not be consumed in equipment rooms, workshops (including near the opened parts storage area), communications rooms, or enclosures; this includes customer premises (excluding designated areas) and equipment rooms.

When driving long distances outside of the metropolitan area (i.e. more than 200 KMS or 2 hrs.), appropriate rest periods should be taken or a change of driver if accompanied. Refer to ***VT-FM 107 VicTrack Safe Work Method Statement 010 (Work Related Driving)***.

At times personnel will find themselves working alone. Refer to the ***TS-SP 102 Lone Worker Procedure***, available via "The Loop", Safety @ VicTrack.

7.2. Planning:

7.2.1. Site Surveys, Planning

A joint inspection of the site is to take place prior to the commencement of any work.

If VicTrack does not supply a detailed route design, then the Contractor shall carry out a site survey and prepare the necessary drawings and reports setting out the detailed route design.

The Contractor is also required to carry out a detailed services search over the proposed route.

The route design shall include, but not be limited to, the following:

i. Proposed conduit installation location along the entire length of each route marked up on geographic route plans (plans may be supplied by VicTrack) with distances from the rail and the reserve boundary, and proposed trenching depth;
ii. Location and type of all proposed pits;
iii. Location and depth details of all proposed underground bores;
iv. Type and size of conduit being used;
v. Location of all trackside cabinets (where required);
vi. Method proposed for installation of conduits and pits in areas of protected or endangered flora and fauna;
vii. Locations of all cable coils in pits (where required);
viii. Proposed joint locations (where required);
ix. Cable length required (where required);
x. Locations where the desired conduit depth will not be achieved;

xi. Locations determined to require Track Occupation;
xii. Methods of installation at all roads, pedestrian, Occupation or Stock Crossings;
xiii. Details of proposed use of existing VicTrack infrastructure;
xiv. Details of proposed arrangements in the vicinity of rail tunnels (where required);
xv. VicTrack will advise the Contractor of any known areas of protected or endangered flora and fauna (Biosites), and known areas of significant cultural heritage (Aboriginal and Post Contact) on the designated route. The Contractor is to carry out their own investigations and develop an Environmental Management Plan specific to the project being undertaken, including the necessary protocols to be followed;
xvi. VicTrack's preference is to utilise underground conduit infrastructure for as much of the route as possible. However, other considerations may affect this preference, such as the nature of the rail corridor. The route design and any other necessary documentation shall be submitted to the relevant VicTrack Project Manager, for approval by relevant parties (see Section 8.1.2.xix) before the commencement of the project;
xvii. Once approved, no deviations from this route plan are permitted without the written approval of the VicTrack Project Manager of the change request;
xviii. If any fences or barriers are removed for access, then the opening shall be protected by a temporary barrier and restored to its original status when the work is completed;
xix. At the conclusion of the installation work, the ground shall be restored to its original condition to the satisfaction of VicTrack and the relevant ARO. All surplus material is to be removed from the site; and
xx. All infrastructure shall be installed such that it is safely accessible during both construction and subsequent maintenance activities.

7.2.2. Design Guidelines

The following guidelines are to be followed in any route designs that will ultimately contain VicTrack cables.

This may be a dedicated telecommunications route or a Combined Services Route (CSR) that will contain telecommunications cables as well as signalling power cables:

i. All relevant contract design and construction staff have been familiarised with the latest version of TS-SP-013 Telecommunication- Installation and its relevant derivatives to understand our requirements;
ii. Pits selected in the route design must be pit types approved by VicTrack and appropriate for the function (haul, single joint, double joint) and location required;
iii. The conduit configurations must comply with VicTrack standards and specifications, including having the telecommunications conduits above the power conduits and on the land boundary side of the trench to avoid signal conduits having to pass under the communications conduits to reach trackside signalling assets. The conduits shall be laid so they are uniformly supported over their entire length and maintain the same duct configuration;
iv. Depth of cover over conduits must comply with stated depths within this specification;
v. Appropriate conduit labelling has been specified;
vi. There are to be no lateral deviations of conduit from the straight line between pits greater than 2 metres over the nominal 380 metre pit spacing. The deviation must be gradual and

not all at a single or several distinct points. If this cannot be achieved, then the pits need to be at a closer spacing;

vii. In CSR situations where separate pits are found in clusters and conduits are deviated from the straight line to get to the pits, that deviation is to be achieved with the natural flex of the conduits where possible, and not with angled connectors. The intention is that the conduits enter and leave the pit perpendicular to the faces of the pit and that all conduits pass mandrel testing. Any deviation from this requirement is to be submitted to the VicTrack Project Manager for consideration and approval before being included in the route design;

viii. Conduits entering into signalling zone boxes (location cases) must be continuous through the base and protrude 50mm into the upper portion of the box;

ix. The correct class of conduit must be specified in the route design to cover main lines, tails, ULX and URX situations;

x. If any sub ducts are required, they must be specified within the design for class and type. However installation of sub ducts is only to be considered where a third party cable is to be installed or where the flow of the conduits is such that it would be expected that further cables could not be hauled in without damage. Trenching or boring in ULX and ULX situations are exceptions (see Section 8.3.1.v.i & ii);

xi. Full details of bore pipes are to be supplied;

xii. Entries into buildings (ZER, SER, CER, PCER) must include the sealing of conduits at the installation stage to prevent the entry of rodents/water/gas into the building;

xiii. DBYD (Dial before You Dig) and VicTrack Property searches are to be carried out to discover all services and these services must be shown on relevant plans or drawings. These details are for initial design only and must be positively discovered using NDD (Non Destructive Digging) prior to civil works;

xiv. Required enabling works are to be identified and planned as part of the project schedule. VicTrack will endeavour to gainfully assist the Contractor to meet their installation schedules. Temporary enabling works will be reviewed for possible relaxation of some network standards to help reduce costs, but the temporary cabling will be replaced with final cabling from original joint-to-joint and not just the area that the temporary enabling works covered;

xv. Details of the proposed use of existing VicTrack infrastructure are to be provided;

xvi. Protected or endangered flora and/or fauna sites and areas of significant cultural heritage are to be included in design reports and shown on plans;

xvii. Design drawings and design reports are to be provided to VicTrack at the initial draft design stage, then at the subsequent stages including changes required from reviewer comments and detailed site investigations, finishing with IFC (Issued for Construction). If the design contractor has different design steps, these are to be presented to the VicTrack Project Manager for approval prior to design commencing;

xviii. VicTrack requires 15 business days for the initial design review and 5 business days for the staged and final design reviews. Any design changes following the IFC approval will require 5 business days for VicTrack review and approval;

xix. Design reviewers and approvers within VicTrack will include assigned project staff, construction and maintenance section heads. Final design approval is required from VicTrack before drawings and designs are IFC (Issued For Construction) or AFC (Accepted For Construction);

xx. Contact and authority details of contract route designers and construction managers are to be provided to VicTrack, and the contact details of VicTrack's construction, maintenance and project managers are to be provided to the Contractor to cater for necessary field changes.

Field changes to the approved design are not to be made without prior discussion with and approval from VicTrack;

xxi. VicTrack is a registered Telecommunications Carrier and this specification is the network standard adopted by VicTrack for its network. AS/ACIF S009 – 2006 is the standard to be used for customer premises cabling that attaches to the VicTrack network;

xxii. In VicTrack's network, activities are underway to reduce copper cabling from VicTrack's backbone network., but the 300mm separation is still required between copper communications cables and HV power cables;

xxiii. Designs are to ensure safe access to all sites for construction and future maintenance purposes; and

xxiv. Design plans and construction schedules are to include activities that will ensure the construction sites/routes are left in a clean state and excess materials have been appropriately disposed of.

xxv. When and where VicTrack intends to bury conduits for a cable route, the Project Manager is to make contact with the Asset Managers of the ARO's (at least the MTM Signalling Asset Manager and the MTM Communications Asset Manager) to allow them to also contribute to the project by having a CSR (even for future works) and avoiding the cost and space issues of double trenching. Any extra works for the other ARO's would require funding by them.

7.2.3. Pre-Construction Activities

i. Approved IFC route design, drawings, design steps and design report are to be provided to relevant VicTrack project managers and field supervisors;

ii. Names, roles and contact details of all contract and subcontract staff are to be provided to VicTrack prior to construction commencing;

iii. All relevant contract and subcontract staff are to attend the VicTrack Network Protection presentation;

iv. VicTrack management and inspection staff are to be assigned and advised of their duties;

v. Proposed marker tape is to be submitted to the VicTrack Project Manager for approval;

vi. Details of the proposed marker and protection posts are to be submitted to the VicTrack Project Manager for approval;

vii. Approved route GPS details have been provided to VicTrack for approval, prior to trenching commencement; Contractor may use: TS-FM 094 Template for Asset GPS Data

viii. Proposed route marking warning signs are to be presented to VicTrack for approval prior to ordering;

ix. A sample conduit spigot proposed to be used in pit entries is to be provided to VicTrack for approval prior to ordering and/or installation;

x. Details and/or samples of sealing method for sub ducts under tracks and roads in trenching or boring situations, and main conduits, are to be presented to the VicTrack PM for approval;

xi. Details of pits proposed for use are to be provided to VicTrack for approval, if those pits are different from the pits detailed in TS-SP-013 Telecommunication -Installation;

xii. Details of proposed bore backfill material and method are to be presented to VicTrack for approval, prior to construction; and

xiii. If any conduits are proposed to be used are outside the specifications outlined in Section 8.2, then samples are to be provided to the VicTrack PM for approval, prior to ordering or installation.

7.2.4. Temporary and Enabling Works

i. There will be times when existing network infrastructure needs to be relocated or modified in some way to allow other works to be carried out, either by VicTrack or by third parties. Network integrity is the foremost factor to be considered when evaluating proposals. In that context this Specification must be read in conjunction with the current version of VicTrack's TS-SP 015 Network Protection Procedure;

ii. The existing network has areas that are non-compliant with this specification, VRIOG 12.2.1 (or its replacement) and AS/ACIF S009. ACMA agreed to the rail telecommunications network remaining in its configuration when the ACMA Rules were administered in the early 1980's. This was done on the basis that any future change to the infrastructure would be made compliant to the extent of the change and to the standards at the time of the change. Therefore any enabling works, relocations or modifications must meet ALL relevant current standards;

iii. VicTrack obtained a Telecommunications Carrier licence in 2001 so the current standards that apply are:

   a. TS-SP-015 Network Protection Procedure,
   b. TS-SP-013 Telecommunication – Installation; for carrier network infrastructure installations;
   c. TS-SP 351 External Plant Maintenance
   d. TS-SP-066 – Attachments to Tram Poles;
   e. Several other specifications or standards – details can be supplied on request; and
   f. AS/ACIF S009 for Customer Premises Cabling (CPC);

iv. Carrier network infrastructure covers all telecommunications cabling and associated infrastructure (pits, conduits, ducts, pillars, terminations, etc.) along the rail and tram routes, plus any off-corridor cabling;

v. Customer Premises Cabling is cabling and associated infrastructure at service end locations such as stations, offices, depots, signal location cases and equipment rooms that will attach to the VicTrack Carrier cabling;

vi. Designs for temporary or permanent relocations must take all factors into consideration, including the requirement for fibre cables to be replaced from existing joint to existing joint, which may require infrastructure to be constructed outside the immediate area of interest. If temporary works are proposed, it is VicTrack's decision alone whether any relaxation of this Specification's requirements can occur. If the works are temporary and requirements are relaxed by VicTrack (using an engineering directive) to aid the project to meet tight schedules, the final works must fully adhere to this Specification;

vii. Network infrastructure protection must be addressed by the relevant party and agreed to by VicTrack prior to any construction work commencing;

viii. It is essential that ground disturbance, planned or unplanned, does not impact on the minimum required cover over the VicTrack conduits nor damage any pits;

ix. All design, plans, drawings and schedules for proposed works are to be submitted to the VicTrack Project Manager for review and approval by relevant VicTrack project, operations and maintenance sections. VicTrack requires 15 business days to review and comment on initial submissions and 5 business days on subsequent iterations;

x. A Network Protection Plan is to be developed by the Contractor and submitted via the VicTrack Project Manager to the VicTrack Network Protection Manager. The plan will detail how protection will be provided to VicTrack's infrastructure from vehicles driving over the VicTrack infrastructure (trenches, conduits, pits, etc.), loading, unloading and storage of materials, excavations and bores. This plan is to be consistent with the requirements outlined within TS-SP-015, VicTrack's Network Protection procedure;

xi. If required (to be determined by the VicTrack Project Manager), the Contractor will also prepare and submit the following documents to the VicTrack Project Manager for approval:

a. Safe Work Method Statements (SWMS);
b. Site Safety Plans;
c. Traffic Management Plans;
d. Pedestrian Management Plans;
e. Haulage and Outage Briefs;
f. Fall-Back Plans.

xii. The locating of existing VicTrack telecommunications assets is to be performed as per TS-SP-015; and

xiii. All cable cuts or service interruptions are to be carried out only ALBF (After Last and Before First train services).

xiv. All optical fibre and copper cables that are taken out of service are to be recovered where and when possible and returned to Sunshine Depot for reuse, recycling or scrapping. This will aid in activities toward sustainability targets.

7.2.5. Permits to Work (PTW's):

PTW's are required to be obtained before any exposure of direct buried cable or underground conduit or other above ground/underground assets.

It is common to find signalling LV and HV cables in close proximity to the communications cables, especially assets that were installed before 1990, (*Refer:* ***TS-FM 002 Hazard & PTW Management Flow Chart)***.

The requirements for PTW's are:

i. A request must be submitted to the VicTrack NMC for permission to work on, or near, VicTrack's operational telecommunications infrastructure. Any work within five (5) metres of the nominal plan location requires a PTW. The PTW must contain descriptions of all planned work, and once approved, only the work contained in the approved PTW can be performed. This is usually a two-step process where the first PTW is for locating the VicTrack assets (with inspection and approval from the VicTrack Telecommunications Network Protection Officer) followed by a second separate PTW for the follow-on works;

ii. PTW's are required for all asset location activities as well as subsequent works. The asset location activity is classed as a Hazard;

iii. PTW requests are to be provided on the VicTrack PTW form. The current version of the application form may be obtained by requesting such from the VicTrack Telecommunications Change Management Team on 03-9619 8008 (***Refer: TS-SP 049 Permit to Work)***.

iv. The completed application form must be accompanied by:

a. Safe Working Method Statement (SWMS – used to be called JSA or Job Safety Analysis);
b. A clear plan of all civil works;
c. A description of how existing VicTrack assets will be protected ***(refer TS-SP 015 Network Protection Procedure)***
d. ARO access approvals;
e. The date or range of dates that it is proposed the works will be carried out; and
f. Relevant plans of works to be performed and detailed activity lists;

v. All PTW's are completed in two stages:

a. Stage 1 requires the PTW to be activated by calling the VicTrack Contact Centre on 03-9619 8008 and advising the PTW number and that the works described on that PTW are about to commence. If the work to be carried out requires service outages, the Contact Centre personnel will pass on that advice to the NMC personnel for their involvement. If the work spans more than one day, then the NMC is to be advised at the start and close of work each day;
b. Stage 2 requires the PTW to be closed at the conclusion of the prescribed works by calling the VicTrack Contact Centre and advising that works have been completed on a particular PTW. If service outages have been necessary, the Contact Centre personnel will check with the NMC personnel to ensure that all affected services are operational before closing out the PTW

vi. If the PTW is not activated as required before works commence, or work is carried out that is not prescribed in the PTW, then VicTrack reserves the right to suspend works until matters are corrected. If required, VicTrack may require a Non Conformance Report to be provided explaining the deviation from agreed works or how damage occurred and works will not be approved to restart until VicTrack is satisfied with the corrective actions provided in the NCR; and

vii. Emergency changes are those that, due to circumstances, do not meet he required timescales of normal changes and the relevant PTW process. Emergency PTW's can only be applied for on the grounds of safety, environmental grounds or a perceived risk to VicTrack telecommunications network infrastructure, not because someone forgot to apply for a PTW or site circumstances have changed. The VicTrack NMC is to be called on: ***1 800 887 662*** and the situation explained, requesting an Emergency PTW. The NMC operator will treat this request as a critical fault and organise for an Incident Response Team to attend the site and investigate the risks to VicTrack's infrastructure. The PTW paperwork must be completed retrospectively.

7.2.6. Project Management

i. VicTrack will nominate a Project Manager for the project. The Contractor will advise VicTrack's Project Manager of the name and contact details of the Contractor's Project Manager responsible for this project, and notify VicTrack immediately of any changes.
ii. Proposals must include details of the parties involved and details of any subcontractor that will carry out works. If the Contractor has not yet chosen the subcontractors to be used on this project, but will make a selection from a list of known subcontractors, then the list of subcontractors is to be supplied. The details to be provided include the business name and address, the name of the principal(s), and the type of work the subcontractor will perform. VicTrack reserves the right to veto any sub-contractor.
iii. It is expected that a number of site inspections will be made by the VicTrack Project Manager or delegated representatives from time to time to review the progress of the project.
iv. Before the commencement of any construction or installation work, the Contractor shall supply a detailed project schedule to the relevant VicTrack Project Manager. It is expected that this schedule may change from time to time; consequently, the Contractor is to advise VicTrack promptly of any such changes. A soft copy of the project schedule may also be supplied in a format compatible with Microsoft Project 2007.
v. Project meetings will be scheduled from time to time to review progress.
vi. Details of all new FOC cables installed will be logged in ***the External Plant Asset Register*** (request from the External Plant Manager), added to the ***TS-FM 097 Cable List*** and advised by the External Plant Manager to the Maintenance Contractor at the Performance Review Meetings.

7.2.7. Maintenance Works

Construction works required on the basis of maintenance shall conform to the same requirements as new dedicated construction works. Temporary cable and infrastructure repairs may be afforded relaxed requirements; however the final repairs must meet the full standards.

7.2.8. Inductions and Worker Accreditation

In order to maintain our network standards for installation and maintenance, it is required that:

i. All workers that will have access to VicTrack network external plant shall attend induction workshops where they will be given the required information as contained within ***this document and: TS-SP-015 Network Protection Procedure and TS-SP-066 (Attachments to Tram Poles);***
ii. On demonstrating an adequate understanding of VicTrack network requirements, these staff will be issued with a "VicTrack Network – External Plant" accreditation card. This card will enable these workers to work on or near VicTrack external plant for a period of five (5) years, after which a refresher workshop will be held. As industry workers often change employers, it is required that companies used by VicTrack for external plant work will advise VicTrack on changes of staff to allow us to organise workshops for new workers and/or refresher courses.

iii. The courses may be different for different areas of expertise, such as planning and design guidelines for design staff, and detailed courses on pits, conduits, etc. for field supervisors.
iv. Minor specification changes will be advised to card holders as a matter of keeping up to date with our standards.
v. Installation and maintenance contract companies will be required to advise which of their staff will be working on or near VicTrack external plant and will be required to provide their current accreditation details before those staff can perform those works.

7.3. Installation Works – Rail Corridor

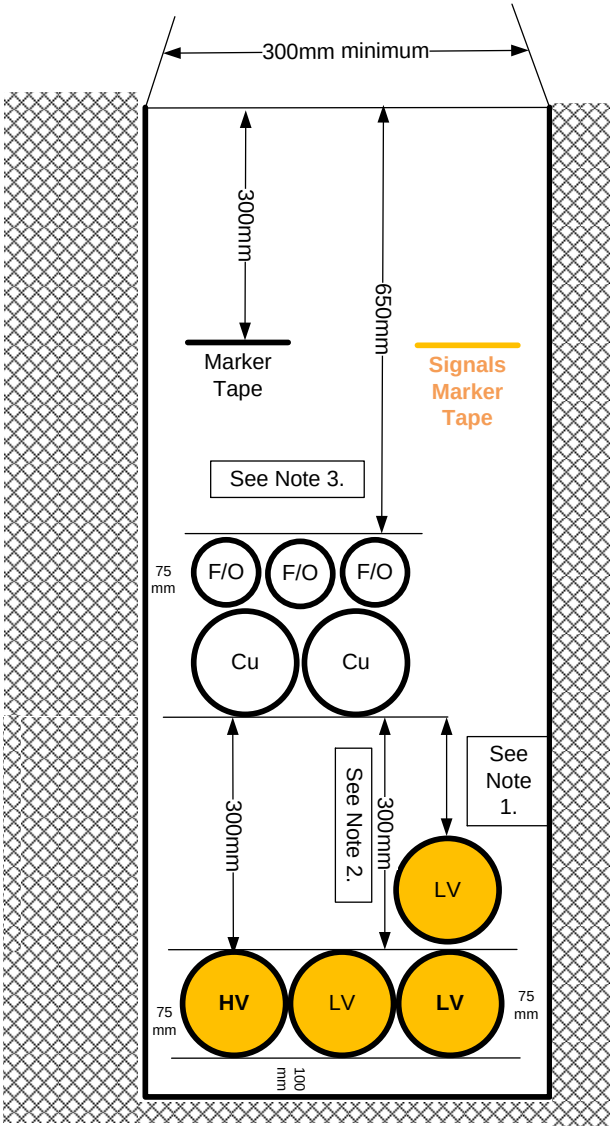
When installing communications conduits on the rail corridor, the Contractor must ensure that all installation methods and activities comply with the following requirements, and the installation conforms to the agreed route plan.

7.3.1. Trenching and Boring

The depth of conduit below tracks must be measured from the top of the rail;

i. Unless otherwise specified, the target depth for underground conduit must be a minimum of 650 mm to the top of the conduit in general areas. A minimum cover of 1200 mm is to be achieved under VicRoads roads (URX) and under broad gauge rail tracks (ULX). A minimum cover of 1600 mm is to be achieved under standard gauge rail tracks (ULX). Depth of cover under Council controlled roads will be as required by the relevant Council, but generally the cover will be at least 900mm;
ii. If site conditions make it difficult or unsafe to achieve the target cover over conduits, consideration will be given by the relevant VicTrack Project Manager (or the Network Protection Manager in the event of a fault repair) to allow the use of alternative methods of installation. The presence of rock, underground drainage pipes, oil/gas/sewerage/water/power facilities are all examples where it may be difficult to achieve the target conduit depth. The specific utility may have existing standards as to digging and installing infrastructure in the vicinity of their facilities and the designers are to discover these requirements and include it in their presentation to VicTrack No work is to be undertaken until all services have been properly located and verified, and alternative installation methods have been presented to VicTrack. VicTrack alone will make the final decision on alternative installation and coverage requirements. Adequate protection of the cabling is the guiding factor in these decisions;
iii. In areas where rock is encountered, the conduits shall be laid on a clean bed of sand 100 mm thick. The depth of conduits in rock and shale areas shall normally be at least 650 mm to cover strip or conduit; except for areas of unbroken rock where a reduction in depth to 300 mm may be permitted. The final 150 mm of fill of trenches in rock areas shall be stabilised sand (3% cement), or concrete - see section 5.2.1.xv - (with potential use of 25 MPa geopolymer concrete in accordance with VicRoads Section 703 encouraged due to its sustainability credentials including low embodied carbon) , if in vehicle access roads. The conduit shall be covered with sand to protect it;
iv. Where communications cables are in the same trench (in conduit or direct buried, as signalling and power cables, then:

a. All communications cables shall be housed in conduits unless permission is granted by the General Manager, Telecommunications to install direct buried cable. Direct buried cables are generally in non-urban areas;
b. The minimum separation between communications cables in conduit and signalling and power cables shall be as specified in Figure 1 for CSR configurations and Figure 2 for communications only trenches -Communication cable, trench plan, stressing that a minimum of 300 mm separation is required between copper communications cables/conduits and HV cables/conduits (twin core power cables).
c. The communications cables shall be laid above all the signalling, and power cables (HV and LV) for the total length of the cable run. If the proposed route design requires otherwise, it is only to be included in the route design after consultation with, and agreement by, VicTrack;



Marker Tape — Must be white, minimum 75mm wide, have an embedded stainless steel trace wire and have the words – "COMMUNICATIONS CABLES"

Signals Marker Tape — Must be orange, minimum 150mm wide, and have the words – "DANGER – RAILWAY SIGNALLING CABLES"

Cu — Copper Communication Cable in 100mm ID White Conduit

F/O — Fibre Optical Communication Cable in minimum 50 mm ID White Conduit

LV — Low Voltage Signals Cable in 100mm ID Orange Conduit.

HV — High Voltage Signals Cable in 100mm ID Orange Conduit.

Notes	
1	Minimum Separation Nil if either the communications cable or the LV cable is in approved conduit.
2	Minimum vertical separation between copper communications cables and HV cables is 300mm if the HV cable is in an approved orange heavy duty UPVC conduit, otherwise the separation needs to be 450mm.
3	All communications conduits to comply with the requirements of AS/ACIF S008:2006 and power conduits must comply with the requirements of AS/ NZS 3000 - 2000.

Figure 1. CSR (Combined Services Route) trench plan

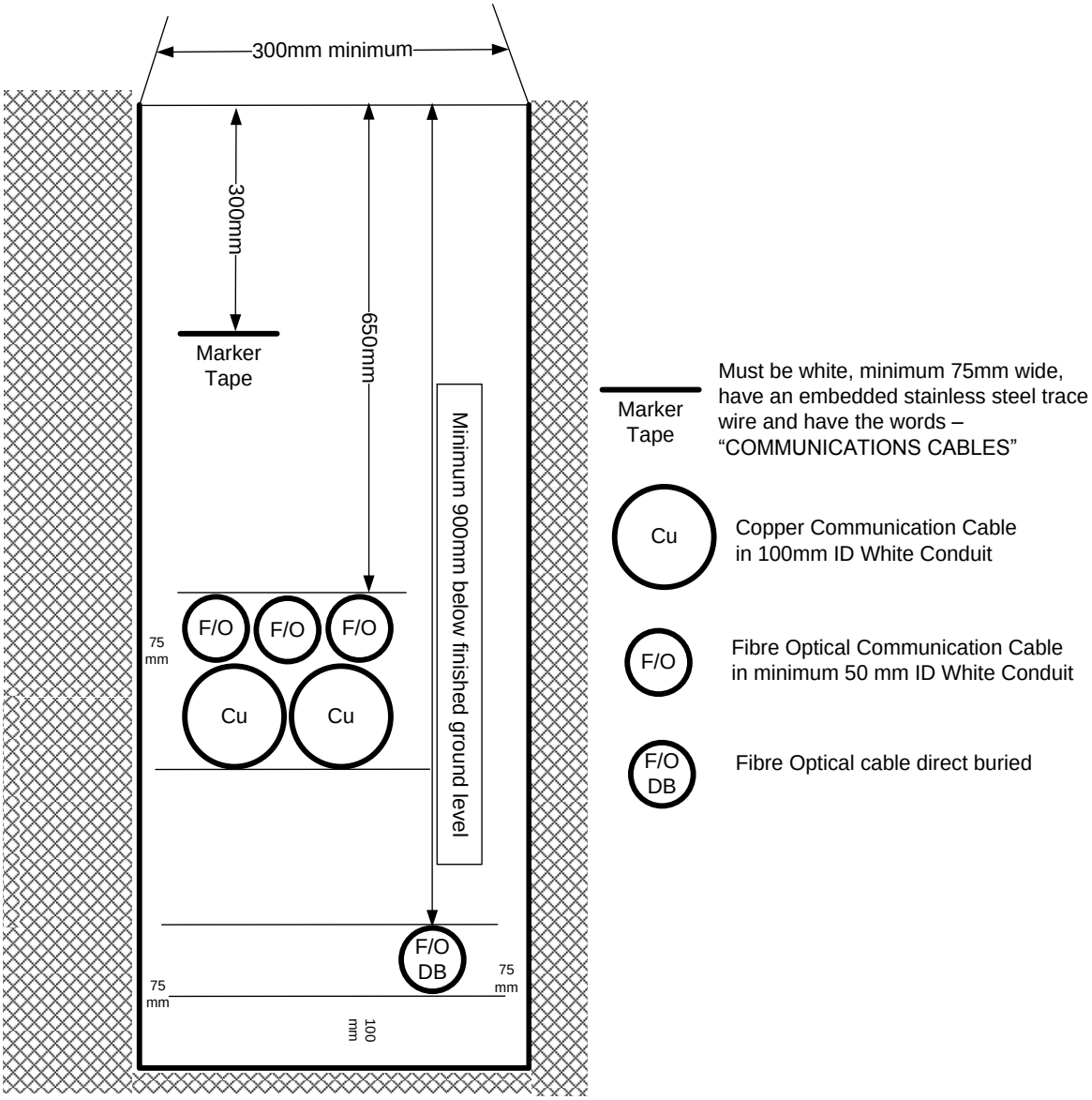


Figure 2. Communications only trench plan

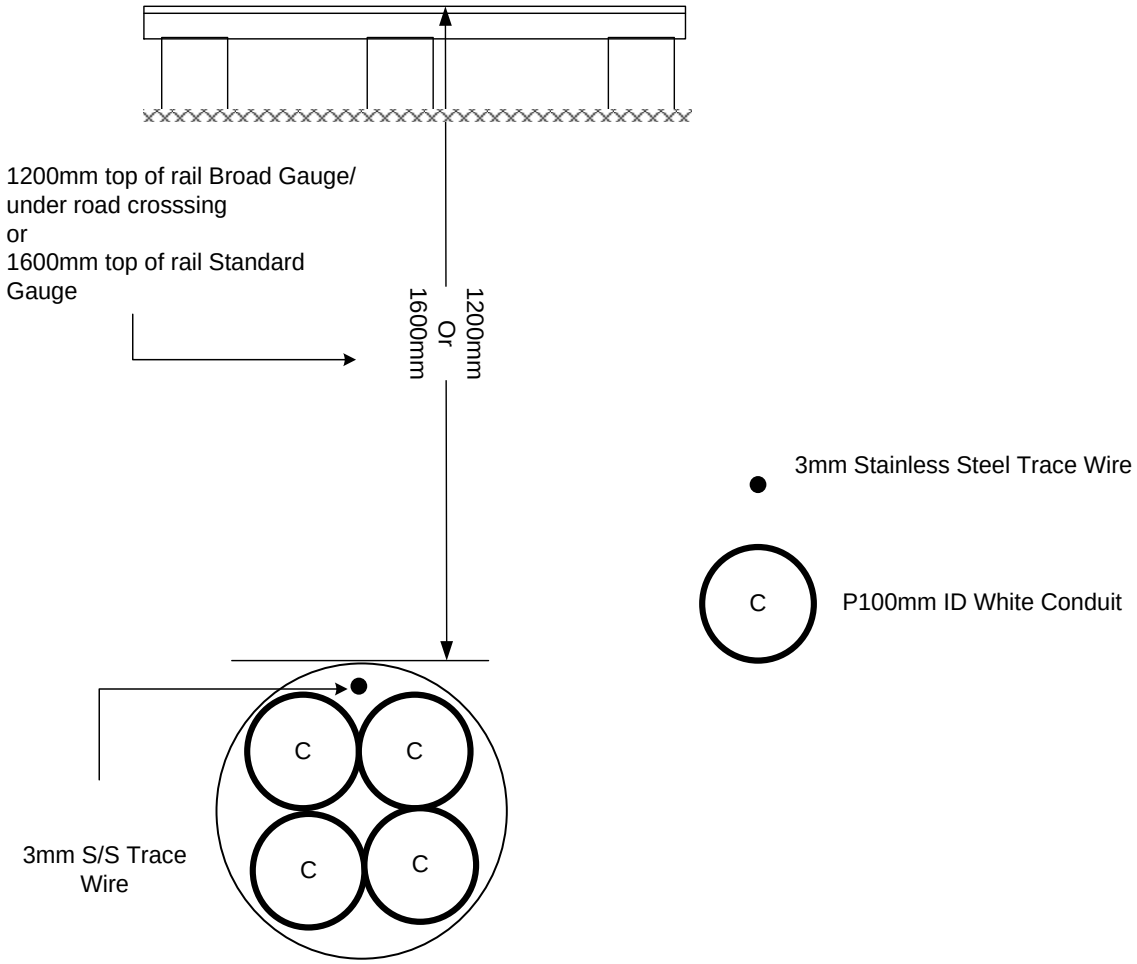


Figure 3. VicTrack ULX / RUX Bore

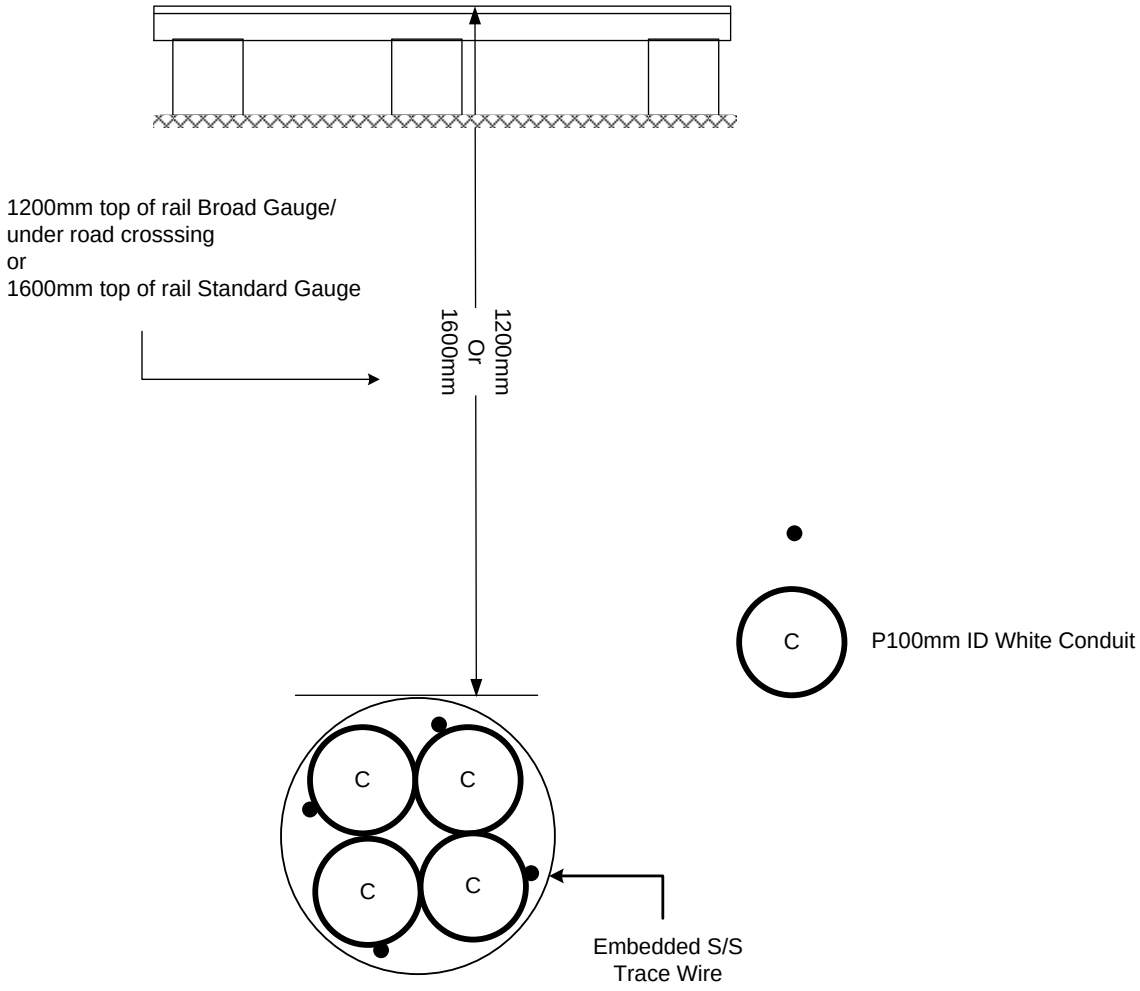


Figure 4. VicTrack ULX / RUX Bore with Embedded Trace Wire

v. Where a conduit is to be installed under railway tracks or public roads, the following shall apply:

a. Where multiple tracks exist, the minimum depth of the conduit (measured from the top of the rail) shall meet or exceed the depth requirements of all parties (1.2 m for Broad Gauge tracks, and 1.6 m for Standard Gauge). This depth shall be maintained for at least 3 m beyond the outer rails; when measured at right angles to the track (see figures 3, 4, and 5);
b. Where all the rail tracks are Broad Gauge, the minimum depth required shall be 1.2 metre measured from the top of the rail, and this depth shall be maintained for not less than 3 metres beyond the outer rails, when measured at right angles to the track; as illustrated in figures 3, 4, and 5;
c. Bore logs and bore path diagrams are to be provided by the installer showing depth below rail in relation to the lateral route at each rod length;
d. The trench or bore under tracks and roads is to be at right angles to the axis of the rail/road unless approved otherwise, and minimum depth of cover is to extend for at least 3 metres past the outer rails on a track crossing (ULX), and 4 metres past the edge of the road for road crossings (URX – depth of cover 1.2 metres unless the local authority deems otherwise);
e. Appropriate transition pits are to be provided at each end of the crossing trench or bore. The bore pipe is to be coupled to 100mm ID PVC pipe within one conduit length of the transition pit so that the normal PVC pipe entry and spigot arrangement can be used in that pit. Smoothing is desirable of the inside edge of both the bore pipe and the 100mm ID PVC pipe so they do not present any sharp edges inside the coupler;
f. All bores are to be appropriately backfilled to prevent subsidence and interference to track drainage. Bore annulus is to be no more than 50 mm without appropriate grouting. Betonite slurry mix is not an appropriate grout;
g. Where trenching or boring activities may affect road use, the Contractor shall institute an approved Traffic Management Plan; and
h. Where trenching or boring activities may affect pedestrians, the Contractor shall institute an approved Pedestrian Management Plan;
i. Excavation by digging machines is not permitted within 5 metres of existing VicTrack communications infrastructure, unless under the direction and supervision of an authorised representative of VicTrack, refer to”TS-SP-015 Network Protection Procedure” for details. An approved VicTrack PTW is also required;

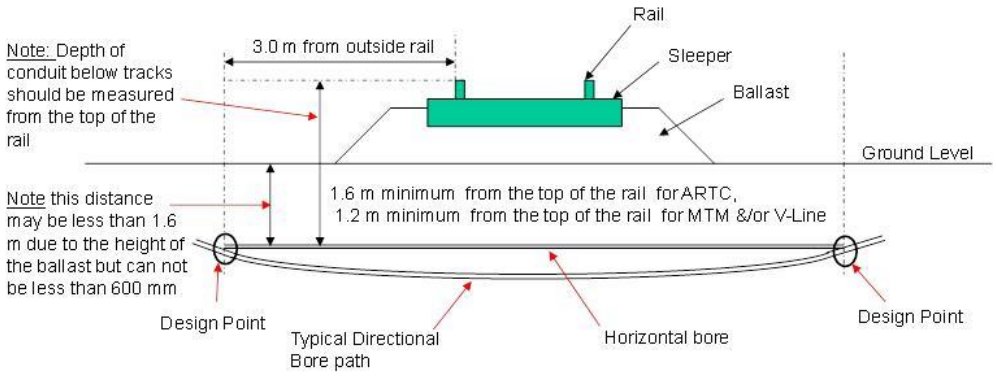


Figure 5. Design for under track bore

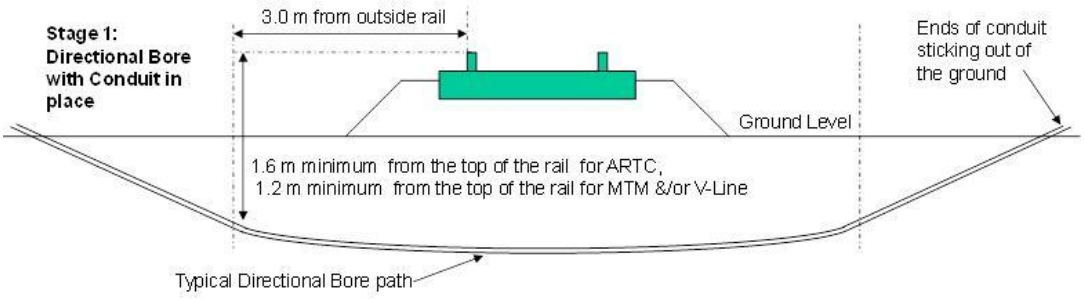


Figure 6. Construction of under track bore using Directional Boring Stage1 - with conduit in place

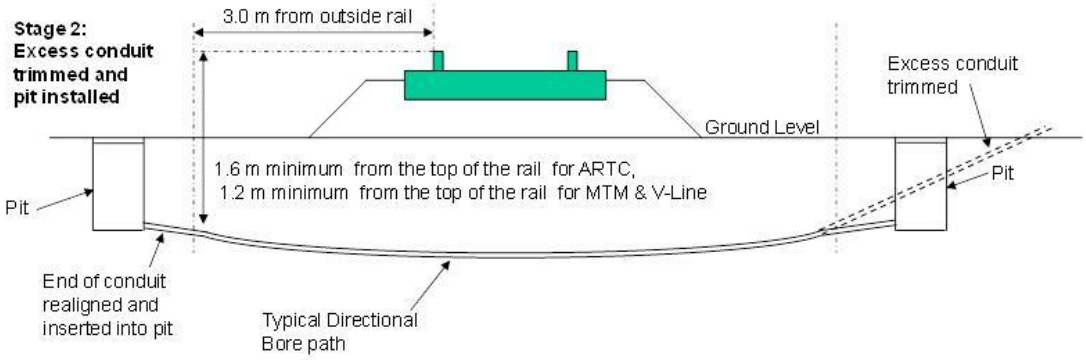


Figure 7. Construction of under Track bore Stage2 - Excess conduit trimmed and pit installed

Excavation by digging machines or by hand within 2,000mm of a high voltage cable is not permitted unless the power has been turned off (High voltage is above 1000V);

vi. Any exposure of existing conduits (or direct buried cables) is to be done only with NDD (Non Destructive Digging). A Hazard PTW is also to be obtained prior to work commencing. Signal LV and HV cables may also be present. The use of water lance and vacuum extraction technology is the preferred method of physical exposure of VicTrack External Plant. Should this not be possible, then the Contractor must propose an alternative method to VicTrack for approval prior to works being carried out. It is to be noted that water lance pressure must be less than 1500psi (10443kPa) to prevent damage to the marker tape and direct buried cables. Once the level is below the marker tape, the pressure can be increased if all cables are in conduit, but care must still be taken. The water flow is to be stopped before removing the water lance to avoid damaging the marker tape;

vii. Compaction of trenches and other excavated areas is to be carried out to industry standards. The contractor is responsible for ensuring adequate restoration of the excavated areas for a period of twelve months following the completion of the project; the cable trench shall not be compacted by driving excavating machinery or other vehicles along the trench.;

viii. Services searches are the responsibility of the contractor. Requests for services searches shall be made in the first instance to VicTrack Property Group, Third Party Access, via the VicTrack Project Manager but shall also include a request to MOCS;(Melbourne One-Call service 1100 – now known as Dial Before You Dig);

ix. VicTrack's RailMap is a web-based GIS that provides information to authorised users on property boundaries, utilities, service crossings and other property features that lie within VicTrack's rail land. For access to RailMap, request this access on-line on the VicTrack web site – www.victrack.com.au. ;

x. The Metro Trains local signal fitter can provide information on the location of signal cables in the area. Metro Trains Electrical Substations Department can provide information on the location of cables in the vicinity of substations;

xi. VicTrack's Network Protection Procedure, TS-SP-015, sets out the requirements for cable location/ excavation / ground penetration activities in the vicinity of existing communications cables;

xii. Trenches under culverts/open drains that are less than 900mm cover to the invert of the culvert/drain are to be protected with the installation of a concrete slab (25MPa strength) 150 mm thickness extending 1 metre minimum outside the edges of the culvert/drain and 900 mm minimum width over the top of the trench/bore. The marker tape is to be run continuously under the concrete slab. Marker posts are to be as close as practicable to both edges of the culvert/drain to give a visible indicator that the cable route is present at that location. If the under-crossing of a culvert/open drain is a bore, the depth of cover must be more than 900 mm. If the bore is under a creek then the depth of cover beneath the creek is to be at least two metres to guard against scouring of the creek bed during extreme flooding.. Access pits either side of a bored conduit pathway are to be placed above the 100 year ARI flood level;

xiii. The cable route shall, as far as possible, follow a constant grade and line. Rough and uneven ground shall be levelled to the extent necessary to achieve this object. This levelling work shall not adversely affect rail or natural drainage, pedestrian or vehicular access routes. The lateral route should be at least 500mm from boundary fences to allow future fence work without risk to the CSR.

xiv. Where reduced trench depth situations occur, and have been agreed to by VicTrack with the conduits encased in concrete, the following conditions will apply:

a. Regular wooden, foam or plastic spreader bars, every two metres, to ensure the

150mm separation is maintained when the concrete is poured;

b. The concrete is to be at least 50mm thick over the top of the conduits to minimise cracking over the conduits as the concrete shrinks with drying and age;
c. The conduits must still be 300mm apart when they enter and exit the concrete part of the route if existing copper communications need to be accommodated. If no copper communications cables are needed, no separation is required as long as all cables are in their own conduits;
d. No metal to be used in the concrete;
e. The communications cables are to be in conduit;
f. The LV & HV cable are to be in conduit;
g. This only relates to areas where concrete encased conduits have been approved due to constricted space or the correct depth not being able to be achieved;
h. Copper Communications cables in conduit require at least 300mm separation to HV (also in conduit), whereas copper communications in conduit do not require any separation from LV cables.

7.3.2. Protection of existing services

When working near existing VicTrack assets, extreme care must be taken. Refer to TS-SP-015 Telecommunications Network Protection Procedure for all requirements prior to commencement of works. Ideally, these factors shall be taken into consideration at the design stage.

7.3.3. Backfilling and compaction of trenches

7.3.3.1. General obligations

i. The Contractor shall compact all trenches and excavations to reinstate the original surface, in accordance with Section 8.2.3.3 v, vi & vii. A mound of fill is to be left on top of the trench to a height equal to 25% of the trench width. A Certificate of Practical Completion is provided at this stage.
ii. The Contractor shall ensure adequate restoration of the excavated areas and no subsidence for a period of 12 months following the completion of the project.
iii. Before issuing the Certificate of Final Completion, VicTrack may examine the backfilled excavations and ask the Contractor to rectify the cause of any erosion of the backfilling.

7.3.3.2. Methodology – all types of areas

i. The contractor shall ensure Clean Fill is utilised to cover the conduits or cables to a depth of 50 mm minimum over the conduits to ensure the conduits remain in the set configuration. Care must be taken laying PVC conduit and compacting over PVC conduit to ensure that necking or distortion does not occur. Conduit shall be placed in the trench and clean fill placed around the conduits so that as far as possible the fill and surrounding soil and/or rock shall exert an even pressure on the entire surface of the conduit. To this end installers shall ensure that there are no voids between the conduit/s and surrounding soil and/or rock. This is best achieved by laying conduits one layer at a time with spacers every three metres along the cable route and between the conduits to ensure that the voids can be completely filled with Clean Fill. A mandrel test is required after installation and trench backfilling, so due care

must be taken at each stage to ensure the mandrel test is successful;

ii. The contractor shall fill the trench above the clean fill with materials free of broken concrete, brick, rubble, wood, glass, rubbish, or metallic objects that may damage the cable or affect the operation of electronic cable locators. All material present in the trench must be able to pass through a 30 mm sieve;

iii. Surface drains shall be reinstated during the backfilling operations to the satisfaction of the relevant ARO;

iv. The backfilling of the excavations will normally take up the majority of suitable spoil. However, the Contractor shall remove any surplus or unsuitable spoil for disposal at an agreed location; and

v. The Contractor shall not compact the trenches by driving excavating machinery or other vehicles over the trench.

7.3.3.3. Access areas

i. Unsealed - Where the access roads or pathways are unsealed, the top 150 mm (or more) of fill shall consist of material that matches the material in the road or pathway surface in both texture and density. The Contractor shall compact the fill to achieve matching density;

ii. Sealed - Where the road or path is sealed, the Contractor shall cap the trench with the same material to the same thickness as the original seal. The Contractor shall also match any substrate or capping layer below the seal;

iii. In paved areas, the Contractor shall spread a certain amount of moisture evenly through the surface material. The Contractor shall spray water until moist;

iv. For any excavations on platforms, access tracks, pathways, under or adjacent to rail lines, through shunting yards or at the base of embankments;

v. The Contractor shall use a mechanical vibrator to ensure that the fill has minimum relative compaction to AS3798;

vi. The Contractor shall compact the first 150 mm of fill over the cover strips or conduits carefully to ensure that these cover strips and conduits are not disturbed;

vii. The Contractor shall fill and compact by approved mechanical means in layers of maximum thickness of 150 mm to achieve the specified density, and to achieve 95% standard compaction in accordance with AS1289. Note: VicTrack may conduct tests to audit the soil compaction; and

viii. To allow for further settlement, the Contractor shall finish the compacted area with a slight mound with an approximate height of 25% of trench width.

7.3.3.4. Non-access areas

i. In areas where it is not possible to be accessed by the public or rail staff, compaction of backfill with a mechanical vibrator is not required. In this case, the Contractor shall backfill all trenches and excavations by appropriate means and leaves the area free of obstruction and depressions except for a slight mound over the excavation area to allow for further settlement.

7.3.4. Other Considerations

Wherever premixed concrete is to be used, preference is to be given where practicable to use of geopolymer concrete (in accordance with VicRoads Section 703) to take advantage of its sustainability credentials including low embodied carbon.

7.3.5. Conduit

i. Unless otherwise specified, all conduits are to conform to AS/CA S008;
ii. Underground conduit shall be minimum PVC pressure pipe Class 12, but any conduit that will be above ground is to be UPVC. The minimum 50 mm ID conduit shall have a minimum wall thickness of 3.3 mm. The minimum 100 mm ID conduit shall have a minimum wall thickness of 6.3 mm. Convoluted conduit is not an acceptable conduit within VicTrack's underground network;
iii. Standard backbone conduit is to be white in colour, of PVC material, 50 mm internal diameter with a minimum wall thickness of 3.5 mm, and be provided in minimum 4.5 metre lengths;
iv. Subduct is a high density, black polyethylene, type 50, minimum Class 12, 32 mm outside diameter, or at least equivalent. Subducts are joined (only in pits) with a Plasson subduct joiner or a Comfit "push-fit" coupler;
v. Any conduit or sub duct proposed to be used that differs from the above requirements is to be advised to the VicTrack PM and a sample provided for approval. This approval is to be gained prior to ordering or installation;
vi. Conduit used under rail tracks or roads shall be:

    a. In a trenching situation there shall be a minimum of two conduits provided, white in colour, of PVC material, 100 mm internal diameter with a minimum wall thickness of 6.3 mm, and be provided in 6 metre lengths. Each conduit is to be fitted with a minimum of three subducts at the construction stage. The subducts must be sealed upon installation into a Jackmoon conduit sealing unit with duct plugs (as a minimum but not limited to this device) and each subduct labelled or numbered at each pit to assist with identification when cables need to be installed; and

vii. In a bore situation there shall be a minimum of two conduits or bore pipes provided, white in colour, of continuous Class 9 HDPE material (High Density Polyethylene), and 100 mm minimum internal diameter. If the bore pipe needs to be joined, it must be by means of electro fusion or collar method. Both methods require mandrel and pressure continuity testing. Each bore pipe is to be fitted with a minimum of three subducts at the construction stage. The subducts must be sealed upon installation into a Jackmoon conduit sealing unit with plugs (as a minimum but not limited to this device) and each subduct labelled or numbered to assist with identification when cables need to be installed. Draw ropes are to be attached to the rear of the Jackmoon plugs and pushed back into the subduct to allow a full seal around the plugs. 3mm stainless steel trace wire can be installed with the bore pipe but not within any bore pipe. Bore pipe with embedded trace wire is also acceptable provided it is installed in accordance with the manufacturer's recommendations;
viii. All changes of conduit direction are to be with long radius bends; the shortest radius bend in any conduit shall be not less than 600 mm and bends shall be smooth and rounded to prevent

damage to or pressure on the cables;

ix. All conduit ends in pits are to be correctly fitted with spigots to ensure that there are no sharp edges on the conduit; they are to be mounted flush with the pit wall and not touching any other spigot;

x. Where a buried conduit is to connect to existing above ground trunking, a transition pit (P8 minimum) must be placed at the end of the trunking. A conduit is then to be angled up from the pit towards the trunking and be connected to the trunking via an offset blister using GI pipe. If the conduit is plastic, it must be protected by metal trunking or other suitable material and sealed within the blister by means of a VicTrack approved conduit plug – foam filler is not to be used;

xi. Conduit entering buildings should be sealed within the pit and within the building to prevent entry of moisture/gas/vermin into the building;

xii. Where water may flow through an entry conduit into a building, the conduit shall be terminated outside the building. The entry into the building shall be above the overflow level of the conduit;

xiii. The conduit shall be labelled only with “VicTrack Telecommunications” (preferred) or “Communications”. Any other proposed labelling is to be approved by VicTrack before purchase or installation;

xiv. A draw rope is to be provided in installed conduit. The draw rope is to be 6 mm blue and yellow polypropylene rope and compliant with ***AS 4142: Fibre Ropes***. The draw rope is to be continuous between pits and at least two metres pushed back into the conduit or sub ducts and secured to the back end of the Jackmoon plugs inserted into the conduit or appropriate Jackmoon conduit sealing units at each end. When a cable is pulled into a conduit, a new draw rope is to be hauled in at the same time and attached to the rear of a spare Jackmoon sealing plug, until such time as the conduit is deemed to be full;

xv. Conduits between pits are to be as straight as possible (in both the horizontal and vertical planes) and not exceed two metres deviation between pits at normal (380 metres) spacing. If the deviation limit will be exceeded then the pit spacing is to be reduced to achieve the required limit. The conduit configuration leaving one pit is to be the same at the entry to the next pit and the configuration must stay the same for the full section, with no interlacing or transposition of conduits at any point (see Figure 5a below);

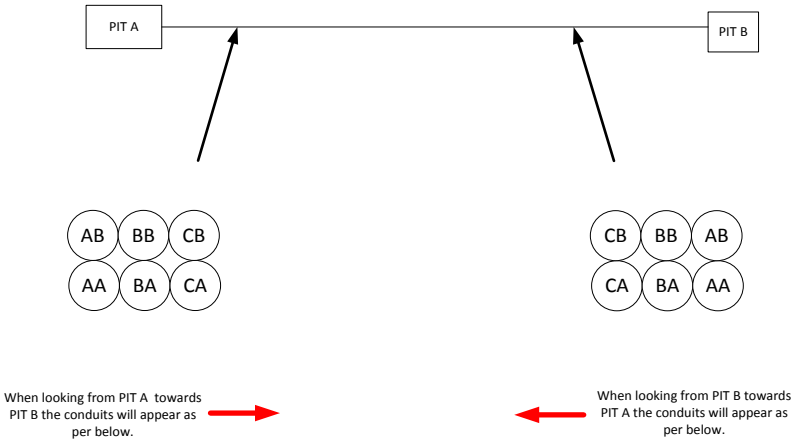


Figure 8. Conduit Installation Guide

xvi. Conduits are to be joined by utilising the spigot and socket ends;

xvii. The ends to be joined shall be thoroughly cleaned using a conduit-manufacturer approved priming fluid;

xviii. The ends of the conduits, both spigot and socket shall then be coated for the full length of the spigot/socket with a conduit-manufacturer approved adhesive and connected together for the full length of the socket;

xix. Conduit in trunking shall be minimum PN 12.5 (SDR 13.6) sub duct – refer to Section 8.2.5 sub-clause iv;

xx. All conduit sections between pits (and building entries) must be checked for concentricity and clearance of any obstructions that may hinder cable installation. A conduit cleaner may be employed to first clean out any obstructions (crushed rock, dirt, etc.). Each conduit is to be checked for concentricity, correct diameter and a clear path by the hauling of an oval shaped mandrel or plug for the full length. The mandrel or plug must be minimum 90% of the diameter of the installed conduit. The mandrel testing is to be carried out (at a minimum) after trench backfilling and compaction. All mandrel tests are to be witnessed by an authorised VicTrack representative. Results are to be recorded and provided to the VicTrack Project Manager;

xxi. After mandrel testing all conduits are to be sealed with Jack Moon conduit sealing units with plugs, with the draw ropes tied to the rear of the Jackmoon plug/s and pushed back into the conduit to allow a full seal around the plug/s.;

xxii. Sub ducts are to be tested for unobstructed continuity by blowing a sponge through the sub duct. The sub duct is to be sealed with an appropriate Jackmoon sealing plug after successful testing;

xxiii. In instances where trenching cannot be carried out, conduit may have to be installed on wall mounted ladder tray. Plastic conduits are not to be exposed to UV radiation; therefore full covers are required on the ladder tray or metal conduits used. Access points such as pull boxes are to be provided at less than 100 metre spacing and the lid of each access point is to be indelibly marked with “VICTRACK COMMS ACCESS POINT”. All conduits are to be sealed at each access point with Jackmoon sealing plugs. These plugs are removable when cables need to be installed and reusable in new conduits;

xxiv. Where conduits pass over bridges the conduits must be steel to prevent heat expansion.

The steel conduits must be adequately secured and have pull boxes or transition pits to go back to PVC conduits at the ends of the bridge. All conduits are to be sealed with Jackmoon sealing plugs. Draw ropes are to be tied to the rear of the Jackmoon plug/s and pushed back into the conduit to allow a full seal around the plug/s. When cables are to be installed, refer to 6.2.x; and

xxv. If sub ducts are installed in the conduits a Jackmoon sealing unit (or similar) is to be used to accommodate the number of sub ducts installed. Each sub duct in the sealing unit is to be sealed with an appropriate duct plugs. When cables are to be installed, refer to 9.2.x.

7.3.6. Pits – Size and Use

i. Pits required to contain a loop of cable must be of sufficient size as to accommodate safely 15 metres of slack cable from each direction (a total of 30 metres of cable, P8 minimum). This will allow for future jointing, or for existing joints to be removed from the pit and worked on in a portable shelter or vehicle. Coiling must be performed in accordance with the manufacturer's specifications. Pits that are not required to contain neither a loop of cable nor a splice may be smaller than P8, as long as the conduit depth of 650mm minimum is maintained;

ii. Pits must be provided for all joints and must be large enough to accommodate 15 metres of slack cable from each direction per joint (a total of 30 metres of cable, P8 minimum). A minimum of P8 pit is required for rodent-resistant cable with a core count of 96 or greater. Pits must also be provided where required for changes of direction or changes of construction method and must be a minimum of P8 provided the conduit depth of 650 mm minimum is maintained. Construction methods may dictate that additional pits are required. Where the conduit used for a bore continues along the trench area without a change in , a pit is not required in the transition area between the bore and the trench;

iii. The pits used for communications purposes are to be separate from the pits used for signalling purposes. However, communications cables may pass through a signalling pit ("shared pit"), if approved by the relevant VicTrack Project Manager, and as long as the cables can be clearly identified and protected by a through conduit or non-crushable flexible subduct. Where such a shared pit arrangement is permitted, the communications conduit must not physically obstruct access to the signalling cables. No loops or joints in communications cables are permitted in a signalling or shared pit. The VicTrack communications through conduits are to be tagged or permanently labelled as "VicTrack" to distinguish the white conduits from possible post phone conduits installed by Signals. Where flexible non-crushable subduct is not installed, remove the subduct and install non-crushable flexible sub-duct. Examples of suitable flexible non-crushable subducts include; Treotham VOH "PMA HEAVY DUTY conduit type VOH" and Thomas & Betts "XTRA-FLEX Type LTC";

iv. Pit selection must also take into account the number and size of conduits that will need to be accommodated. The bottom of the lowest conduits should be 50 mm minimum above the inside bottom of the pit. The top of the highest conduit must still be 650 mm minimum below ground level. Conduits must also be placed so that the internal spigots do not touch each other. All spigots must be flush to the pit wall. With plastic pits, no wall ribs are to be cut nor be under any spigots. The pit type (plastic or concrete) and size must be selected to meet all of these requirements. Pit collars are not acceptable methods of achieving greater pit depth. A minimum of two spreader bars are to be fitted low in plastic pits to prevent subsequent collapse of the pit sides. If they are removed for maintenance work or cable

installation/jointing, they are to be replaced as soon as possible;

v. Pit provision and installation must conform to the agreed route plan.

vi. Individual pit lids must not exceed 30kgs in weight (current weight of P6, P8 & P9 lids), except where they are used in trafficable pits (see Section 8.2.8.viii).

vii. All new pit lids must provide slip resistance to meet AS/NZS 4586-2013 (Slip resistance classification of new pedestrian surface materials – Appendix D);

viii. Where pits are installed as part of a major project (using heavy earthmoving machinery, trucks or cranes) consideration should be given to the use of concrete pits to avoid damage to the pits during the project phase. Damage of this type has been experienced in previous projects and the pits have to be replaced under the Defect arrangements, but it would be better to avoid the damage in the first instance, as the cables will be operational at the end of the project;

ix. All pits are to have their length (L), width (W) and depth (D) recorded in Connect Master and on the As-Built drawings, so the civil constructor will need to capture and record this information;

x. Pits deeper than 1200mm, shall be classed as Special Work Locations (SWL) and are to be recorded as such in Connect Master and on route drawings, as special precautions may need to be taken during construction and subsequent maintenance phases (such as gas detection, oxygen levels available and more than one person present);

xi. The length and width of these pits, which are necessarily of concrete construction, need to be greater than shallower pits. The length of the pit shall be at least the same as the depth and the width shall be at least 80% of the depth to allow for adequate space for a person to work with reasonable comfort. It will also allow cable to enter and exit at different depths without undue strain on the cable (which could be present in pits of a shorter length). Workers entering deep pits (greater than 1200mm) shall be fitted with a hauling strap to allow them to be lifted up, in the case that the person has collapsed, without extra personnel entering the pit; and

xii. Where lead-in conduits are installed up piers and over tracks, an accessible pull box is to be installed on each pier to prevent the number of bends exceeding 180˚, thus making cable hauls very difficult.

7.3.7. Pits - Location

i. Spacing between pits should not exceed 380m;

ii. Pits and/or associated infrastructure shall be installed at 4 m minimum from the nearest running rail to enable staff to work around all sides of the pit without encroaching into the three-metre zone where track protection becomes necessary. If the infrastructure must be installed at less than 4 m minimum from the outside edge of the closest running rail, then a suitable barrier is to be considered to prevent inadvertent entry into the three-metre zone during maintenance or inspection activities. If the pit does not contain a joint, then it is unlikely that the pit will be attended so a temporary barrier can be used in those cases;

iii. Where a pit is to be located between the rail tracks to serve a rail location, for example an island platform, then the approval of the VicTrack Project Manager is required. A loop of cable or joint is not permitted in such a pit, unless an exemption is granted by the VicTrack Project Manager;

iv. Pits are not to be to be planned to be located in the maintenance access track on the rail corridor;

v. Where a pit has to be located in a trafficable area (for example a car park or the maintenance access track), then it must be a trafficable pit and pit lid specified to carry the required load (minimum axle load of 4.5 tonne). It may be preferable to locate the pit in the centre of the access track to avoid vehicles driving on the pit, or have the conduits in the access track and the pits diverted to the side off the access track; where possible, especially in public pedestrian areas, pits are to be fitted with lightweight lids. Metal lids are no longer to be used, except in specially approved trafficable pits Type A manholes and trafficable pits;
vi. The lids are to be installed correctly so they do not present a trip hazard; and
vii. Lifting holes are to be fitted with appropriate plastic lugs.

7.3.8. Pits - Installation

i. All pits are to be installed with a minimum of 50 mm of crushed rock underneath the pit;
ii. Pits must be installed in such a way that ordinary ground water and silt will not drain into the pit - therefore the following guidelines apply:

a. in a natural ground area (dirt) with no pedestrian traffic, pits are to be installed 50-100 mm above the natural ground with marking and bollards warnings and a surround of crushed rock to prevent tripping hazards for maintenance staff;
b. in a pedestrian traffic area, pits are to be installed with the upper surface flush with the surrounding natural ground surface to prevent it from being a tripping hazard for pedestrians;

Figure 9. Pits in uneven or sloping ground

iii. If the ground is uneven or sloping and the slope is greater than 1 in 5, then a retaining wall needs to be constructed. The retaining wall is typically constructed from sleepers, on the low side of the pit and set away from the pit by a minimum of 300mm. The design of a proposed retaining wall must be approved by the VicTrack Project Manager. Where the slope is less

than 1 in 5, the VicTrack Project Manager may give approval for the ground to be battered around the pit; otherwise, a retaining wall needs to be constructed, as detailed in this paragraph (see Figure 6);

iv. Pits in paved areas must be constructed so as not to be a tripping hazard to pedestrian traffic;

v. All cable entries to rectangular pits must be through the ends and not the sides;

vi. Where conduit accommodation or space limitations determine the use of concrete pits, the minimum size is to be 900 X 900 mm. If joints are to be accommodated then 1200 X 1200 mm is the minimum size. If the pit depth is greater than 1200mm refer to Clauses 8.2.6. xi & xii. Conduits may be placed in the sides (the faces parallel with the track) of these pits, with the agreement of the VicTrack Project Manager, as the minimum bending radius of 600 mm for the fibre cables can be achieved. The conduit entries are to be limited to three sides of the pit. On square pits, the end faces are those perpendicular to the track alignment;

vii. Entry holes for conduits in pits shall be sealed at the outside entry point after the conduit is installed to prevent siltation of the pit. The proposed method of sealing entry holes is to be provided to the VicTrack Project Manager for approval;

viii. Pit lids appropriate to the pit type are to be engraved or indelibly labelled with “VicTrack Communications.” and the weight of the lid in kgs. The lifting holes in the pit lids must be filled with plastic key hole plugs. Pit lid material may be specified as part of the project requirements (refer to 8.2.6.vi & vii). Pit lids must be appropriate for the location of the pit and be able to support the expected loads as follows:

   a. Class A – up to 10kN – pedestrian applications, inaccessible to vehicular traffic;
   b. Class B – up to 80kN – footpath and paved areas where vehicles may mount accidentally or such light vehicles as tractors, and livestock;
   c. Class C – up to 150kN – Light vehicular traffic, minor roads such as cul-de-sacs and parking areas;
   d. Class D – up to 210kN – roads carrying fast moving heavy vehicles;
   e. Class E – up to 400kN – very heavy wheel loads such as on construction sites;
   f. Class F – up to 600kN – extra heavy wheel loads such as in container terminals, docks and mining areas; and
   g. Class G – up to 900kN – extra heavy wheel loads such as at airports, military traffic, etc.;

ix. All pits installed must match the route design or approved variations;

x. There is to be no subsidence around pits. The installer is to inspect all pit installations with VicTrack after twelve months and rectify any subsidence or erosion found; and

xi. If the civil contractor has excess spoil, that spoil may be used to build pit mounds where the surface at the pit is up to 500mm above surrounding ground. This will help in keeping the pit/s visible and deter vehicles driving onto them. The grade from natural ground to the top of the mound is to be light and gradual, using the natural flex in the conduits to ensure perpendicular entry into the pit faces. If the lift in grade is started at least two conduits lengths from the pit, there should not be too much upward lift on the pits due to the conduit flex.

7.3.9. Installation of VicTrack Infrastructure Bollards and Marker Posts

For installation of Bollards and Marker posts – please refer to ***Appendix 3 – DMS Drawings for Marker/Protection Posts*** for guidance on replacement or repair

7.3.10. Use of Existing VicTrack Infrastructure

i. Existing VicTrack infrastructure may be of use to the Contractor. VicTrack's preferred method is underground conduit. Alternative solutions are to be in consultation with the VicTrack External Plant Manager All possibilities are to be explored and fully justified if underground conduit is not proposed;
ii. The use of existing underground conduit infrastructure may be permitted where it is suitable for the intended use, AND where it conforms to the specifications set out in this document, particularly the requirement for a minimum cover of 650mm and a suitable marker tape;
iii. Where the infrastructure does not conform to the specifications set out in this document or is suspected of not conforming, it must be brought up to these specifications by the Contractor; otherwise, new infrastructure is to be built;
iv. An application will need to be made by the contractor seeking permission to use any of VicTrack's existing infrastructures. VicTrack will consider such an application having regard to the standard and condition of the infrastructure and its suitability for the use proposed, and VicTrack's requirements for network integrity and resilience;
v. Where physical separation is required, it must be noted on the route plan and the method of achieving the separation noted;
vi. If any asbestos products (pits or ducts or building materials) are found (or suspected to be asbestos) during design, construction or maintenance activities, the VicTrack Asbestos Management Plan is to be strictly followed.

7.3.11. Types of Existing Infrastructure:

Details of existing infrastructure in a specific area are available on application to VicTrack. The major items that exist in the network area are:

7.3.11.1. Troughing:

The above-ground galvanised steel troughing, GST or "trunking," as well as ground level troughing (GLT – concrete or HDPE) used in the rail reserves, may carry existing communications copper and fibre cables, copper signalling, supervisory / control copper cables and high voltage copper cables (>1KV). This existing troughing, which does not have separate channels for different cable types, can only be used when there is no other reasonable alternative these alternative solutions are to be in consultation with the VicTrack External Plant Manager and there is no HV cabling present. Where this facility is used (communications cables only or with LV power cables), a minimum 50mm PN 12.5 (SDR 13.6) subduct with rodent retardant fibre cable, or short sections of thick wall 50mm solid conduit with SMOF cable is to be installed to house the new VicTrack communications cable. This class of infrastructure is not a preferred method of cable housing;

The minimum standard of existing troughing to be used shall be as follows:

i. Existing Surface Troughing

a. All lids to be in place and correctly aligned;
b. Troughing to be clear of debris, especially ballast; and
c. All holes are to be repaired or the damaged section replaced.

ii. Existing Raised Trunking (above ground or attached to walls):

a. All lids to be in place and correctly aligned;
b. The trough joint and the lid joint are to be separated by approximately one metre;
c. Lids to be secured with a minimum of three straps, located approximately 100mm from each end and one in the middle;
d. Trunking to be upright, and placed on pedestals, or correctly attached to wall brackets when attached to walls or bridge abutments;
e. All gaps are to be eliminated;
f. All holes are to be repaired or the damaged section replaced; and
g. Where existing troughing is to be used, the cable route must be such that the radius of any bend must not be less than the manufacturer's specifications.
h. Where a pit is required in an existing trunking run, then a blister of an approved design must be used to connect the existing trunking to the new pit. Then, either of the two following options is to be adopted:

iii. Trunking is angled from the blister to the pit as shown in Figure7- Pit installed in section of above ground trunking- Where this option is used, the trunking is not to enter the pit. Conduits or sub ducts are to enter the pit and the entry be sealed around the conduits; and

iv. Two 50mm GI pipes are installed between the blister and the pit;

Figure 10. Pit installed in section of existing above ground trunking

a. The minimum size of a blister is to be 450mm long and 150mm wide. An example of a blister is shown in Figure 8, and Figure 9. The blister is to be bolted to the existing trunking with a round headed bolt and the head of the bolt inside the existing trunking. All conduits entering blisters are to be appropriately sealed by the conduit installer. Foam filler is not appropriate;

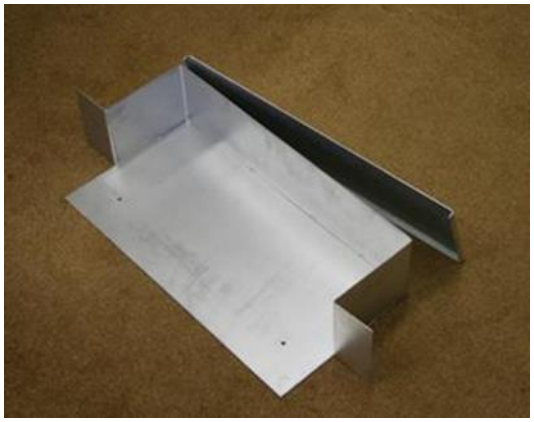


Figure 11. Sample of a blister

Figure 12. Sample of a blister-side view

b. No welding in trunking is to take place under any circumstances. If drilling is required, the existing cables must be protected. If existing power cables need to be moved to install the blister, then consultation with the rail operator is required to ensure appropriate power isolation is carried out;
c. Where a short section of existing trunking is to be utilised, for example over a culvert, in the middle of a conduit run, then the conduit is to be secured in the centre and 100mm from each end, may be continued on through the existing trunking. This eliminates the need to use rodent resistant cable in the existing trunking. In these circumstances, it may be more appropriate to use 50 mm conduit. Any such areas shall be identified on preliminary route and as-built drawings;

i. ***External cable tray:***

a. If covers have been used, ensure that all covers are in place to prevent cables and/or conduits being exposed to heat and UV radiation.
b. If no covers have been provided and the run is less than 50 metres, the cables

can be installed in UPVC conduit.

c. If the length of the conduit run is more than 50 metres steel conduits are to be used.

When shared pits (shared with signal cables) are used, the communications fibre cable is to be protected with non-crushable flexible pipe;

The use of any existing trunking is dependent on satisfactory capacity being available in the existing trunking for the communications cable as well as possible future signalling cables. There shall be a minimum of 10% available space remaining after the proposed installation; and

The VicTrack Project Manager will be the final arbiter on the suitability, design and use of any existing trunking (GST or GLT) proposed to be used.

7.3.11.2. Conduit:

There are areas where VicTrack has existing underground telecommunications (white) PVC conduit. Where spare capacity exists, these conduits may be available for use, provided they are minimum 650mm deep, and have a marker tape in place. Where no marker tape exists, a two-pair copper cable may be installed to aid location. Where the conduit is already in use, it may be appropriate to install subduct to provide protection for the Fibre Optic cable;

Orange conduit typically contains signalling and / or power cables and vacant orange conduits may be required for future signalling works. Use of such conduits is to be assessed on a site-specific basis and approval should be provided by VicTrack (both the Project Manager and the Network Protection Manager) and the associated ARO. The fibre optic cable is to be installed in white subduct and labelled at all access points with a “VicTrack Fibre Optic Cable” weatherproof label. If copper communication cable is to be installed, this will restrict future signalling cables to LV, as the separation requirements between copper communications cables and HV power cables cannot be met.

Where the location of underground conduit is marked by old style route marker posts, typically lengths of rail with a metal “VicTrack Cables” label attached, then those old marker posts are to be removed if convenient and new style marker posts (see section 8.5.xiv) are to be installed at the same location. If it is difficult to remove the old rail marker post, leave it situ and place the new cable marker posts next to the old post; and

Any exposure of existing marker tape, conduits (or direct buried cables) is to be done only with NDD (Non Destructive Digging) using a water lance and vacuum techniques with a maximum water pressure of 10.34 MPa (1500 psi) to avoid breaking the marker tape trace wire. NDD activities are to stop once the marker tape is uncovered. If a marker tape is not found (approximately 300mm below ground level), the NDD activities may continue until the conduit or direct buried cable is found. The water pressure is to be reduced to avoid cable damage and the water lance is not to be used to dislodge dirt – vacuum only. A Hazard PTW is also to be obtained prior to work commencing. Signal LV and HV cables may also be present.

7.3.11.3. Bridges:

VicTrack's policy is to avoid making attachments to bridges where possible, noting, however, that at some locations this may be unavoidable. If the Contractor determines that it is essential that infrastructure be attached to a bridge or other structure, then this may be allowed in accordance with the following principles:

i. Attachments must be clamped to the bridge. Drilling into the bridge structure is not permitted unless engineering calculations have been carried out proving that the bridge structure will not be degraded, and approval is given by the relevant ARO responsible for that structure;
ii. If there are already fittings in place that can be used, these should be used in preference to attaching new fittings;
iii. The engineering structure of the existing fittings cannot be compromised; and
iv. The Contractor shall not proceed with such an attachment, unless it is approved by VicTrack as part of the design approval process;

7.3.11.4. Poles:

In some country areas, VicTrack still has open wire pole lines in operation. These poles are generally steel rail. VicTrack plans to remove these pole lines so the Contractor shall not use any of these poles.

7.3.11.5. Stanchions supporting overhead rail traction conductors:

In the metropolitan areas, stanchions are used to support the overhead rail traction conductors, which operate at 1,500 Volts DC (high voltage). The stanchions also support electrolysis conductors and other high-voltage power distribution circuits. Accordingly, these stanchions are unsuitable for the attachment of telecommunications infrastructure.

7.3.11.6. Poles supporting overhead tramway traction conductors:

i. In the metropolitan areas, poles are used to support the overhead traction conductors, which operate at 600 Volts DC. The poles often also support power conductors and other non-tramway power distribution circuits. Tramway poles may be used for the attachment of telecommunications infrastructure with the approval of the VicTrack Project Manager AND Yarra Trams Electrical Overhead Department;
ii. The Contractor must undertake all engineering reviews necessary to ensure that VicTrack's existing structures, or parts thereof, which will be used by the Contractor as part of the Project, are suitable for their intended use. This includes sufficient space in existing conduits and trunking; and
iii. The Contractor should note that recovery of unused cables is VicTrack's responsibility and that programs to recover such cables are activated from time to time.

7.3.12. Troughing / Trunking Standards

The following standards apply to troughing to be used for a cable project:

Lids shall be in place throughout the entire length of metal trunking sections so that positioning of the lid shall overlap approximately two thirds of the troughing. This shall stagger the trough joint and the lid joint. The lids shall be secured with three 19 mm galvanised steel strappings (bandit or similar type fitting), one located approximately 100mm from each end and one in the centre;

i. The metal trunking shall be complete except where blisters or other cable exit systems are installed. Bent, dented or distorted sections resulting from previous impacts shall be considered suitable providing lids can be fitted. In some sections small gaps may result from damage to lids or trunking bodies;
ii. Trunking support posts shall generally be in place to support the trunking segments. Due to the age and the pre-existing condition of some VicTrack existing above ground trunking, it is not expected that each post or other support system shall be in place in “as constructed” condition. Sections not fully supported due to missing, sunken or damaged supports shall be considered suitable for use provided:

    a. Trunking is intact, continuous and stable and is unlikely to be subject to further damage;
    b. Trunking lids can be installed without excessive bending or distortion; the smallest radius bend shall be not less than the manufacturer’s recommended minimum radius to cater for the largest cable to be laid;
    c. No communication cable is under any strain or subject to laying on or around sharp edges;
    d. There is no risk of total collapse of the trunking section;
    e. No occupational health and public safety risks are presented by the trunking section; and
    f. Trunking leaning from the vertical position is acceptable, provided minimum clearances to rail, road vehicles, and pedestrians are maintained.

iii. Chipped lids or missing corners on concrete surface troughing are considered acceptable. However, the cableway should be clear of ballast and all lids should be capable of being installed without creating a safety hazard;
iv. When subduct is installed in existing trunking, all lids in the vicinity of locations where services enter or exit the trunking are to be removed to facilitate the installation;
v. In areas where VicTrack considers the trunking to be congested, and there are no redundant cables to be removed, then the existing trunking is not available for further use; and

7.3.13. Traction Sub/Tie Station compounds:

Special conditions are required when installing telecommunication conduits and other facilities in the grounds surrounding traction power substations and tie-stations. These areas have many hazards not generally found in the rail reserve at large. This includes high voltage DC cabling for the overhead traction power, electrolysis cabling, earth grids, and H.V. street power cables;

To ensure safety in these areas, the following specific conditions shall apply in these locations:

i. All trenches to be excavated using non-intrusive methods;

ii. All conduits to be at a depth between 350 mm and 450 mm below ground level measured to the top of the conduit;
iii. Passive transponders are to be installed at the same depth as the conduit at changes in direction, every ten metres on straight runs and the start and finish points;
iv. The conduit is to be covered by concrete pavers;
v. A white warning tape is to be laid above the concrete pavers;
vi. Minimum 150mm of existing substation surface to be laid over the trench to ground level;
vii. The depth and cover requirements are to be continued to the interface pit at the boundary of the substation area.; and
viii. Access and permission to work is to be obtained from the MTM Senior Substation Foreman.

7.4. Installation Works – Off Rail Corridor

i. When installing communications conduits off the rail corridor, for example in road reserves, the Contractor must ensure that all installation methods and activities comply with the requirements of the authority that owns the road reserve. While the standards set out for the installation of external plant on the rail corridor should be followed, it is noted that in some cases, such as the depth of conduit, it may not be possible to comply with the rail corridor standards. Such instances are to be resolved and agreed with the VicTrack Project Manager;
ii. Where possible, VicTrack ID marker pins (stainless steel disc, stamped with ID information such as VICTRACK FIBRE OPTIC CABLE 1 800 619 111 and a direction arrow, with a stainless steel securing pin) are to be placed into kerbs , footpaths or roadways (see Figure 13);
iii. It is also noted that where works are being carried out to connect into the network of other carriers (especially Telstra), the standards of the other carriers are to be adhered to, in addition to VicTrack's standards; and
iv. The Contractor is responsible for all notifications and for obtaining permits for work on road reserves, these may be required from VicRoads and or the local municipal council depending on the owner of the road reserve.

7.5. Project Documentation

i. The Contractor must comply with the following record keeping procedures during the construction of the Project. The records are to be kept up to date during construction and supplied to the VicTrack Representative on request or as a schedule if agreed to in the contract process. They must include:

    a. A log showing the work locations and dates when work was carried out;
    b. The nature and amount of work carried out; and
    c. Contract staff and sub-contractors used at the specified location;

ii. Following the completion of the civil construction phase of the project, the contractor is to supply As-built drawings in Auto CAD format in compliance with VicTrack's technical specification – ***CD000_TS001_V01_R4 – VicTrack Telecommunications Cable Route Drawing*** Standards showing the cable route, civil construction method, location of pits, marker posts, termination locations and any other nominated events, and offset from the

nearest rail. Where available, VicTrack will supply a set of base drawings in Auto CAD format to facilitate the preparation of As-built drawings. The availability of the base drawings will be advised during the design phase;

iii. The Contractor shall also supply a spread sheet of GPS co-ordinates for all pits, termination points, marker posts, changes of direction and offset of the cable route to the nearest rail at 10 metre intervals (or otherwise as determined by the VicTrack Project Manager) along the cable route. If the trench is not straight between pits the Contractor is to provide sufficient GPS readings to enable subsequent discovery of the trench in all areas. Route drawings are also to be red-lined to indicate the area where the trench is not straight and an indicative sketch of the deviation. The datum required for the GPS data is the Map Grid of Australia 1994 (MGA94) Zone 54 or 55 with coordinates in Easting and Northing format. The GPS coordinates supplied shall be to 0.1-metre accuracy. The contractor must provide evidence of the accuracy of GPS coordinates provided; ***Contractor may use: TS-FM 094 Template for Asset GPS Data & TS-FM 099 DMS Drawings for Marker or Protection Posts***

iv. If the contract includes cable installation, then cable sheath metre readings are required at the centre of each through pit (if visible), the entry and exit of each loop and joint pit, and at each termination point. Manufacturer's batch numbers, drum numbers, etc.; and

v. If any of the route is outside rail land, then VicTrack will advise DBYG with the GPS route information supplied by the installer.

7.6. Route Marking

The Contractor is required to undertake route marking activities in accordance with the following requirements:

i. In all underground sections of the cable installation, an approved PVC marker tape is to be installed 300 + 50 mm below ground level, except where normal depth cannot be reached due to rock or other fixed obstacles;

ii. Where rock conditions preclude a trench depth of 650mm, the marker tape is to be installed halfway between the conduit and ground level;

iii. Where a section of the route has been bored, a stainless steel wire of minimum 3 mm diameter should be pulled back externally to the conduit. This should then be anchored in the pits in a similar manner to the marker tape trace wire. Bore pipe with embedded trace wire is also acceptable provided it is installed in accordance with the manufacturer's recommendations;

iv. The marker tape must be white, have a minimum width of 75mm and must be fitted with a trace wire (minimum 3mm stainless steel) to facilitate detection from above ground for cable location purposes. A sample is to be provided to VicTrack for approval prior to ordering and/or installation. Proposed alternative traceable marker tapes are also to be supplied to VicTrack for approval prior to ordering and/or installation;

v. The marker tape is to be placed directly above the location of the communications conduits;

vi. The trace wire must be brought into each pit a minimum of 500 mm and be secured to allow connection of tone generation equipment used for cable location purposes. Fittings to secure the trace wire in all pits are to be made of non-corrosive material;

vii. The tape must have the words "WARNING COMMUNICATIONS CABLES" (or similar) in letters at least 45mm high, inscribed at regular intervals (being not less than 2 metres) along the tape. A sample of the tape proposed to be used is to be provided to the VicTrack Project

Manager for approval prior to installation;

viii. Where it is necessary to join marker tape, the metal tracer wire must be joined with a stainless steel crimped connector to ensure continuity and resistance to corrosion. A twisted wire joint is not acceptable;

ix. Route marker posts must be placed directly adjacent to each change of direction, with at least one between each pit (except where the pits are either side of a track, road, gully or creek/river under bore where a marker post is to be installed both sides of these crossings) such that from any marker, the adjacent marker in either direction is readily visible from the surrounding vicinity of the immediate marker post, with a maximum spacing of 400 m in open country or 200 metres in closer settled or lightly timbered areas. In heavily timbered areas, it is not viable to place marker posts so close together so the placement will be as agreed with the VicTrack Project Manager. It is not required to install a marker post at a pit location as it is already evident where the cable route is situated;

x. Additional route markers are to be placed at each end of changed construction method, including at each end of significant changes in depth such as concrete enclosed conduits because of reduced depth;

xi. Route marker posts must not be installed directly over the cable route. They should be placed to the side of the cable trench and be located so that they are close (within 0.5m) to fences or fixed objects;

xii. Route marker posts should not obstruct pathways or vehicle access tracks or be likely to be hit or run over by maintenance vehicles. They must also be at least 4m from any rail;

Route marker posts are to be 50 mm or 89 mm galvanised iron water pipe with 800mm of the post concreted in the ground, and to protrude a minimum 800mm above ground and must be painted white. For maintenance purposes, a steel wedge footing may be used with maintenance stocks of 50mm pipe, but the new location must be within 0.5 metres of the original location. Where possible, geopolymer concrete is to be used to take advantage of the lower Portland Cement content and improve the environmental factor;

xiii. As shown in Figures 10 and 11, the marker post may be assembled from:

a. A post (E) (1600 mm high) made of steel and galvanised (to DMS Drawing RRL-G-YSG-DWG-1109 if 89mm pipe is used);
b. Alternative footing method is with the use of a wedge footing (A) (approximately 600mm high) made of steel and galvanised;
c. if the wedge fitting is used the post is 800 mm high which is held in the footing with a locking ring (C);
d. a triangular marker head (B) made from an aluminium extrusion (constructed to DMS Drawing RRL-G-YSG-DWG-1110 for 89 mm posts), to which is attached (with blind stainless steel or aluminium rivets) powder coated and screen printed cable warning marker plates (manufactured to DMS Drawing RRL-G-YSG-DWG-1111 for use with 89mm posts); and
e. and a triangular marker sign (D), (manufactured to DMS Drawing RRL-G-YSG-DWG-1112 for use with 89mm posts), which is riveted to the top of the marker plate and is stamped or legibly engraved with the cable details. As the marker post is galvanised, it does not need to be painted.

xiv. A sample of the marker post proposed to be used is to be provided to the VicTrack Project Manager for approval prior to ordering posts;

Figure 13. Marker Post components

Figure 14. Marker Post with wedge footing

xv. Route marker posts are to be fitted with a permanent cable warning sign, on at least two faces. If the route is dedicated to communications then the usual communications warning sign (Figure 12) shall be on the two faces of the triangular head facing the cable route. If the route is a CSR then those two faces shall each have the combined communications and signalling cables warning sign. ***Refer: TS-FM 099 DMS Drawings for Marker or Protection Posts***

xvi. The top marker plate shall contain legible details of the marker post ID, offset of the cable route from the post (to an accuracy of 0.1 metres), depth of the cables/conduits (to an accuracy of two decimal places where the conduits are less than one metre deep and one decimal place over one metre deep), GPS details of the marker post (if the top plate has a space for it, but it is not essential as these details are kept on a central database) and shall point towards the location of the cable route. The direction arrow/s at the point of the top plate closest to the trench shall indicate the status of the conduit/cable (straight, turning to indicate a change of direction such as going under a track or a road);

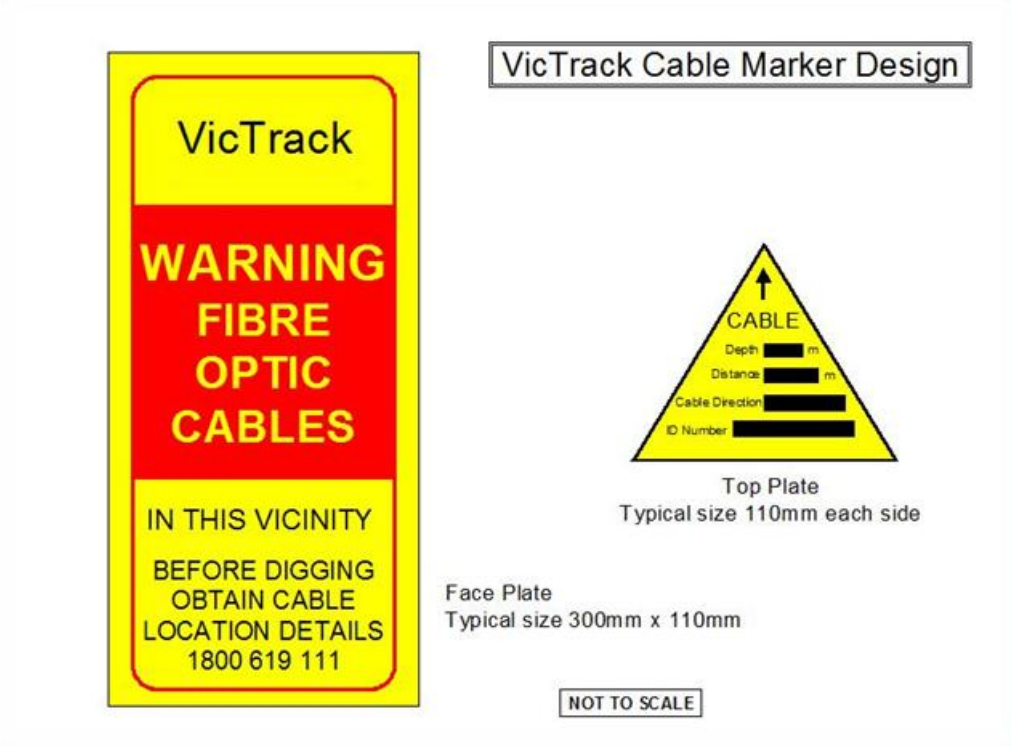


Figure 15. VicTrack warning signs

xvii. A sample of the warning signs currently used by VicTrack can be made available for inspection; and

xviii. The Contractor shall provide a sample of the proposed warning signs to the VicTrack Project Manager for approval, before ordering them; and

xix. Where normal route marker posts cannot be installed (car parks, footpaths, roadways, rail

platforms, etc). a ground level VicTrack ID marker pin (stainless steel disc with ID information such as VICTRACK FIBRE OPTIC CABLE 1 800 619 111 and a direction arrow with a stainless steel securing pin) can be used. (see Figure 13);

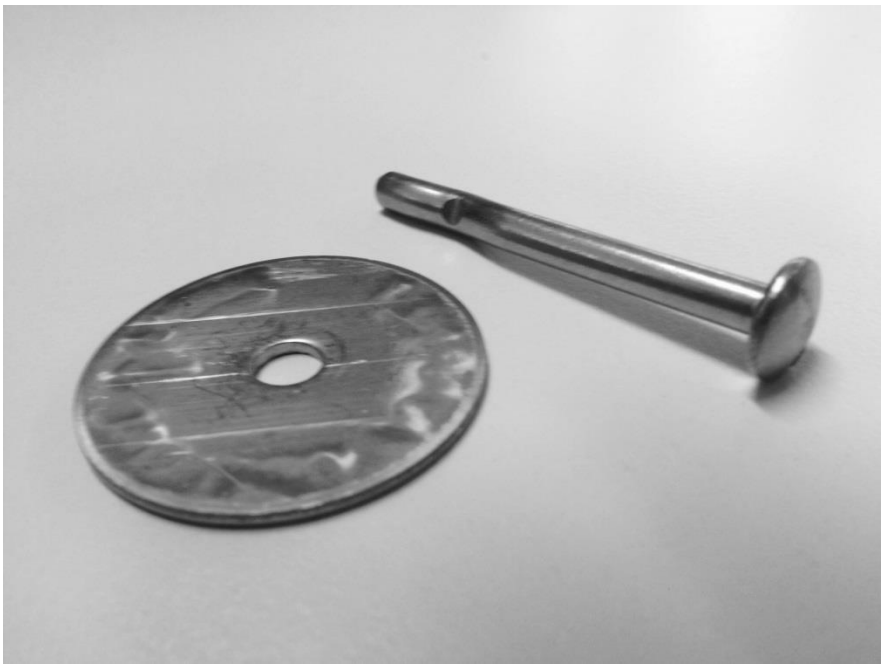


Figure 16. Figure 13 – Cable Route Marker Pin

7.7. Cable Pit Protection

i. Additional protection is required for each pit in the form of two steel posts or bollards, generally installed diagonally opposite each other at each end of the pit, approximately 2 metres apart. This will deter vehicles driving over the pits, and enable pits to be located when grass or undergrowth in the reserve is high. Bollards shall be installed no closer than 300mm from the edge of the pit and shall not force vehicles into the three metre danger zone;

ii. These steel posts are to be a 50 mm or 89 mm (preferred) galvanized iron water pipe fitted with a cap with 800mm of the pipe embedded in the ground in a cement dry mixture and then wetted, and to protrude a minimum 800mm above ground;

iii. The posts are to be painted in high visibility paint – yellow for pits that contain a joint, and white for all other pits;

iv. Note that where bollards are likely to be subjected to persistent vehicle damage, VicTrack may request the use of bollards made from sections of rail. Also, note that bollards may not be required in certain circumstances, such as in footpaths or locations adjacent to buildings that are not trafficable. The VicTrack Project Manager will determine the bollard arrangements at these types of sites; and

v. Projects requiring installation of a large number of route marker and/or pit protection posts may use premixed normal-class concrete N20, or 20MPa geopolymer concrete in

accordance with VicRoads Section 703, to embed the post in the ground. Use of geopolymer concrete shall be prioritised where possible to take advantage of its sustainability credentials including low embodied carbon.

7.8. Hold Points

VicTrack may request hold points be placed on project works to ensure required standards are met. The list of hold points below is not exhaustive, and other hold points may be required on a project-by-project basis. The onus will be on the Contractor to contact the VicTrack Project Manager before commencing to determine hold point requirements and notification lead times. If the VicTrack representative cannot attend Hold Point inspections at a reasonable time, the VicTrack Project Manager may deem that detailed photographs are sufficient in order not to delay build schedules;

i. Hold Point 1 - Trench Profile / Conduit Configuration. VicTrack to witness open trenches with conduits laid before backfilling. This will verify that the correct class/sizes of conduit have been installed, the correct conduit labelling is present, the conduits have been jointed correctly and the correct depth of cover has been achieved as per the approved route design. This is a witness point so VicTrack must be contacted with at least 24 hours' notice to inspect progress;

ii. Hold Point 2 – 1st Layer Backfilling. VicTrack will then witness the first layer of backfilling of trenches with clean fill material, compacted to minimum 50 mm above the top of the conduits;

Note1: If a variation to standards, such as depth, is required, the contractor must send a formal request to VicTrack, before commencing works in the section requiring non-standard installation. Where unforeseen issues are identified during construction works, the contractor must contact the relevant VicTrack representative immediately to seek direction on how to proceed; and

Note 2: If the conduits are covered prior to the Hold Point 1 inspection, and VicTrack believes that the work may not have met specifications, VicTrack reserves the right to direct that the areas that have not been checked be exposed for inspection;

iii. Hold Point 3 – Backfill to the marker tape level with material less than 30mm in size. Marker Tape Placement. This hold point is to view that the backfilling of the trench has been done in 150 mm layers and properly compacted, the correct marker tape has been placed at the correct depth, and the trace wire is continuous with any joins having been done with stainless steel crimp connectors. The VicTrack representative is also to ensure that the trenching is straight between pits by visual inspection. If it is not, the route drawings are to be red-lined to appropriately show the route deviation and extra GPS readings may also be requested so the exact route can be found in future years;

iv. Hold Point 4 - Acceptance: Final backfill must not contain any material >30mm. Upon completion of pit and pipe work, VicTrack will complete formal acceptance of the conduit route before the commencement of cable installation works. Civil deployment may be broken down into separable portions of delivery depending on size of the project;

Note 3: Upon acceptance of the conduits into the VicTrack network, no further civil works

are to be carried out within 5 metres of the accepted pit and pipe installations without advice to and subsequent approval (PTW) from VicTrack, as the conduit becomes an operational facility. The Network Protection Plan, TS-SP-015 comes into effect. If fibre is installed (by VicTrack or by the contractor) and subsequently damaged by the civil contractor, the replacement costs will be borne by the contractor responsible for the damage;

v. Fibre is to be replaced from joint to joint as per design; and
vi. All repairs may be subject to hold points, in addition to the originally agreed points.

7.9. Project Completion/Acceptance:

i. At the completion of the project, or at agreed stages, inspections are to be carried out using the relevant ITP checklists. Any defects are to be rectified as soon as is practicable;

ITP Checklists are as follows:

- TS-FM 065 Field Audit & Inspection Form – Design;
- TS-FM 066 Field Audit & Inspection Form - Pre Construction Activities;
- TS-FM 067 Field Audit & Inspection Form - Trenches & Conduits;
- TS-FM 068 Field Audit & Inspection Form - ULX and URX Bores;
- TS-FM 069 Field Audit & Inspection Form – Pits;
- TS-FM 070 Field Audit & Inspection Form - Route Marker & Pit Protection Posts;
- TS-FM 071 Field Audit & Inspection Form - Existing Infrastructure Conduits;
- TS-FM 072 Field Audit & Inspection Form - Existing Infrastructure GST & GLT;
- TS-FM 073 Field Audit & Inspection Form - Site Works;
- TS-FM 074 Field Audit & Inspection Form - AS-Installed Documentation;
- TS-FM 075 Field Audit & Inspection Form - Enabling Works;
- TS-FM 076 Field Audit & Inspection Form - Permits to Work;
- TS-FM 089 Field Audit & Inspection Form - Fibre Optic Cables (Installs);
- TS-FM 090 Field Audit & Inspection Form - Fibre Optic Cables (Testing);
- TS-FM 091 Field Audit & Inspection Form - Copper Cables (Installs);
- TS-FM 092 Field Audit & Inspection Form - Copper Cables (Testing);
- TS-FM 088 Field Audit & Inspection Form - Quality Plan;
- TS-FM 087 Field Audit & Inspection Form - Trenching & Boring;
- TS-FM 086 Field Audit & Inspection Form - New Conduit;
- TS-FM 085 Field Audit & Inspection Form - Route Marking;
- TS-FM 084 Field Audit & Inspection Form - New Cable;
- TS-FM 083 Field Audit & Inspection Form - Testing & Attenuation Targets;
- TS-FM 082 Field Audit & Inspection Form - Network Records;
- TS-FM 081 Field Audit & Inspection Form - Compliance with Standards and Specifications;
- TS-FM 080 Field Audit & Inspection Form - Maintenance Agreement Requirements.

ii. A Certificate of Practical Completion will be provided by VicTrack to indicate that the infrastructure, or agreed portions thereof, has been constructed correctly as per IFC/AFC route plans, approved route design and any approved variations; and
iii. A Certificate of Final Completion will be provided by VicTrack after twelve months has elapsed from the Certificate of Practical Completion and all known defects and subsidence

issues have been rectified.

7.10. Asbestos

i. In the event that suspected asbestos is identified during works conducted by VicTrack personnel or contractors, the material will be managed in accordance with Section 15.3 of the ***VT-SP-032 VicTrack Asbestos (and Hazardous Materials) Management Plan*** –. An extract of VT-SP-032 (Section 15) can be found in the appendix of this document;
ii. The use of asbestos products in new telecommunication infrastructure is prohibited.

8. INSTALLATION OF FIBRE OPTIC CABLES

When installing Fibre Optic cables, the Contractor must ensure that all installation methods and activities comply with the following requirements.

8.1. Cable Requirements

8.1.1. General Cable Requirements

i. Unless otherwise specified, the cable to be supplied and installed is to be constructed using 9/125 micron single mode fibre optic (SMOF), in a loose tube configuration, suitable for use with transmission systems operating in the 1300/1500 and 1600 nm bands and, unless otherwise specified, have a blue-coloured outer sheath, dry core, and compliant with ***ITU-T Specification G.652 (D);***
ii. The tube and fibre configuration will be specified by VicTrack;
iii. All cable and equipment used in relation to the provision of the Cable must meet standards as set out in Australian Standard ***AS/ACIF S008, "Requirements for authorised cabling products***" (previously ACA Technical Specification 008);
iv. Unless otherwise specified, Fibre Optic cables installed on VicTrack property shall be constructed entirely of non-conductive materials. Additional material constraints are applicable to tunnel and underground station installations as detailed in Section 6.1.2;
v. The Cable Running Plan will minimise the number of joints required between terminations. Generally, a cable drum will contain at least 5 kilometres of cable. At least three 30 metre loops of cable must be provided between joints;
vi. Unless otherwise specified, the cable shall be indelibly labelled as "VicTrack" at intervals equal to or less than two metres;
vii. Running distance in metres to be indelibly printed on the outer sheath at one metre intervals for each drum of cable to aid in recording as-installed details for future maintenance;
viii. The construction and colour coding of the fibres and tubes is to conform to the current version of applicable AS/ACIF Standards;
ix. The smallest FOC installed in external plant should to be 48 fibre based on 12 fibre per tube, and new backbone FOCs are to have a minimum of 144 fibres;
x. Where fibre cables are to be installed in existing trunking, the FOC cable must be rodent resistant. Where a short section of existing trunking is to be utilised, for example over a culvert, in the middle of a conduit run, then the conduit may be continued on through the existing trunking. This eliminates the need to use rodent-resistant cable in the existing trunking. In these circumstances, it may be more appropriate to use 35 mm conduit. Any such areas shall be identified on preliminary route and as-built drawings;
xi. Riser FOC must not be used for external plant installations;
xii. Unless otherwise approved, all communications cables shall be laid so that the outer end of the cable on each drum is at the Melbourne, or UP, end of the route;
xiii. Copies of all cable manufacturers' test sheets are to be provided to the VicTrack Representative;
xiv. The cable installer is to provide an Acceptance Testing Plan to the VicTrack Representative for approval prior to any testing being carried out.

8.1.2. Layout and Labelling of FOC Patch Panels

Optical Fibre cable patch panels are to be labelled in a manner that makes it easy to identify the appropriate fibre.

The labels consist of three parts:

a The identification of the patch panel by means of an 'FT' number, such as FT456. This number is typically allocated to a rack, which may contain one or more patch panels. VicTrack allocates the FT number. The FT number must be clearly displayed on the patch panels.

b The identification of the cable terminated on the patch panel by means of a letter, such as 'A' for the first cable, 'B' for the second cable and so on. VicTrack allocates the cable letter. The cable letter must be clearly displayed on the patch panel.

c The identification of the individual fibres. This is done sequentially, ***with the fibre number in the cable corresponding with its position on the patch panel***. Where a fibre is spliced to another fibre behind the patch panel, and thus does not appear on the patch panel, then a blank plate shall be inserted in lieu of a connector on the patch panel. The identification of the fibres must be clearly displayed on the patch panel, and must indicate unambiguously the identity of the fibres.

The following drawings show typical patch panel arrangements. Where the proposed patch panel layout is not readily covered by the following examples, it should be discussed with VicTrack staff. The numbers above each connector are for the purposes of illustration only and do not imply that individual connectors have to be labelled.

8.1.3. Layout and Labelling of FOC cables, Joints and Patch leads

a. Fibre Optic Cables:

- Ensure all VicTrack FOCs are labelled at both ends, including loops, with a legible label identifying the cable number and fibre capacity;

e.g.

F31238
24 fibres
FT2092 : FT6612-A

b. Fibre Optic Enclosures (Joints):

- Ensure each joint has a dedicated tag with its identification;

e.g.

FT6651

c. Fibre Optic Patch Leads:

- Ensure each fibre patch lead has a printed thermal labelling strip at both ends, clearly identifying the Service ID and the patching locations of both ends;

e.g.

M03342
FT2500-A, 09-10 : SSP-JEX4200-001, 0/0/18

d. Fibre Termination Panels:

- Ensure all new FTPs are legibly labelled on a printed thermal labelling strip, identifying the FT number and alphabet;

e.g. FT6612-A

- Ensure the last port at each of the four corners of every sub-panel is labelled.

e. Equipment / Communication Rooms and Racks / Cabinets:

- Room and rack designation labels:
  - At least 12mm height, as measured on the lettering's vertical axis;
  - Full capitals;
  - White lettering on black label strip;
  - Single line of text on label strip;
  - Label to be centred on the door, at eye level, approximately 1500mm AFFL;
  - Small labelling tags for patch leads and patch cords are not to be used for this.

e.g. **WLD RS001 ER001 RK-A01**

8.1.4. Tunnel and Underground Station Cable Requirements

i. For the safety of passengers and staff, all cabling installed in rail tunnels or at underground stations shall be manufactured from fire retardant materials and shall not support combustion or give off products that are hazardous to human health;

ii. The outer jacket of all cables, conduits and fittings used in this situation SHALL conform to the following requirements in a fire situation:

a. Be of high fire resistance;
b. Be self-extinguishing;
c. Emit ZERO halogen gases;
d. Have ZERO corrosive emissions.

iii. All materials used in the construction of the cables (including the insulation material used on the inner cores, strength members, fillers, water proofing compounds, conduits) and cable fittings shall emit ZERO Halogen gases in a fire situation;
iv. All mounting brackets, saddles, and straps used to support cables in rail tunnels and underground stations shall be made of stainless steel. Samples of the mounting hardware shall be supplied to the relevant VicTrack Project Manager, for approval before installation. Installation shall not proceed until such approval is granted;
v. The Contractor must supply data sheets and certified test results from a NATA accredited test centre(s) on the conformity of all cables where they are to be installed in underground stations or rail tunnels. Installation shall not commence until the relevant VicTrack Project Manager endorses these certificates;
vi. The contractor is to consult the VicTrack External Plant Manager in relation to the design of the new cable route methodology through Tunnels and underground station build.

8.1.5. Cables for aerial installation

Fibre Optic Cables for aerial installation in the vicinity of power cables, for example on tramway poles, shall be of an All Dielectric Self Supporting (ADSS) type and, unless otherwise specified, have a grey coloured sheath. This cable is a non-metallic, non-conductive cable designed to support its own weight under certain specified conditions, particularly span length. Manufacturer's specifications, particularly the maximum span length, are not to be exceeded. For details on aerial installation on tramway poles, refer to the current version of TS-SP-066 - Attachments to Tram Poles.

8.1.6. Cables installed for use by third parties

The outer sheath of a cable being installed by a third party shall include a marking that enables the cable to be unambiguously identified as a third party cable. The preferred approach is for the cable to be clearly labelled with the third party's name. The cable may also be a distinctive colour or may have a continuous colour stripe.

8.1.7. Laser Warning Label

Wherever the FOC is accessible in pits or at terminations, the cable or termination panels must be labelled with warning labels indicating that the cable may contain laser light sources that may be hazardous to health, in accordance with ACIF Regulations.

8.2. Installation Requirements - Conduit

i. The cable running plan or table will indicate where immediate splice joints and termination locations are required, as well as possible future splice joints and termination locations. At the immediate termination locations, the "cable running plan" will indicate whether all fibres

in the cable are to be terminated or a “tail” cable is to be run from an adjacent joint with only some of the fibres terminated. The terminating cable should include at least fifteen (15) metres of cable coiled up in the pit prior to the entry to the termination rack. At least one cable loop is to be left, and preferably two cable loops, between splice joints or between a splice joint and a termination panel. Loops are also to be left at one side of a road or rail track crossing. It is recommended to have a loop every 200 m - 500 m, depending on surroundings;

ii. Where a loop is to be left, the loop must be a minimum of 30m. At a cable end, the loop must be a minimum of 20 m. Coiling must be performed in accordance with the manufacturer’s specifications;

iii. Once approved, no deviations from the “cable running plan” are permitted without the approval of the relevant VicTrack Project Manager. This includes the number and location of splice joints and terminations;

iv. The Cable Manufacturer’s specifications relating to bending radius and hauling tension are to be strictly adhered to;

v. All FOC cable to be installed in existing trunking (GST) or surface troughing (GLT) is to be rodent resistant and installed in PN 12.5 (SDR 13.6) sub-duct or short sections of solid 50mm ID conduit;

vi. To enable VicTrack’s Service Records Management Systems to record VicTrack’s transmission network and services, the Contractor is required to ensure that each termination panel, joint and cable is labelled. Cables are to be labelled at each end. VicTrack will supply a list of locations and the information for these labels to the Contractor after the route design is approved. The Contractor is to procure and install these labels during construction. Sample labels are to be provided to the VicTrack Project Manager for approval before ordering these items;

vii. At all points of access to the FOC, including pits, equipment rooms and patch panels, the cable shall be fitted with permanent indelible labels warning that the attached is an FOC and there may be danger of laser light in the cable;

viii. The contractor is responsible for security of the cables installed until handover, and the contractor will meet any costs associated with theft or damage caused by vandalism, or vermin;

ix. Where existing VicTrack infrastructure is being used, for example above ground trunking surface troughing or bridges, the Contractor must undertake all engineering reviews necessary to ensure that VicTrack’s existing structures, or parts thereof, which will be used by the Contractor, are suitable for their intended use ;

x. After installation of cable in a conduit or sub duct, the conduit or sub duct is to be sealed with an appropriate Jackmoon conduit sealing unit and an appropriate Jackmoon Bushing Sleeve Adapter to prevent rodent entry, or a T-Dux sealing wrap.

8.3. Installation Requirements - Aerial

i. All aerial installations are to comply with the Electricity Safety (Network Assets) Regulations 1999 (S.R. No. 141/1999) from the Office of the Electrical Inspector (Victoria) and VicTrack’s TS-SP-066 – Attachments to Tram Poles;

ii. Specialised pole fittings and framing methods specifically designed for use with ADSS FOC cables must be used to avoid stressing or damaging the cable and the optical fibres within the cable;

iii. Staff working on this type of construction where the point of attachment is more than 500mm from low voltage conductors (less than 1000 Volts) and where they will not encroach within 500mm of the low voltage conductors must have completed a power awareness training course and be accredited by the organisation responsible for the maintenance of the poles and services;
iv. Staff working on this type of construction where the point of attachment is less than 500mm from low voltage conductors (less than 1000 Volts) and where they will encroach within 500 mm of the low voltage conductors must have the following qualifications:
v. A Grade electrical linesman; and
vi. Be authorised by the organisation responsible for the maintenance of the poles and services to carry out this work;
vii. Note that individual organisations responsible for the maintenance of the poles and services may have additional requirements. It is the contractor's responsibility to determine these requirements and to ensure full compliance with them;
viii. A Yarra Trams "Permit To Work" is to be obtained from Yarra Trams Carlton Control Centre PRIOR to any construction work on tram poles;
ix. Spiral dampers must be fitted to spans greater than 50 m; and
x. A detailed Route Survey table, which identifies each pole and the method of attachment of the cable to each pole, is to be approved by the VicTrack Project Manager and the relevant maintenance organisation prior to the commencement of any works (***Refer: TS-FM 102 Aerial Design Route Survey Field Sheet)***.

8.4. Direct Burial of Cable

i. Direct burial of cable for telecommunications purposes is not permitted, unless permission to do so is granted by the Manager, Technology and Strategic Planning, Telecommunications, VicTrack;
ii. The direct ploughing of cable is not to be used in urban areas. In non-urban areas, it may be used only if approved by the relevant VicTrack Project Manager;
iii. The cable is to be installed only by equipment capable of zero tension installation. The contractor will be required to produce current certification of the equipment used for cable installation;
iv. The plough shall place the cable at a minimum depth of 900mm and incorporate a chute that automatically installs the standard VicTrack plastic marker tape at a minimum depth of 300mm above buried plant. In addition to the locatable tape, transponders are to be placed at all changes of direction, and details marked on the as-built drawings;
v. The route will be pre-ripped prior to the cable being ploughed. Where multiple rips are required due to rocky terrain, the last rip will always be in the same direction as the cable passing;
vi. In areas where the ripping indicates the presence of rock, the use of 32mm HDPE split duct over the cable is required. The VicTrack site representative, where possible, will assist in advising the contractor on the use of this product. However, it is the contractor's responsibility to deliver to VicTrack a trouble-free cable installed to meet manufacturer and design specifications;
vii. The cable used shall have a "Hardened Sheath", and the specification of the cable to be used needs to be approved by VicTrack before purchase and installation.

8.5. Optical Fibre Cable Details

8.5.1. General Details:

Copies of all manufacturers' factory test sheets are to be supplied to the VicTrack Project Manager within one week of the Contractor receiving them from the manufacturer and prior to the cable installation works. These test sheets shall include, at a minimum, the following information:

- Drum Number;
- Cable ID Number;
- Ordered Length;
- Actual Length;
- Length Marking at Outer End (m);
- Length Marking at Inner End (m);
- Outer End Cable Diameter (mm); and
- Inner End Cable Diameter (mm).
- Records of drum details corresponding to physical installation locations are to be kept and provided to the VicTrack Project Manager to enable comparison of factory testing and as-installed testing.
- Cable meterage markings are to be documented for every cable installation in the following manner:
- Start meterage of each cable;
- End meterage of each cable;
- At through pits (no coil of cable) one cable meterage;
- At pits where coils are located – entry and exit meterages; and
- At pits where joints are located – entry and exit meterages as well as the end of cable meterage.
- Note that where a cable is carried through a pit in conduit, for example in a signalling pit, it is not necessary to provide a cable meterage. At the Acceptance Testing of any segment of the Cable, the Contractor must supply marked-up route plans of the segment.

8.5.2. Joints and Terminations

i. Details of arrangements for cable loops associated with joints and terminations are provided in Section 8.2.6 - Pits – Size and Use; and
ii. All fibre splicing must be fusion splicing.

8.5.3. Joints

Optical splice closures are also commonly referred to as splice joints or joints, and will henceforth be referred to as joints;

Where connections are made to a backbone cable for the purposes of providing services or for a 3rd party connection, or access, a demarcation joint must be provided. For further details, please refer to VicTrack ***TS-ST-028- External Fibre Design***:

i. Joint enclosures in pits must be secured to the side of the pit in such a way that there is no strain on any cables with the non-cable end of the joint as close as possible to the end of the pit;
ii. Joints have to be environmentally sealed with pressure relief valve; Unless otherwise specified, all fibres are to be cut and spliced in joints to facilitate access to any of the fibres in the future;
iii. Splice joints are to be assembled using only the components supplied by the manufacturer of the joint assembly. This particularly applies to the splice trays included in the joint enclosure and the heat shrink tubing used to seal the cables at the base of the joint;
iv. Joints must have dedicated cable ports for at least 6 FOCs;
v. Joints should not have gel-filled ports. Cable ports are to support heat-shrink sealing;
vi. Joints must be capable of holding at least 144 splices in dedicated splice holders;
vii. Joints must have facility to attach an identifier label;
viii. Joints are to be designed with provisions for mounting to poles and side walls of manholes;
ix. Transport tubes (for fibres) between splice trays are not allowed;
x. Fibre patching within a joint is not allowed. Only fusion splicing is allowed;
xi. The joint must be able to support a customer-connection fibre network infrastructure; in other words, the joint must be able to support entire tubes of fibres that are not butt-spliced one-to-one. The joint must be able to support easily the random splicing of numerous fibres of different tubes and cables;
xii. Joints must be assembled using only the components supplied by the manufacturer of the joint assembly; particularly splice trays and heat shrink tubing; and
xiii. Joint to be mounted in VicTrack pits
xiv. Old joints and pits are to be upgraded progressively through new projects to meet all current network standards.

8.5.4. Fibre terminations

i. Unless otherwise specified, any outdoor cabinets to be provided must be constructed of stainless steel, sealed to IPX6 in accordance with AS1939, and supplied and installed by the Contractor;
ii. All enclosures shall provide double insulation from internal terminations to 240 V rms grade in accordance with AS/NZS 3260;
iii. All FOCs within a building or structure, or entering or leaving the building, must be fully terminated, and presented on SC/APC with through- connectors, and dust caps for every termination;
iv. For internal sites with an expected fibre count capacity of up to 144 fibres to be terminated, a standalone Small Optical Distribution Frame (SODF) with a 300 mm width by 300 mm depth footprint and 2200 mm height is to be used. A Fibre Capacity Matrix is being prepared;
v. For internal sites with an expected fibre count greater than 144 fibres to be terminated, a standalone dedicated 19” optical distribution frame or rack is to be supplied and installed, capable of holding up to 45 RU of usable Rack space, with a maximum footprint of 1200 mm(W) x 400 mm(D). Note that expansion may be provided by similar racking positioned back to back;
vi. A 1RU cable organiser tray should be provided below each 6RU FTP shelving for internal rack fibre distribution;
vii. Unless otherwise specified, these frames, racks and FTPs are to be provided and installed

by the Contractor; and

viii. All termination panels are to be fitted with labels supplied by VicTrack.

8.6. Testing

Testing of completed cable installations shall use the following equipment:

i. Light Source and Light Meter - this equipment will measure the insertion loss only and will confirm that there are no fibre transpositions;
ii. Optical Time Domain Reflectometer (OTDR) - this equipment will measure all parameters required for acceptance testing (splice loss, insertion loss, reflections, connector losses and reflections and end-to-end losses;
iii. The Contractor must also supply a correlation list to identify where particular cable drums were used, to enable test comparisons to be made;
iv. The FOC shall be terminated onto the Fibre Optic patch panels at each site before any tests are carried out. Where the cable, or a number of the fibres in the cable, is not being terminated on a patch panel, then bare end testing is required. Loss measurements shall be made for each fibre in each section of the cable, together with an overall measurement for each corresponding fibre (including the patch leads) over the full length of the installed cable route unless advised otherwise by the VicTrack Project Manager in writing. Tests are also required to ensure that there are no crossed fibres in the complete fibre run;
v. After cable lengths have been laid, all fibres in each separate cable length are to be tested with an OTDR and the electronic results are to be provided to VicTrack. The results are to include the traces for each fibre and a table showing the individual splice losses and the average two-way splice loss for each fibre. The optical fibre test results shall be supplied to a format compatible with NetTest NetWorks and TraceView software. All test results will become the property of VicTrack; and
vi. Any noticeable reflective events in the cable lengths shall be advised immediately to the VicTrack Project Manager. Where joints are found to have unacceptable losses, the Contractor shall rectify the situation at their own expense. Please refer to 9.8 Attenuation Targets for Splices.

8.7. Minimum fibre tests required

The following information is the minimum to be provided to VicTrack, in soft format, as the result of the fibre Acceptance Testing for each cable segments.

Cables to be tested as single lengths, and where possible as cable runs, i.e. through pre-spliced joints.

Cables shall be tested before and after hauling.

VicTrack may alter these requirements by submitting a change request to the Contractor, or as part of the project specifications.

- Project title;
- Optical Fibre cable segment (from and to);

- Optical Fibre cable route length in metres;
- Optical Fibre cable optical length in metres;
- OTDR details including serial number and date of last calibration;
- Light source details including serial number;
- Power meter details including serial number and date of last calibration;
- Operator name at each end of the segment;
- Test wavelengths;(1310, 1550, 1610 nm);
- Fibre attenuation coefficient (dB/km);
- Number of splices in the test fibre including termination splices in multiple cable runs;
- Number of optical through connectors in circuit;
- Tube number;
- Fibre number being tested;
- Transmitted power, received power and calculated loss from both directions;
- Calculated two way loss average insertion loss;
- Pass/fail indication; and
- Completed cable attenuation in dB/km.

8.8. Attenuation Targets for Splices

The following are the attenuation targets for splicing and terminations for new FOC installations. VicTrack will not accept any new FOC installation until these targets are met.

i. The maximum two-way fibre splice loss in any joint/termination is to be 0.12dB @ 1310 nm;
ii. The average splice loss of all fibres in any joint/termination is to be 0.05dB or less @ 1310 nm;
iii. The attenuation of completed fibre cable installation must not exceed 0.5dB/Km at 1310 nm, 0.4dB/Km at 1550 nm and 1610nm;
iv. There must be no localised discontinuities greater than 0.1 dB at the 1310 nm wavelength; and
v. The attenuation targets for splicing and terminations for dedicated fibre services over the existing fibre network are set out in the specification and service description for that service.

9. INSTALLATION OF COPPER CONDUCTOR CABLES

When installing copper conductor cables, the Contractor must ensure that all installation methods and activities comply with the following requirements.

9.1. Cable Requirements

9.1.1. General Cable Requirements

Unless otherwise specified, the copper conductor cabling used by VicTrack and the franchised public transport rail businesses is as follows:

i. Local type cable in 10, 20, 30, 50, and 100 pair sizes;
ii. Filled type cable in 10, 20, 30, 50, and 100 pair sizes;
iii. Conductor diameters used are 0.40 mm, 0.64 mm and 0.9 mm;
iv. Category 5 (or higher) unshielded twisted pair (UTP) copper data cables;
v. All cable and equipment used in relation to the provision of the Cable must meet standards as set out in Australian Standard AS/ACIF S008, “Requirements for authorised cabling products” (previously ACA Technical Specification 008);
vi. All new cables now used in the VicTrack network are to be moisture barrier type.. These cables have a polyethylene sheath with a protective outer nylon jacket to provide mechanical protection to the cable during hauling operations and provide vermin protection after installation. The cable core is wrapped with a non-hygroscopic polyester tape, helically wrapped, (minimum overlap 20%) and then covered with an aluminium tape, 0.15 mm thick one-side copolymer coated, (aluminium side facing inwards), longitudinally laid with >10% overlap to act as the moisture barrier. The copolymer aluminium screen is longitudinally folded around the cable core and sealed at the overlap during extrusion of the polyethylene outer sheath. The cable is also flooded with a water resistant filling compound to prevent water migration along the cable in the case that the moisture barrier is damaged, allowing water ingress;
vii. The construction and colour coding of the wires is to conform to the current version of applicable AS/ACIF Standards; and
viii. Cables with conductor diameters of 0.4mm to 0.9mm must be jointed with appropriate crimp connectors such as Picabond. Proposed connectors are to be presented to VicTrack for approval prior to ordering or using such connectors. Conductors over 0.9mm must be twisted, soldered and sleeved.

9.1.2. Tunnel and Underground Station Cable Requirements

To be updated at next review period – 12/09/2018 JB

9.2. Installation Requirements - Conduit

i. All VicTrack network installations must conform to the requirements detailed in this Specification, TS-SP-013. As these installations are for the VicTrack network, TCA-1 forms are not required. Cable installations carried out beyond the VicTrack network boundaries (stations, car parks, workshops, depots, etc.) must conform to Australian Standard AS/ACIF

S009, “Installation requirements for customer cabling (Wiring Rules) (previously ACA Technical Specification 009), and Australian / New Zealand Standard AS 3000:2000 Electrical Installations (known as the Wiring Rules). Installations outside VicTrack’s network boundaries do require the provision of TCA-1 forms to VicTrack as evidence that the cabling that will connect to the VicTrack network has been installed in compliance with the required standards;

ii. A registered cabling provider, experienced in copper cable installations and holding a current ACMA Basic Cabling Licence, must provide on-site supervision of all trenching and cable laying operations. The registered cabling provider must not be away from the site of trenching or cable laying works for more than ten minutes and must be able to be contacted when away from the site. The registered cabling provider’s name and ACMA Licence Number are to be provided to the VicTrack Manager, Telecommunications Services or his delegated representative before commencing any work On completion of the project, the registered cabling provider must provide to VicTrack a suitable signed statement certifying that the installation complies with the relevant standards;

iii. Particular attention is to be paid by the registered cabling provider to the installation of copper communications cables near power cables. The minimum separation requirements set out in the relevant standards are to be strictly adhered to;

iv. Cable ends are to be promptly sealed with heat shrink cable caps to exclude moisture ingress;

v. When the cables are terminated, the metal screens (if present) and the aluminium moisture barrier screen are to be connected to the local earth (building earth in communications rooms). The screens are only to be connected to earth at one end of the cable, never at both ends as that will create induction loops and noise into the communications systems;

vi. The cable running plan will indicate where immediate joints and termination locations are required, as well as possible future joints and termination locations;

vii. Once approved, no deviations from the “cable running plan” are permitted without the approval of the VicTrack Project Manager. This includes the number and location of splice joints and terminations;

viii. The construction and performance of CAT 5 cabling must comply with that stated in the Australian and New Zealand Standard AS/NZS 3080. The colour coding of the wire pairs are to conform to the TIA/EIA 568A or 568B wiring scheme;

ix. To enable VicTrack’s Service Records system to record VicTrack’s transmission network and services, the Contractor is required to ensure that each termination panel, joint and cable section is labelled. VicTrack will supply the information for these labels and a list of locations to the Contractor after the route design is approved. The Contractor is to procure and install these labels during construction. Sample labels are to be provided to VicTrack for approval prior to ordering these items; and

x. The Contractor is responsible for security of the cables installed until handover, and the Contractor will meet any costs associated with theft or any damage caused by vandalism, or vermin.

9.3. Direct Burial of Copper Cables

Direct burial of copper conductor cable for telecommunications purposes is no longer permitted.

9.4. Testing

9.4.1. Testing of completed cable installations can be carried out using the following equipment:

i. Multimeter;
ii. Megger;
iii. Impedance Bridge;
iv. Time Domain Reflectometer (Echometer); and
v. Pair Identification equipment.

9.4.2. Tests to be performed are:

i. Loop resistance on all pairs;
ii. Insulation resistance on all pairs (A leg to ground, B leg to ground, and A leg to B leg);
iii. Echometer trace recorded on paper printout for 10% of pairs;
iv. Attenuation of all pairs at 1 KHz, 3 KHz, and 2 MHz against length of cable; and
v. Short circuits, open circuits, high resistance joints, incorrect termination sequence, and low insulation resistance faults are to be identified and repaired by the contractor.

9.4.3. All tests are to be performed as follows:

i. As a balanced pair (except Megger based insulation resistance tests);
ii. All tests may be performed from one end; except for the Echometer tests, which are to be performed for the same pairs from each end (termination to termination);
iii. Test results shall be neatly recorded and compared to manufacturer's specifications for cable performance;
iv. Discrepancies shall be brought to the attention of the relevant VicTrack Project Manager;
v. All test requirements and parameters shall be considered when evaluating test results;
vi. Site and installation files are to be updated to ensure traceability of information on system performance; and
vii. All records and system documentation is to be handed to the relevant VicTrack Project Manager at the completion of installation in a clean and orderly manner.

Appendix

Key Contacts - Rail Safety Environment

CONTROL CENTRES

Description of track	Access provider	Name of centre	Phone contact
Interstate mainlines from Spencer St to Serviceton and Wodonga	Australian Rail Track Corporation (ARTC)	ARTC Train Control	08 8217 4540
Country Victoria	V/Line	Centrol	03 9619 1077
Metropolitan	Metro Trains Melbourne	Metrol	03 9610 7206 / 05
	Metro Trains Melbourne	Electrol	03 9610 5222 / 5999

RAIL SAFETY ACCREDITATION

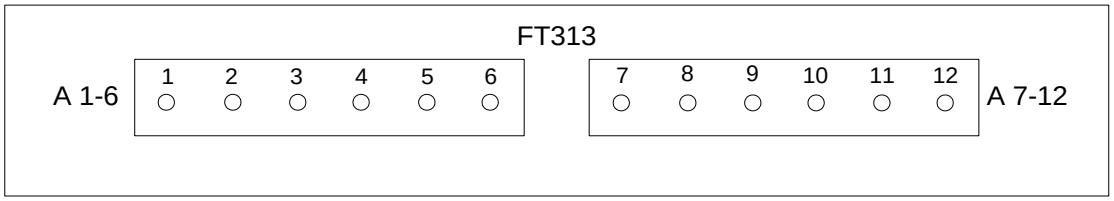
A number of private companies provide Rail Safety training, accreditation, and track protection services.

Note: To be updated at next review period. 12092018 JB

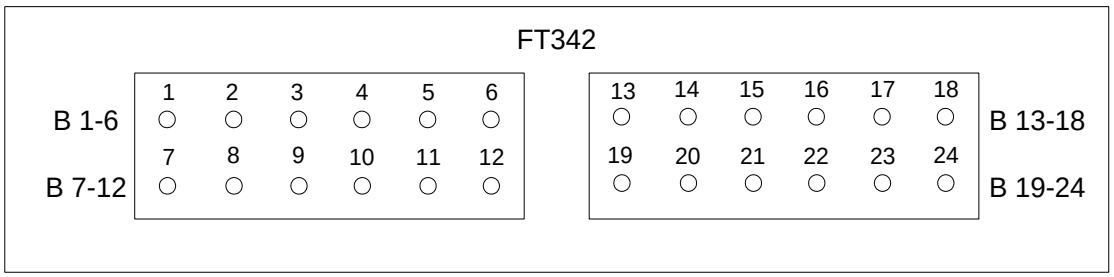
Typical telecommunications pit sizes

Type	Size: L x W x H (ID's)	Use
P5	580mm x 330mm x 549 mm	Plastic - Use to facilitate cable hauling only
P6	1365mm x 550mm x 670mm	Plastic - Cable loop and small joint
P8	1241mm x 431mm x 820mm	Plastic - Multiple cable loops and large joint
P9	1900mm x 432mm x 840mm	Plastic - Multiple cable loops and large joints
J8	1269mm x 479mm x 849mm	Concrete - Multiple cable loops and large joint
J9	1925mm x 460mm x 850mm	Concrete - Multiple cable loops and large joints
J10	1925mm x 460mm x 955mm	Concrete - Multiple cable loops and large joints
Trafficable Square Pit	900mm x 900mm x 1195mm or 1200mm x 1200mm x 1195mm	Concrete - Multiple cable loops and large joints
TYPE A Manhole	1600mm x 1250mm x 1060mm	Concrete - Multiple cable loops and large joints

Layout and Labelling of FOC Patch Panels

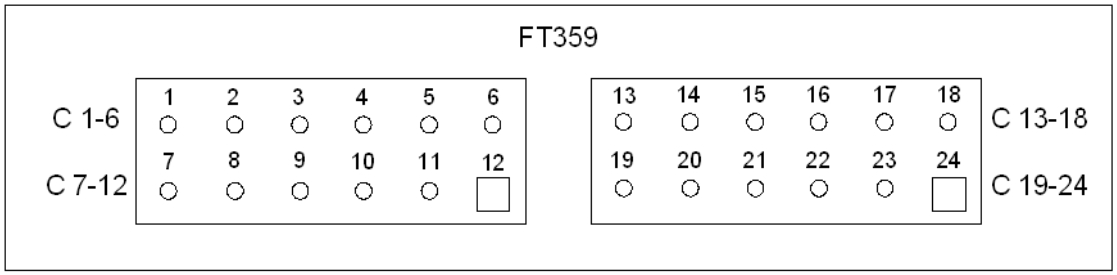


12 Fibre Cable

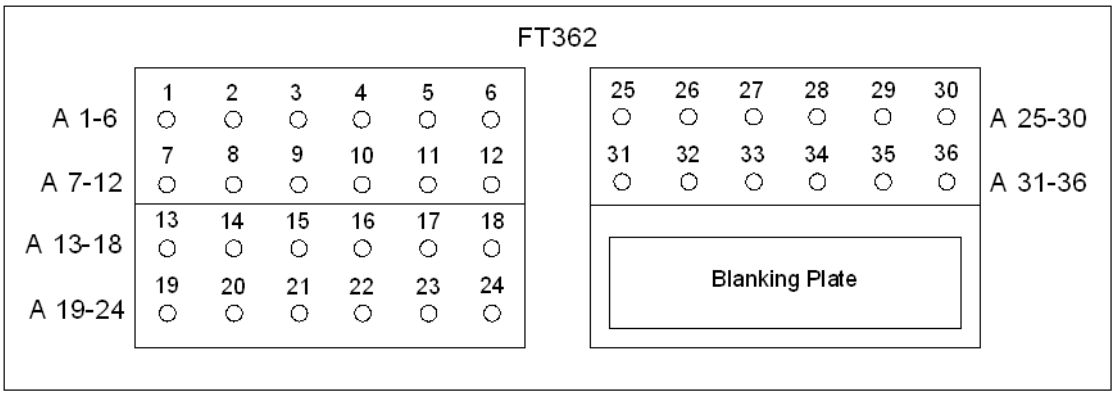


24 Fibre Cable

Note that ***each row*** of connectors must be labelled. It is not satisfactory to label the left hand side as B 1-12 and the right hand side as B 13-24.

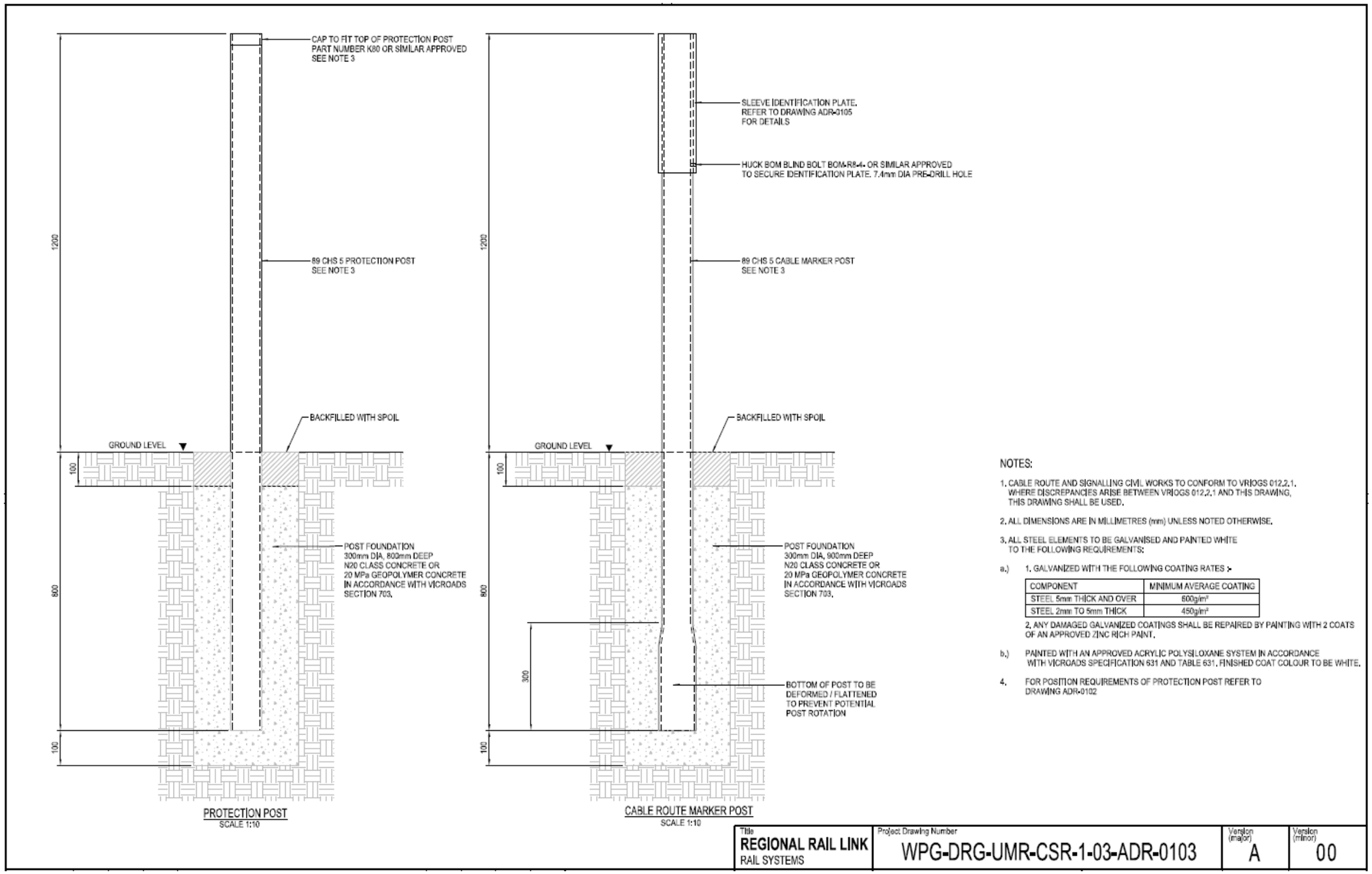


24 Fibre Cable with fibre 12 spliced to fibre 24 behind the panel.
Note blanking plates in these positions.

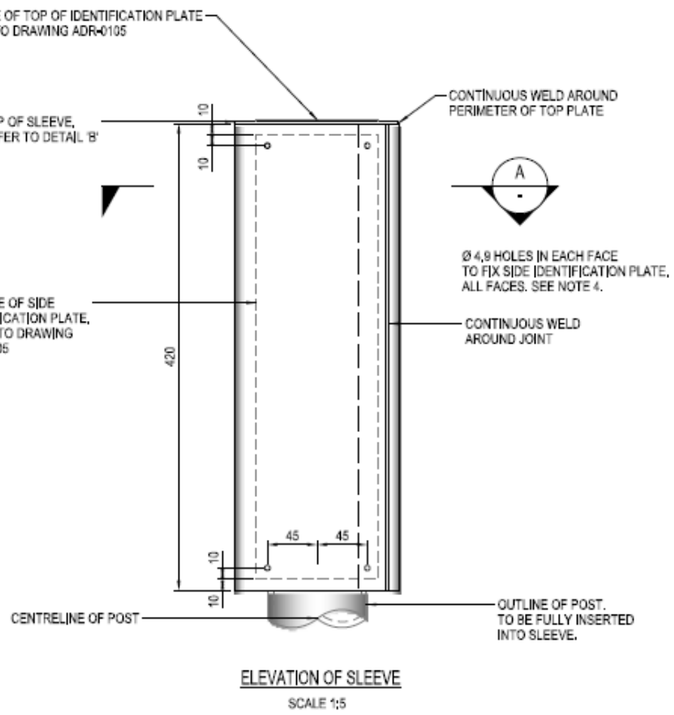


36 Fibre Cable

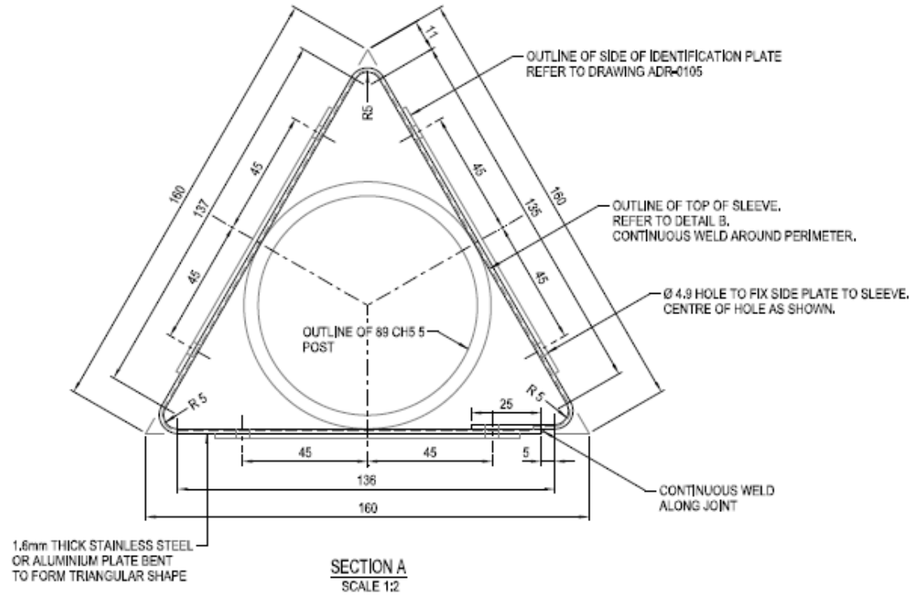
VICTRACK EQUIPMENT PROTECTION BOLLARD AND MARKER POST DETAILS



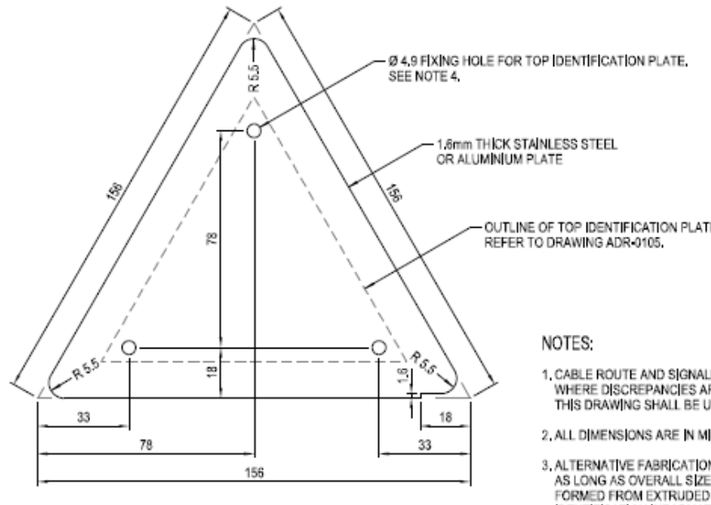
CABLE ROUTE MARKER POST SLEEVE DETAILS



ELEVATION OF SLEEVE
SCALE 1:5



SECTION A
SCALE 1:2



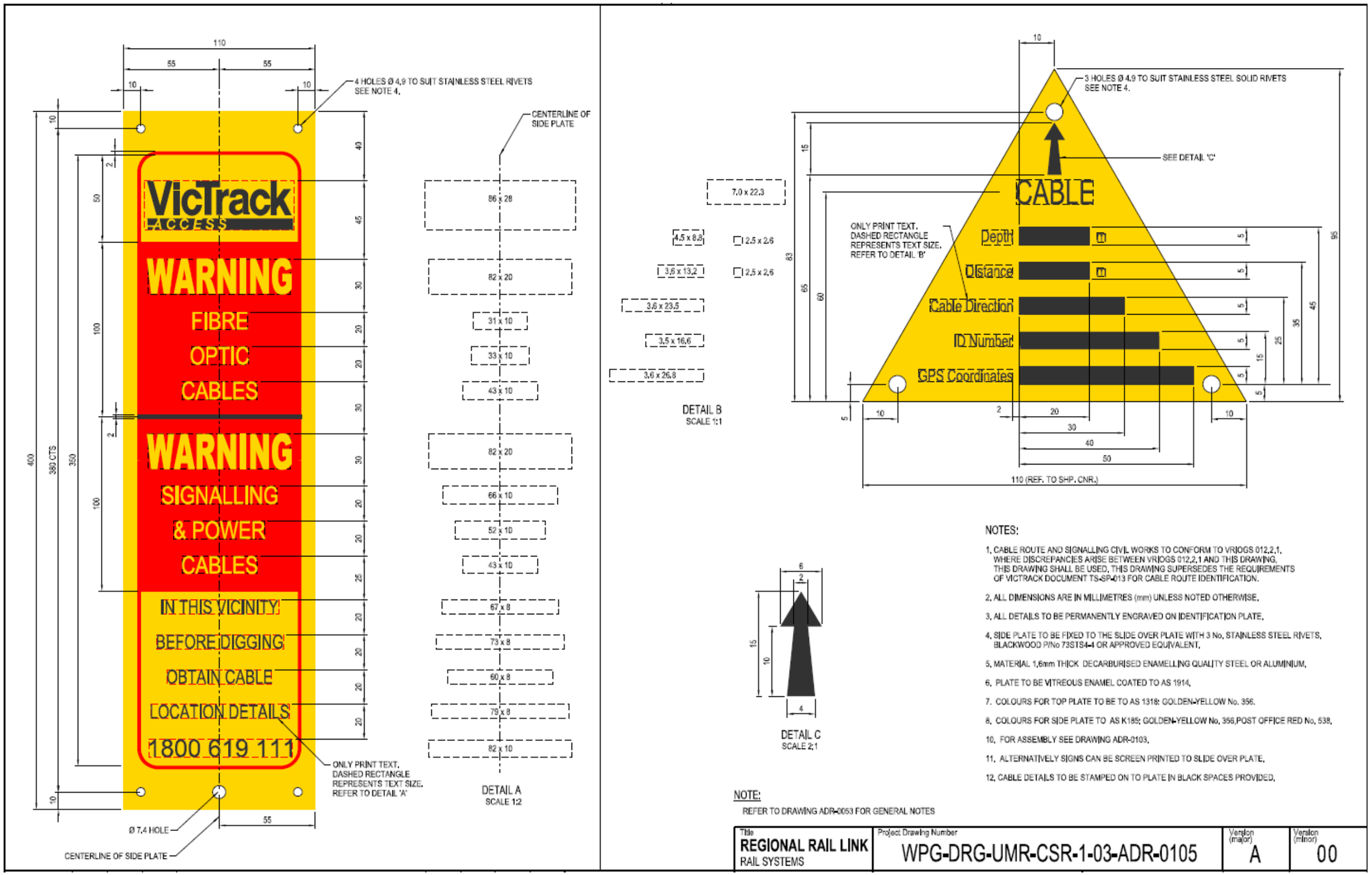
DETAIL B
SCALE 1:2

NOTES:

1. CABLE ROUTE AND SIGNALLING CIVIL WORKS TO CONFORM TO VRIOGS 012.2.1. WHERE DISCREPANCIES ARISE BETWEEN VRIOGS 012.2.1 AND THIS DRAWING, THIS DRAWING SHALL BE USED.
2. ALL DIMENSIONS ARE IN MILLIMETRES (mm) UNLESS NOTED OTHERWISE.
3. ALTERNATIVE FABRICATION DETAILS CAN BE PROPOSED (SUBJECT TO ARO APPROVAL) AS LONG AS OVERALL SIZE AND SHAPE ARE THE SAME. FOR EXAMPLE SLEEVE COULD BE FORMED FROM EXTRUDED ALUMINIUM AND SCREEN PRINTED WITH REQUIRED IDENTIFICATION INFORMATION.
4. IDENTIFICATION PLATE TO BE FIXED TO SLEEVE USING STAINLESS STEEL RIVETS. BLACKWOOD P/No 73STS4-4 OR APPROVED EQUIVALENT.

Title	Project Drawing Number	Version (major)	Version (minor)
REGIONAL RAIL LINK RAIL SYSTEMS	WPG-DRG-UMR-CSR-1-03-ADR-0104	A	00

CABLE ROUTE MARKER POST ENGRAVING DETAILS SIDE & TOP PLATE



NOTES:

1. CABLE ROUTE AND SIGNALLING CIVIL WORKS TO CONFORM TO VRIOGS 012,2,1. WHERE DISCREPANCIES ARISE BETWEEN VRIOGS 012,2,1 AND THIS DRAWING, THIS DRAWING SHALL BE USED, THIS DRAWING SUPERSEDES THE REQUIREMENTS OF VICTRACK DOCUMENT TS-SP-013 FOR CABLE ROUTE IDENTIFICATION.
2. ALL DIMENSIONS ARE IN MILLIMETRES (mm) UNLESS NOTED OTHERWISE.
3. ALL DETAILS TO BE PERMANENTLY ENGRAVED ON IDENTIFICATION PLATE.
4. SIDE PLATE TO BE FIXED TO THE SLIDE OVER PLATE WITH 3 No, STAINLESS STEEL RIVETS, BLACKWOOD P/No 73STS4-4 OR APPROVED EQUIVALENT.
5. MATERIAL 1,6mm THICK DECARBURISED ENAMELLING QUALITY STEEL OR ALUMINIUM.
6. PLATE TO BE VITREOUS ENAMEL COATED TO AS 1914.
7. COLOURS FOR TOP PLATE TO BE TO AS 1318: GOLDEN-YELLOW No. 356.
8. COLOURS FOR SIDE PLATE TO AS K185; GOLDEN-YELLOW No, 356,POST OFFICE RED No, 538.
10. FOR ASSEMBLY SEE DRAWING ADR-0103.
11. ALTERNATIVELY SIGNS CAN BE SCREEN PRINTED TO SLIDE OVER PLATE.
12. CABLE DETAILS TO BE STAMPED ON TO PLATE IN BLACK SPACES PROVIDED.

NOTE:
REFER TO DRAWING ADR-0053 FOR GENERAL NOTES

Title	Project Drawing Number	Version (major)	Version (minor)
REGIONAL RAIL LINK RAIL SYSTEMS	WPG-DRG-UMR-CSR-1-03-ADR-0105	A	00

Asbestos Removal

Extract from VicTrack VT-SP-032 Asbestos (and Hazardous Materials) Management Plan

General

The Victorian OHS Regulations require that the removal of ACMs be undertaken by contractors holding an appropriate asbestos removal licence. The regulations require that any friable asbestos containing materials be removed by a licensed contractor. The regulations do allow some minor removal of non-friable material to be undertaken by personnel that do not hold a licence, however, any asbestos removal at properties under VicTrack management and control, whether friable or non-friable of any quantity, must only be undertaken by contractors holding an appropriate asbestos removal licence. The licences required for types of asbestos removal are shown in the following table:

Table 1. Asbestos Removal Licence Requirements

Type of Asbestos Removal	License Requirements
Removal of friable asbestos containing materials	Class A Licence
Removal of non-friable asbestos containing materials	Class B Licence
Removal of asbestos contaminated dust, debris or contaminated soil	Class A Licence

Additional information detailing VicTrack's preferred licensed asbestos removalists is provided in Section 25.2.

VicTrack Requirements and Minimum Standards

Prior to the commencement of asbestos removal work from VicTrack assets, VicTrack must:

- *Provide a copy of the most recent asbestos survey report, risk assessment and register to the asbestos removalist contractor;*
- *Obtain from the asbestos removal contractor a copy of their licence to ensure that the licence is adequate for the proposed asbestos removal;*
- *Obtain from the asbestos removal contractor a copy of the removalist's asbestos control plan. A review of this plan should be undertaken, in consultation with relevant stakeholders, where required, to ensure that the asbestos control plan is adequate to control the risk of asbestos exposure during the removal works. This should include, where applicable, the erection of protective enclosures, the definition of appropriate asbestos removal boundaries, warning signs and barricades and the use of decontamination procedures;*
- *Obtain from the asbestos removal contractor, a copy of the notification document provided to WorkSafe;*
- *When required, obtain training records from the asbestos removal contractor;*

- *Consult with relevant stakeholders with respect to the proposed removal works including adjacent sites, affected tenants etc;*
- *Engage the services of an approved analyst to undertake para-occupational airborne asbestos fibre monitoring during the removal of friable ACMs, as per the requirements set out in Section 16); and analyst to undertake para-occupational airborne asbestos fibre monitoring during the removal of non-friable ACMs, as per the requirements set out in Section 16).*

After completion of the removal work from VicTrack assets, VicTrack must;

- *Engage an independent qualified asbestos consultant to undertake a visual inspection (as per Section 16.3) of the removal area to confirm that the asbestos removal was completed to a satisfactory standard in accordance with the requirements of the Victorian OHS Regulations;*
- *Engage an approved asbestos analyst to undertake para-occupational airborne asbestos fibre clearance air monitoring within the removal zone, when the removal is undertaken indoors, prior to removal of any protective enclosure (Refer Section 16.3); and*
- *Obtain a clearance certificate (Refer Section15.3) from an appropriately qualified asbestos consultant confirming that there is no visible asbestos remaining in the removal zone and when the removal was undertaken indoors, that clearance air monitoring confirms that airborne asbestos concentrations are <0.01 F/mL.*

Following asbestos removal works undertaken on VicTrack assets, VicTrack must:

- *Provide the results of the visual inspection to the asbestos removalist;*
- *Provide the results of the airborne asbestos fibre monitoring to the removalist following receipt from the occupational hygienist; and*
- *Provide the results of the airborne asbestos fibre monitoring to all relevant stakeholders, including health and safety representatives.*

Telecommunication Assets

A key function of the telecommunications business unit is to install, operate and maintain telecommunication assets along the rail network and within various structures. As many of the assets, particularly telecommunication pits, were installed prior to the prohibition of asbestos, they may contain asbestos.

Having identified that the telecommunications asset contains damaged or deteriorated asbestos as per requirements set out in Section 9, VicTrack must undertake one of the following:

- *Arrange for the asbestos to be removed from the asset, or remove the entire asset and replace with a non-asbestos equivalent;*
- *Find an alternative non-asbestos asset in which to undertake the desired work; or*
- *Construct a new non-asbestos containing asset in the desired location.*

If the asset contains asbestos that is in good condition, the telecommunications asset can be utilised, subject to re-inspection.

The telecommunications group have established protocols when undertaking works on assets which may contain asbestos. Where pits or other items of asbestos are identified which are damaged, the pit will be removed in accordance with Section 15 of this AMP.

When telecommunications staff or contractors are conducting minor works in a building or structure, reference must be made to the asbestos register (provided either by VicTrack or third party lessee). If an asbestos register is not available, the Asbestos Manager should be requested to arrange an inspection.

It is noted that the disposal of asbestos must be undertaken in accordance with IWRG 611.1 (Refer to Section 3.11).