AS 7664:2020

Railway signalling cable routes, cable pits, and foundations

Train Control Systems Standard

Please note this is a RISSB Australian Standard® draft

Document content exists for RISSB product development purposes only and should not be relied upon or considered as final published content.

Any questions in relation to this document or RISSB's accredited development process should be referred to RISSB.

RISSB Office

Phone:
(07) 3724 0000
Overseas: +61 7 3724 0000

Email:
info@rissb.com.au

Web:
www.rissb.com.au

AS 7664 Assigned Standard Development Manager

Name:
Cris Fitzhardinge

Phone:
0419916693

Email:
cfitzhardinge@rissb.com.au

This Australian Standard® AS 7664 Railway signalling cable routes, cable pits, and foundations was prepared by a Rail Industry Safety and Standards Board (RISSB) Development Group consisting of representatives from the following organisations:

Victrack
Level Crossing Commission Victoria
Queensland Rail
Transport for NSW
PTA WA
Sydney Trains

The Standard was approved by the Development Group and the Enter Standing Committee Standing Committee in Select SC approval date. On Select Board approval date the RISSB Board approved the Standard for release.

Choose the type of review

Development of the Standard was undertaken in accordance with RISSB's accredited process. As part of the approval process, the Standing Committee verified that proper process was followed in developing the Standard

RISSB wishes to acknowledge the positive contribution of subject matter experts in the development of this Standard. Their efforts ranged from membership of the Development Group through to individuals providing comment on a draft of the Standard during the open review.

I commend this Standard to the Australasian rail industry as it represents industry good practice and has been developed through a rigorous process.

Deb Spring
Exec. Chair / CEO
Rail Industry Safety and Standards Board

Keeping Standards up-to-date

Australian Standards developed by RISSB are living documents that reflect progress in science, technology and systems. To maintain their currency, Australian Standards developed by RISSB are periodically reviewed, and new editions published when required. Between editions, amendments may be issued. Australian Standards developed by RISSB could also be withdrawn.

It is important that readers assure themselves they are using a current Australian Standard developed by RISSB, which should include any amendments that have been issued since the Standard was published. Information about Australian Standards developed by RISSB, including amendments, can be found by visiting www.rissb.com.au.

RISSB welcomes suggestions for improvements and asks readers to notify us immediately of any apparent inaccuracies or ambiguities. Members are encouraged to use the change request feature of the RISSB website at: http://www.rissb.com.au/products/. Otherwise, please contact us via email at info@rissb.com.au or write to Rail Industry Safety and Standards Board, PO Box 518 Spring Hill Qld 4004, Australia.

Notice to users

This RISSB product has been developed using input from rail experts from across the rail industry and represents good practice for the industry. The reliance upon or manner of use of this RISSB product is the sole responsibility of the user who is to assess whether it meets their organisation's operational environment and risk profile.

AS 7664:2020

Railway signalling cable routes, cable pits, and foundations

Document details

First published as: AS 7664:2012

ISBN Enter ISBN.

Document history

2020	Select Board approval date	Review

Draft history (Draft history applies only during development)

1.1	November 22, 2018	Updated to latest template
1.5	May 15, 2020	Post review Public Consultation draft

Approval

Rail Industry Safety and Standards Board	Select Board approval date

Copyright

Published by SAI Global Limited under licence from the Rail Industry Safety and Standards Board, PO Box 518 Spring Hill Qld 4004, Australia

This Standard was prepared by the Rail Industry Safety and Standards Board (RISSB) Development Group AS 7664 Railway signalling cable routes, cable pits, and foundations. Membership of this Development Group consisted of representatives from the organisations listed on the inside cover of this document

This Standard AS 7664:2020 supersedes AS 7664:2012

Objective

The objective of this Standard is to set out the minimum requirements for:

(a) signalling cable routes, cable pits and for foundations at signals, gantries, location cases, equipment rooms, telephones and ground frames;

(b) minimising the risk of asset failures;

(c) minimising harm to personnel working with, or in the vicinity of, signalling cable routes and trackside infrastructure when such work is taking place outside the rail danger zone;

The standard is intended to:

(a) provide a uniform basis for compliance with AS4292 railway safety management;

(b) support mutual accreditation by infrastructure managers, operators and regulators;

(c) cover differing rail operations across Australia;

(d) identify the risks (hazards) being controlled;

(e) ensure that appropriate cable routes and infrastructure foundations are installed in the signalling system;

(f) support a consistent approach in the use of signalling cable routes, cable pits and signalling infrastructure foundations, enabling common practices to be used across state boundaries.

The standard excludes the requirements for other services (e.g. communications or power) and the rail infrastructure manager should consider these in the design and installation of signalling infrastructure.

This paragraph is used to indicate this Standard's relationship to other standards … only change this paragraph if it is applicable

This paragraph is used to provide statement about this Standard's significant technical changes from any previous edition of the document and/or objective for the revision. … only change this paragraph if it is applicable

Compliance

There are two types of control contained within Australian Standards developed by RISSB:

1. Requirements.
2. Recommendations.

Requirements – it is mandatory to follow all requirements to claim full compliance with the Standard. Requirements are identified within the text by the term 'shall'.

Recommendations – do not mention or exclude other possibilities but do offer the one that is preferred. Recommendations are identified within the text by the term 'should'.

Recommendations recognise that there could be limitations to the universal application of the control, i.e. the identified control is not able to be applied or other controls are more appropriate or better.

For compliance purposes, where a recommended control is not applied as written in the standard it could be incumbent on the adopter of the standard to demonstrate their actual method of controlling the risk as part of their WHS or Rail Safety National Law obligations. Similarly, it could also be incumbent on an adopter of the standard to demonstrate their method of controlling the risk to contracting entities, or interfacing organisations where the risk may be shared.

Contents

Appendix Contents

1 Introduction

1.1 Scope

This standard specifies the accepted criteria to be employed when designing, procuring or installing signalling cables routes, cable pits and signalling infrastructure foundations on the Australian rail network.

This standard covers the materials, types, design and installation requirements for signalling cable routes, cable pits and signalling infrastructure foundations to ensure technical and safety integrity.

This standard is intended to be used by rail infrastructure managers (RIMs), designers and installers of signalling systems (including communications for signalling purposes) and suppliers of signalling cable routes, cable pits and signalling infrastructure foundations.

This standard is intended to be applied for new installations and upgrades; it need not be applied retrospectively.

This standard also includes the requirements for the following:

(a) Buried cable routes;
  i. cables directly buried;
  ii. cables in conduits.

(b) Surface cable routes;
  i. ground level troughing;
  ii. galvanised steel troughing.

(c) Cable ladder routes.

(d) Under track crossings (UTX).

(e) Under road crossings (URX).

(f) Cable pits.

(g) Signal foundations.

(h) Gantry foundations.

(i) Ground frame foundations.

(j) Location case and equipment room foundations.

1.2 Exclusions

The following items are excluded from this Standard:

(a) Aerial cable routes.

(b) Communications cables in dedicated routes.

(c) Rail line crossings for tail cables, track connections and bonding.

1.3 Normative references

The following referenced documents are indispensable for the application of this Standard:

- AS 1074 Steel tubes and tubulars for ordinary service.
- AS 1170.2 Structural design actions – Wind actions
- AS 1302 Geometrical product specifications (GPS) - Indication of surface texture in technical product documentation.
- AS 1379 Specification and supply of concrete.
- AS 1597.1 Precast reinforced concrete box culverts – small culverts
- AS 2053.1 Conduits and fittings for electrical installations – General requirements
- AS 2758.1 Aggregates and rock for engineering purposes - Concrete aggregates.
- AS 3000 Electrical installations.
- AS 3972 General purpose and blended cements.
- AS 3996 Covers and grates
- AS 4671 Steel for the reinforcing of concrete.
- AS 4680 Hotdip galvanized (zinc) coatings on fabricated ferrous articles.
- AS 7633 Railway Infrastructure - Clearances.
- AS 7638 Railway earthworks.
- AS/ACIF S009 Installation requirements for customer cabling.
- ANSI/SCTE 77 Specifications for Underground Enclosure Integrity

1.4 Terms and definitions

For the purposes of this document, the terms and definitions given in RISSB Glossary https://www.rissb.com.au/products/glossary/ and the following apply:

1.4.1
cable jointing pit

cable pit containing a joint in the cable located in it

1.4.2
cable ladder

cable trunking that allows cables to be attached to generally vertical surfaces

1.4.3
cable turning pit

cable pit with the purpose of allowing a change in direction of the cable route

1.4.4
ground frame

small lever frame located beside a railway usually operated by qualified workers and not permanently staffed. A ground frame could be released from a signal box before it can be used

1.4.5
main cable

cable carrying signalling functions or reticulates power between apparatus cases or equipment rooms

1.4.6
stabilised sand

mixture of sand and portland cement in the ratio of between 10 % and 4 %

1.4.7
tail cable

cable connected to an item of active signalling infrastructure (e.g. signal, track circuit). Can also be referred to as local cable

1.4.8
top of formation

point equivalent to the top of the capping layer

1.4.9
under track crossing

cable route under a railway line. Also known as under line crossing

1.5 Abbreviations

HDPE

high-density polyethylene

HV

high voltage

PVC

polyvinyl chloride

UTX

under track crossing

URX

under road crossing

uPVC

un-plasticised polyvinyl chloride

2 Cable route design

2.1 General

Cable routing can be achieved through many different methods, each with their benefits and issues. When designing cable routes, a RIM should assess the suitability of the individual methods and select the best method for the situation.

Cable runs along the formation at the toe of ballast should be avoided.

Acceptable cable routing includes:

(a) buried routes, including cables directly buried or cables in conduits;

(b) surface routes, including ground level troughing (GLT) or galvanised steel troughing (GST);

(c) cable ladder routes.

2.2 Cable route design selection

When determining what type of cable routing is suitable a RIM shall conduct a documented assessment to determine the most suitable method.

Cable route materials, including pits and foundations, shall have a design life of not less than 50 years.

This assessment should evaluate the following factors:

(a) Cable type.

(b) Safe construction, accessibility and maintainability, including access to and from the track for persons or plant.

(c) Alignment and route diversity.

(d) Cable failure and repair.

(e) Security and cable protection.

(f) Standards compliance.

(g) Infrastructure layout and aesthetics.

(h) Other services and infrastructure.

(i) Constructability.

(j) Environment and sustainability.

(k) Services.

(l) Whole of life considerations.

Further detail is provided in Appendix E.

2.3 Temporary cable routes

Temporary cable routes should be designed, constructed and installed in accordance with this standard.

Where it is not practical to meet the requirements of this standard the installation of temporary cable routes the RIM shall demonstrate the risks to safety are managed SFAIRP.

3 Excavation, boring, backfilling and compaction.

3.1 Safety

The RIM shall assess the asset safety and reliability risks associated with the stability of excavations. The RIM should comply the Model Code of Practice: Excavation Work and local standards as applicable.

The RIM shall document the appropriate controls and practices required to minimise excavation risk on its infrastructure.

Prior to commencing any installation activities; a Dial Before You Dig[1] and all RIM required surveys shall be completed. Other surveys such as non-destructive surveys may also be conducted.

When planning works the height and size of plant used for construction activities should be considered in any risk assessment.

3.2 Environment

Construction of cable routes shall be in accordance with applicable environmental legislation and RIM policies.

The selected cable route shall be cleared and levelled only to the extent necessary to permit the works and access for plant/vehicles.

The clearing and levelling work shall not block natural drains or create un-drained areas.

During construction, silt runoff into any waterway should be prevented.

Except for UTX, during construction, the cable route should not disturb the existing track formation or impact the track formation drainage system.

For UTX crossings and other locations, any disturbed track formation condition should be reinstated after construction in accordance with RIM track construction standards or similar.

Cable routes shall be compliant with the infrastructure clearances in AS 7633.

Restoration work should be carried out to restore the route to as near as reasonably possible its original state. Where required restoration work should include ground stabilisation and cross drainage to reduce soil erosion.

Disposal of earthworks shall comply with the requirements of AS 7638.

3.3 Underground services

Underground services provided by RIMs and other authorities including power, telephone, water, sewerage, stormwater, signals, communications, gas or drainage, can exist and could be affected by a proposed cable route.

[1] Dial Before You Dig is a national referral service designed to assist in preventing damage to Australia's underground infrastructure network

Where other services affect a proposed cable route then:

(a) the cable route should be laid 500 mm below the obstructing service; or

(b) if the above is impractical, troughs or conduits should be laid over the obstructing service and continue for 3 m each side of that service.

The RIM should determine the method of avoiding services by agreement with the service owner or manager.

Buried metal pipes, (water, gas, sewerage etc.) and the metal armour on some high voltage cables may be connected to the traction power supply return rail by means of electrolysis bonds at a number of points along the track.

Cable route installation should ensure that electrolysis bond connections or equipment are not damaged or disturbed.

3.4 Cable ploughing

Cable ploughing shall be carried out using methods approved by the RIM and in accordance with cable manufacturer’s installation requirements.

3.5 Trenching

The bottom of trenches shall be flat, in line with the gradient and even, free from stones and sharp objects.

The width of the excavated trench should be no wider than the design trench width to minimise disturbance to the existing track. The geometry of trenches shall be rectangular and straight-sided.

Where main cables are installed in the same trench as communications or power cables, then installation shall be in accordance with AS 3000.

Conduits should be grouped in accordance with the diagrams in Appendix A.

To facilitate connection of tail cables to trackside equipment trenches for the main cable group should be located on the side nearest the running rails.

In continuous rock areas, the RIM may give permission for the depth of UTX and URX to be reduced. In such cases the conduits shall be placed in a trench chased into the rock and encased in concrete with a minimum concrete cover of 150 mm.

In rock areas, direct buried cables shall be laid on a bed of clean sand 100 mm thick.

3.6 Trenchless excavation

Trenchless excavation includes directional drilling, boring, pipe jacking and micro-tunnelling.

Water shall not be used to soften the track or road formation.

The RIM shall document the required process for monitoring ground surface levels and/or track geometry throughout the works.

In the case of track deformation induced by works, the RIM shall determine the method of remedial action to support the track.

UTX and URX may be installed by directional boring.

Where it is not practical to install UTX or URX by the boring process, the UTX or URX shall be installed by trenching, backfilling and compaction in accordance with the RIMs requirements.

Launch and receive pits should be no less than 5 m from the toe of batter of the railway or road formation, or as otherwise approved by the RIM.

It is important to prevent subsidence of the area surrounding the bore. At the completion of the installation the annulus shall be grouted as per RIM requirements.

3.7 Depth

Conduit buried in normal or open ground shall have a minimum cover as specified in AS 3000. A RIM may specify greater depth if required.

If the depth requirements cannot be met and need to be reduced below AS 3000 requirements the RIM shall identify and assess the risks to ensure that the risks to safety are managed SFAIRP.

The depth of cables in rock will be dependent upon the geotechnical conditions present. The minimum requirements are described below:

(a) The depth of cables in broken rock and shale areas shall be at least 600 mm to cover strip or conduit.

(b) The depth of cables in unbroken rock areas shall be at least 300 mm.

Buried route on each end of the UTX and URX shall be graded as required to line up with the cable pits or cable route.

Conduits shall be provided in the UTX and URX to segregate the various cables as specified in this Standard.

3.8 Cable marker tape and protective strips

Buried main cables require mechanical protection to prevent damage. Cable marker tape shall be installed in all trenches 300 mm below ground level.

Where cables are permitted in shallow trenches due to rock, etc. when the depth of the marker tape shall be not less than 100 mm above the protective cover.

The cable marker tape shall:

(a) conform with AS 3000;

(b) be 150 mm wide orange coloured PVC;

(c) be labelled "Danger railway signalling cables” along its length.

A protective cover strip shall be placed on top of the cables and overlap the cables. The protective cover strip shall comply with AS 3000.

3.9 Embankments

Trenching on embankments shall not destabilise the embankment and erode the vicinity of the route.

Trenching on embankments shall meet the appropriate requirements in section 3.2

3.10 High voltage areas

An earth mat is typically provided around high voltage locations as part of the earth protection arrangements for the high voltage installations. Earth mats shall not be disrupted or damaged by buried cable route construction.

RIMs should assess the cable induction prior to designing any buried cable routes in high voltage areas or within the vicinity of earth mats.

3.11 Backfilling

Trenches shall be backfilled in accordance with the RIMs requirements, including specific requirements in AS 3000 and AS/ACIF S009.

UTX trenching shall be backfilled so the formation meets the requirements of AS 7638.

Backfilling should include:

(a) bedding material around cables or conduits;

(b) cables or conduits covered with clean sand, or equivalent material, to 50 mm above the uppermost cable or conduit;

(c) clean fill in layers;

(d) replacement of surface materials.

The trench shall be backfilled with material free of:

(e) broken concrete, brick, rubble, wood, glass, rubbish or steel;

(f) other objects that could damage the cable;

(g) other metallic objects that could effect the operation of electronic cable locators;

(h) material that will not pass through a 50 mm sieve.

If the trench is not in a vehicular access road then the final 150 mm of fill of trenches in rock areas should be stabilised sand.

If the trench is in a vehicular access road then the final 150 mm of fill of trenches in rock areas should be concrete to a minimum strength of 25 MPa.

Trenches and other excavations should not be backfilled until inspected by the RIM.

Trenches and other excavations should be inspected after backfilling to identify and correct any depressions caused by depression or erosion.

Surface and sub-surface track drainage systems shall be reinstated during the backfilling operations.

All track and other surface treatments shall be restored to pre-works condition at the completion of works as required by the RIM and/or applicable standards.

3.12 Compaction

The first 150 mm of fill over cover strips or conduits shall be compacted in a manner to ensure that the cover strips / conduits are not disturbed.

Trenches and other excavations shall be:

(a) compacted by mechanical means to achieve 95 % standard compaction in accordance with AS 1289;

(b) filled and compacted in layers of 150 mm maximum thickness to achieve the specified density.

The RIM shall document the appropriate controls and practices required to minimise risks associated with compaction works.

Where backfill does not achieve the required density, it shall be re-excavated to within 200 mm of the cover strips and/or conduits and re-filled and compacted correctly.

Trenches and excavations in areas other than UTX or URX should be compacted by any convenient means and should be finished with a slight mound, height equal to approximately 20 % of trench width.

4 Buried cable routes

4.1 General

Buried cable routes shall be located within the railway corridor, and not under access roads or car parks, unless there is no possible alternative. The correct location of the railway corridor should be confirmed as part of the design process.

Cable routes should, where practicable:

(a) be located as near as possible to the railway boundary to accommodate any foreseeable future new constructions;

(b) be located away from the existing ballast shoulder, if practicable;

(c) be designed and constructed to minimise the cutting of trenches in the sub-ballast layer on new railway formations;

(d) be parallel to the running lines;

(e) follow a straight-line route;

(f) be located and installed between cable pits so that it does not divert or interfere with any drainage (railway or natural) or underground services;

(g) be located to avoid areas subject to potential damage due to flood wash outs, scouring or similar events;

(h) be on the side of the tracks not occupied by high voltage earthed locations such as sub-stations, power sectioning huts and transformer locations.

Shared services should be installed as per diagram in Appendix A.

Cable routes under roadways should be installed within the railway corridor whenever possible.

Earthworks associated with cable routes in embankments, cuttings or unstable ground shall be appropriately certified in accordance with RIM requirements.

To assist in identification, as part of the construction of the cable route, GPS mapping of cable routes should be undertaken.

4.2 Conduits

4.2.1 General requirements

Conduit should be rigid uPVC or HDPE. Conduit exposed at or above ground level should be either metal or be shielded to protect the conduit from accidental damage.

Conduit should comply to AS 2053.1, class heavy duty. Other conduits may be used where type approved by the RIM.

The minimum diameter of conduit shall be the greater of:

(a) 3 times the outside diameter of the cable to be pulled through the conduit; or

(b) 50 mm.

PVC conduit should be colour coded as below.

Table 4-1 PVC Conduit Colouring

Location	Cable type	Colour
Underground	Power and signal	Orange
	Communication	White
Above ground	Power and signal	Grey or orange
	Communication	White

Conduits for power and signal cable shall be installed in accordance with AS 3000.

Conduits for communications cable shall be installed in accordance with AS/ACIF S009.

Conduits used for UTX should be placed in the earthworks prior to the construction of the capping layer.

Signalling air mains reticulation should be in a separate route to signal, power and communications cables.

4.2.2 Joints

Conduits shall be jointed using the manufacturer's recommended jointing methods.

4.2.3 Capacity

At the time of installation spare conduits may be provided. Such conduits will not have cables installed in them but provide capacity for future expansion or for future maintenance use.

At least one spare conduit should be provided or 20 % of the number provided, whichever is the greater.

Where a single large diameter pipe is installed spare capacity in this conduit, provided it is not less than 50 % of the cross-sectional area, shall be provided in lieu of additional conduits.

All spare conduits shall have installed a draw wire for installation of future cables and be capped to prevent the ingress of vermin or dirt. The draw wire shall:

(a) be stainless steel or 6 mm polypropylene rope;

(b) have a minimum of 2 m slack at each end of the pipe;

(c) be secured at each end of the pipe.

Spare conduits shall, once installed, be cleaned and then sealed with proprietary end caps. Caps should allow for moisture in the spare pipe to drain out.

All spare conduits shall be tested for correct diameter after installation, backfilling and compaction.

Spare conduits shall not be provided for individual track circuit feeds or tail cables to individual pieces of equipment.

4.3 Earth cables and wires

Stainless steel earth wires should be installed in cable trenches.

The RIM should specify the number and size of earth wires installed in cable trenches.

At a distance midway between location cases or buildings, a 10m long gap shall be provided between the ends of the earth wires.

Earth wires in trenches should not be located within 20m of any high voltage earth installation. The RIM should identify areas that are, or are proposed, for electrification.

4.4 Water courses

Cable routes under a water course should be installed by trenchless methods. If this is not possible then the next preferred method is using an existing bridge or structure over the water course.

For small creeks and occasional waterways, conduits may be laid in trenches across the creek bed subject to RIM's requirements.

The minimum depth of the conduit run shall be 800 mm below the creek bed.

RIMs should monitor water courses for erosion that could cause the buried cables or conduits to be exposed.

Conduits shall be:

(a) covered to a minimum depth of 300 mm with porous bags filled with stabilised sand and the remainder of the trench filled to the top with heavy grade riprap material;

(b) extended past the edge of the creek banks a minimum of 4 m on either side of the creek or waterway.

Conduits should not be placed in any part of a creek bank where obvious erosion has been taking place. If this cannot be avoided, stabilisation of the bank on each side of the trench should be provided.

Conduits on creek banks shall be:

(c) laid in grooves in the banks so that the conduits have a minimum cover of 800 mm;

(d) covered with porous bags filled with stabilised sand and topped with other suitable fill to protect the pipes and prevent erosion of the banks.

4.5 Platforms and other paved areas

Conduits should be arranged in fixed format for the full length of the platform or paved area.

Conduits should be supported so that backfilling will not disturb the format.

Where pedestrian traffic is involved the depth of conduits from the top of the trench to the top of the highest layer of conduits should be not less than 300 mm.

Where motor vehicles can run over the paved surface pipes shall be buried in accordance with AS 3000. A reinforced concrete slab may be provided immediately under the paved surface to provide additional protection.

4.6 Cable route markers

Cable route markers shall be installed along buried cable routes. Cable route markers should be placed close to a fence or other fixed structure.

Cable route marker type, size and post installation depth shall be specified by the RIM.

Cable route markers shall be installed at each point where:

(a) the route changes direction;

(b) at each end of UTX and URX;

(c) at each end of under creek crossings.

Cable route markers should:

(d) be installed at not greater than 50m intervals along the route, or as determined by the RIM;

(e) not obstruct footpaths, walkways or vehicle access-ways;

(f) not be placed directly over the cable route.

Cable route markers should be mounted 1.2m above ground.

The cable route marker should display the location of the cable. Location information may include the distance from the route marker to the route, or the cable route offset from the nearest rail.

The cable route markers should be UV resistant to remain visible and legible for the design life of the insulation, typicality 50 years.

5 Surface cable routes

5.1 General

Surface cable routes should not be installed in areas subject to vehicular traffic or where the surface cable route would impede track maintenance activities such as sleeper replacement.

Copper communications cables shall not be installed in the same compartment within the surface troughing as power or copper main cables.

High voltage (HV) cables shall not be installed in the same compartment as main cables.

GLT installation shall not affect other RIM's infrastructure.

5.2 Environment

Cable routing can have a visual impact on its surroundings, and this can draw attention to the presence of cable. Cable route should be designed to be as unobtrusive as possible.

The route should not be attached to, or alter the appearance of, any building or structure which is on a heritage list or is subject to a preservation order without specific approval from the relevant heritage authorities.

The finished surfaces shall comply with the RIMs requirement.

5.3 Materials

5.3.1 Construction

Surface troughing should be manufactured for the design life, typically 50 years.

Surface troughing should be constructed from the following materials which are presented in order of preference:

(a) UV stabilised linear polyethylene troughing with concrete or polyethylene lids;

(b) Reinforced concrete to AS 1597.1;

(c) Galvanised steel;

(d) Materials approved by the RIM.

Galvanised steel troughing (GST) shall only be used for elevated troughing. GST shall be made from steel, hot dip galvanised to AS 4680 with a coating mass equal to at least Z430.

Steel conduit should not be installed unless being used to protect cable from accidental damage.

Steel components shall have insulated joining pieces installed if in electrified areas.

All steel components or constructions should be proofed against corrosion in accordance with AS 2312.

Freshly cut steel surfaces shall be deburred then recoated in accordance with the appropriate requirements of section 5.3.3. Cut surfaces shall be protected in accordance with the repair requirements within AS 4680.

Where there is an assessed risk of fire damage, troughing should be made from fire resistant materials.

GST shall be provided with a continuous 9 mm thick lining of stable thermal insulating material on the bottom and sides such as fibre-reinforced cement for fire protection.

5.3.2 Lids

Troughing shall have lids interlocked with the trough. The lids shall be compatible with the installed troughing.

Lids should not weigh more than 25 kg. Lids weighing over 25 kg should have manual handling warning labels on the top of the lid advising of the weight of the lid.

The warning labels shall remain visible and legible for the life of the structures.

5.3.3 Finish

Painted or powder coated finishes shall not be used as the primary corrosion proofing process in external applications. Painted or powder coated finishes may be used to provide additional protection in those instances or locations where the primary process cannot provide the specified service life.

In selecting the coating to be used, the likelihood of minor damage during installation such as scraping, scratching and chipping should be taken into account.

Where a paint finish is specified, powder coating, enamel, epoxy coatings or acrylic lacquer finishes may be used.

For painted metal, the surface shall be cleaned, etched, primed, undercoated and finished in accordance with the paint manufacturers' recommendations.

Hot-dip galvanizing of steel components shall be compliant with AS 4680. For applications within buildings, except in wet areas such as cable pits, the level of protection may be reduced to zinc plating or equivalent.

5.3.4 Fastenings

Fasteners used externally on buildings shall be either plated or of a material that provides the specified life.

If stainless steel nuts are used on stainless steel fasteners, an anti-seize product shall be used between nut and bolt.

5.4 Capacity

At installation the trough should have at least 25 % spare capacity to support future additional cables and to allow the replacement of the existing cables.

5.5 Ground level troughing

5.5.1 Design

Where GLT use is unavoidable in areas subject to vehicular traffic the trough and lid shall be capable of carrying a load of 4.5 t over a contact area of 100 mm x 300 mm applied to any part of the lid. GLT shall be designed to be installed with the top of the lid inline with the ground level.

The RIM should document the clearance limits for GLT route alignment.

GLT should have the means to enable bottom entries or exits.

5.5.2 Drainage

Where GLT could act as a barrier to slow the dispersal of storm water, drainage ducts shall be provided under the GLT. The drainage ducts shall be provided to enable the quick dispersal of storm water.

Drainage ducts may be constructed from inverted GLT, pre-cast concrete box drains, PVC or HDPE pipes.

If necessary, ramps over drains, ducts and pipes under the GLT route shall be provided in conjunction with the requirements of clause 5.2.

5.5.3 Installation

GLT runs shall have the smallest practical number of changes in direction and gradient.

For directional changes of greater than 45 ° in the GLT, the change shall be made using transition pieces.

Construction of a GLT route on banks and sloping sites shall be designed so that the supporting ground will not be eroded during periods of rain.

GLT shall be positioned such that it will not obstruct or be likely to be damaged by, the removal and replacement of railway sleepers. GLT within 3 m of the face of the nearest running rail shall be installed such that the top of the GLT lid is at least 200 mm below the underside of adjacent sleepers.

GLT cable entry points shall be sealed after cables are laid.

If the laying of cables is being undertaken separately from the construction of the cable route, the GLT shall be free from ballast or debris which can cause cable damage, cable entries are sealed and the lids refitted after cable laying.

5.5.4 Lids

GLT shall be thoroughly cleaned out of debris and detritus prior to installing lids.

If the new GLT is in the vicinity of pedestrian walkways, it could be necessary to fit the lids as the work progresses and reopen the GLT when required for cable laying.

GLT lids that cross over pathways, or could be used as pathways, shall be installed as part of the pathway.

GLT that is installed adjacent to or across a pathway shall have a top surface of sufficient strength and of a non-slip finish to allow its use for pedestrian traffic.

Polyethylene GLT should have the lids secured to the trough.

Troughing lids should be embossed with "Railway Signal Cables" on the lid as determined by the RIM.

5.6 Elevated troughing

5.6.1 General

Elevated troughing requires access by maintenance staff. Elevated troughing should be designed and installed at:

(a) maintainable height and outside the structure outline;

(b) constructed to prevent the entry of vermin;

(c) a constant level.

Cable jointing bays ensure that the capacity of the troughing is not diminished due to the size of cable joints.

Cable jointing bays shall be provided where cable joints occur and be supported to prevent any deflection or twist of the jointing bay or cable route.

Elevated troughing attached to walls or rock faces shall have a minimum clearance between the trough and the wall or rock face of 25 mm.

Elevated troughing on walls or in tunnels shall not obstruct access to staff refuge recesses.

Steel air lines shall not be installed in elevated troughing

Flexible PVC air lines up to 25 mm diameter may be installed on top of signalling cables in elevated troughing.

5.6.2 GST lids

Lids shall be fitted onto GST and secured with stainless steel strapping.

GST lids shall be positioned such that they overlap. The overlap should be approximately two thirds of the troughing base.

GST lids shall be fitted in a manner that does not electrically short out insulating gaps.

On bridges, viaducts and over waterways, lids shall be fitted with galvanised chain (link size: 20 mm, thickness between 4 mm and 5 mm, length between 250 mm and300 mm) attached at both ends of the lid and in the centre section by welding or bolted connection; the free end of the chain shall be attached to the troughing in the same manner.

For the requirement above, if bolted attachments are used then:

(a) all sharp edges shall be deburred and covered;

(b) the intrusion of nuts and threaded portions shall not reduce the troughing space available for cables.

5.6.3 Joints and insulated sections

Elevated troughing shall have means to connect individual sections of trough. This may be achieved through:

(a) male / female joints moulded as part of the troughing;

(b) separate joiners and connectors.

Where installed, metal troughing shall have expansion joints installed in the troughing runs at intervals of not greater than 50 m. Metal troughing expansion joints shall provide for change in length for a temperature range of – 5 °C to 60 °C, or as determined by the RIM.

Extended continuous lengths of metal troughing can develop significant induced voltage to earth, hence are prone to step and touch potential hazards as well as electrolysis damage at transitions to earth. Insulated saddle joints should be used to minimise the effects of induced currents in the troughing.

Continuous metal troughing or metallic air reticulation lines shall be suitably earthed to manage the step and touch potential and risk of electrical shock.

Insulated saddle joints shall be installed in metal troughing runs at intervals of not greater than 300 m.

Insulated saddle joints shall be installed in metal troughing runs at each end of steel bridges when the route is attached to or supported by the bridge.

Insulated joints shall be arranged to provide a gap of 30 mm between the ends of adjacent lengths of troughing.

Metal troughing shall only be fixed to the troughing support brackets at the expansion joint and arranged so that the troughing between expansion joints is free to expand and contract with temperature changes.

5.6.4 Mounting brackets and fittings

Elevated troughing support brackets, fixings and other fittings shall support the troughing without permanent deflection when loaded to full capacity with cable plus incidental loads up to 100 kg applied at any point on the trough.

A structural factor of safety of at least 3 should be applied in the design and manufacture of brackets and their fitting and fixing.

Mounting brackets shall not extend past the side of the trough by more than 25 mm.

5.6.5 Overhead wiring structures

Elevated troughing installed where overhead wiring exists shall comply with structural standards for separation clearance and insulation requirement as specified by the RIM.

5.6.6 Posts and supports

Posts and supports shall be spaced so that any elevated trough attached to the posts will not deflect or distort when loaded as specified in clause 5.6.4 with the incidental load at the midpoint of the span.

Post spacing should be consistent except where a reduction is necessary for change of direction, support of a joint bay or termination of route.

Posts and foundations shall be designed to support a load of 250 kg vertically applied and a load of 150 kg horizontally applied to the top of the post in any direction. Posts should not deflect more than 10 mm with the above loads applied, measured from top of post.

Posts shall be set in the ground to a depth of at least one third of the total length of each post or 500 mm, whichever is the greater.

5.6.7 Location cases

Entries to location cases should be via cable pits located adjacent to the location case. Appendix B provides an example of this design.

5.6.8 Route transitions

Transition between elevated troughing and GLT, and between elevated troughing and buried cable route should be through a cable pit. An example of this arrangement is shown in Appendix D.

Adaptors used between elevated troughing and cable pits shall extend from the cable route to within 300 mm of ground level. The void between the adaptor and the conduits shall be sealed.

Modifications to the elevated troughing route to accommodate the adaptor shall not result in cables being unsupported over lengths exceeding 600 mm.

The transition between elevated troughing and UTX or URX should be via a cable pit located at either side of the crossing.

The cable pit shall be large enough to accommodate all conduits, including spares, from the buried cable route, UTX or URX.

The arrangements that shall be applied for GST transitioning to GLT and buried routes is shown in Appendix C.

The arrangements that shall be applied for elevated troughing entering pits are as shown in Appendix D.

5.6.9 Bends

All bends in elevated troughing shall be smooth and rounded to prevent damage to or pressure on cables.

Changes in direction in the vertical or horizontal plane of the troughing route shall not be greater than the minimum radius for the largest cable to be installed in that route.

5.6.10 Railway bridges and viaducts

The RIM shall document the process to be applied to ensure risks are minimised when attaching an elevated troughing cable route to the structure of bridges or viaducts.

The bridge or viaduct structures shall not be drilled, cut, bent, welded or otherwise deformed to affect such an attachment.

Suitable clips shall be provided for securing brackets to bridge metalwork.

All bolts effecting the attachment shall have self-locking nuts.

Masonry fixings shall use stainless steel chemical anchors of 12 mm diameter and 75 mm minimum anchoring depth. Expanding masonry anchors shall not be used.

Resilient rubber mountings shall be provided to minimise the vibration transmission between the bridge or viaduct, and the elevated troughing.

5.6.11 Rock faces

Elevated troughing on rock faces shall be supported by brackets chemically anchored into holes bored in the rock face.

Elevated troughing bracket lengths shall be varied to account for variation in the line of the rock face.

Where projection of more than 400 mm from the rock face is required, elevated troughing brackets shall be braced.

The minimum height to the bottom of the lowest trough from ground level shall be 500 mm.

5.6.12 Walls

Elevated troughing supports shall be fixed to retaining or other walls provided that secure fixings can be obtained and there is clearance between the wall and the closest running rail.

Attachment to the wall shall be by stainless steel chemical masonry anchors of not less than 12 mm in diameter with a minimum anchoring depth of 75 mm.

The distance between support brackets shall not exceed 3 m.

Support brackets shall be secured to walls and rock faces using masonry anchors or equivalent, maintaining a straight line.

5.6.13 Tunnels and underbridges

Where clearances are limited at low level or where the troughing would interfere with access to refuges, the route shall be mounted on the wall at a height not less than 300 mm above rail level.

5.6.14 Culverts

Where it is not practical or desirable to install a cable route under culverts, gullies, stormwater channels, etc. or to use above ground troughing on posts, a bridge structure to support the troughing may be used.

The bridge structure shall be wide enough to carry the number of troughs required.

The bridge structure shall have the strength to avoid permanent deflection under the weight of all troughs plus 100 % cable load in each trough plus two incidental loads of 150 kg, one at 1/3 span and one at 2/3 span.

A structural factor of safety of at least 3 shall be applied in the design and manufacture of these bridges and their fitting and fixing.

The bridge structure shall be supported on bearing plates, fixed at one end and free to expand/contract at the other.

Matched expansion joints shall be provided in each trough.

Elevated troughing installation shall not impede the flow of water.

Supports shall be positioned on the edge of the waterway and not in the centre of the flow.

6 Cable ladder

6.1 General

Cable ladder shall be provided where clearance limitations prevent the installation of other types of cable route, such as in tunnels and along platform walls.

The environment in tunnels and platform walls can suffer from:

(a) contaminated groundwater carrying highly corrosive products leaching through the wall;

(b) stray electrical currents;

(c) high levels of ground born vibration;

(d) high velocity winds with buffeting from train movements;

(e) on platform walls significant UV exposure.

The design, construction of and the materials used for the cable ladder and all fittings shall be suitable for the environment.

6.2 Material

Cable ladder shall be manufactured from material type approved by the RIM.

Cable ladder should be manufactured from marine grade aluminium or stainless steel or, in areas that are not subject to ground water leaching through the tunnel or platform wall, galvanised steel.

The ladder shall be of adequate strength to support the cable route when full to capacity with cable plus an additional load of 10 %, or 10 kg whichever is greater, without permanent deflection.

6.3 Design

Cable ladder cable route shall be constructed using the least number of joints; shorter lengths of cable ladder shall only be used to accommodate changes in direction of the route, or to suit equipment positions.

Cable ladder shall be installed at a constant height above rail level.

Cable ladder shall be installed in accordance with AS 7633.

Support centres shall not exceed 2 m except where it can be demonstrated that the ladder to be used and the support system is capable of carrying longer spans with the loading specified in Section 6.2.

Typical cable ladder widths are:

(a) 150 mm;

(b) 300 mm;

(c) 450 mm;

(d) 600 mm.

If the installation is in an area of confined space, then the RIM shall approve other appropriate widths.

Cable ladder shall be earthed and bonded as per RIM requirements.

Cable ladder shall not be installed within 2 m of 1500 V dc overhead wiring, except where a tunnel profile precludes this clearance being achieved.

Cable ladder shall not be installed within 3 m of 25 kV overhead wiring, except where a tunnel profile precludes this clearance being achieved.

6.4 Capacity

Cable ladders shall have capacity to accommodate all the main and tail cables, and low voltage power cables in the cable route.

Cable ladders shall be provided with an allowance of not less than 25 % spare capacity.

6.5 Joints and insulation gaps

Expansion joints shall be installed in the ladder route at intervals of not greater than 100 m.

Attachment to brackets between expansion joints shall be designed to permit movement of the ladder due to change in temperature.

Joints in the cable ladder shall use compatible splice plates and fasteners.

Fastener material shall not corrode or cause corrosion of the ladder.

Air gaps of 30 mm to 40 mm shall be installed in the cable ladder route at intervals of not more than 300 m.

6.6 Mounting brackets and fittings

Cable ladder brackets, supports and fittings shall support the loading specified in Section 6.2, without deflection or distortion of bracket or support.

Cable ladder brackets and supports shall be constructed of materials that are compatible with the ladder material.

Cable ladder brackets and supports shall not cause corrosion of the cable ladder.

Cable ladder supports should be secured to concrete (except for pre-stressed or post tensioned structures) using stainless steel expanding masonry anchors.

Cable ladder shall be installed so as to not degrade the structural integrity of pre-stressed or post tensioned concrete structures and brickwork.

Cable ladder attachment to steel structures shall be by clamp type fastenings.

Any drilling into reinforced, pre-stressed or post-tensioned concrete structures shall be subject to prior assessment and approval by the RIM.

Bolts shall include nut locking.

6.7 Bends

Bends should prevent damage to or pressure on cables due to sharp corners or edges.

All bends shall be smooth and rounded.

Changes in direction in the horizontal and vertical planes of the ladder route shall be constructed using compatible preformed bends and tees.

No bends shall be sharper than the minimum bending radius of the largest cable installed in the route.

6.8 Connections and route transitions

The connection of the main cable ladder route to local cable route and equipment shall be made using tee pieces compatible with the cable ladder.

Transition between different cable ladder sizes shall be made using compatible adaptors.

Transition between cable ladder and other cable routes shall be made using compatible adaptors fabricated from the same material as the cable ladder.

The adaptor for UTX and URX shall be large enough to accommodate all conduits from the UTX or URX, including spare conduits.

The adaptor for UTX and URX shall extend from the cable route to within 300 mm of ground level.

Where route transitions are provided, these should be carefully installed to prevent future maintenance hazards.

At a transition between different cable ladder sizes or types of cable route, voids between transition adaptors and pipes shall be sealed.

Modifications to the cable ladder to accommodate a transition adaptor shall not result in cables in the cable ladder being unsupported over lengths exceeding 600 mm.

6.9 Tunnels and underbridges

Cable ladder and ladder supports and brackets in tunnels or under-bridges shall be installed clear of structure gauge, water springs, seepage and weep holes.

A minimum clearance of 25 mm shall be maintained between the cable ladder and the walls of the tunnel or under-bridge.

Refuges in tunnels are areas of safety for railway workers. Cable ladder shall not obstruct access to personnel refuge recesses.

Main cable ladder should be mounted such that the lowest part of the ladder is at least 3800 mm above rail level.

Irregular or rough finished tunnel wall (such as a shot-crete finished wall) can pose difficulties for maintaining a generally straight alignment. Straight alignment should be maintained by using stand-off pillars as necessary.

The RIM shall ensure that installation of all cable ladder, fittings, brackets, supports and lidding are securely fixed and fastened before trains are permitted to run on adjacent tracks.

6.10 Cable installation

Cables should be attached to the cable ladder using stainless steel cable ties at intervals not exceeding 600 mm.

The cables shall be installed neatly in the cable tray.

The cables shall be laid in such a manner that minimises the need for cables to cross other cables.

6.11 Covers

Cable ladder covers should be provided where the bottom of the cable ladder is less than 2.4 m above the adjacent rail level.

Covers should be designed to prevent animal nesting inside the covers.

Cable ladder covers shall overlap the adjacent covers by a minimum of 20 mm (away from the direction of normal train movements).

Cable ladder covers shall be secured with stainless steel straps.

Where cable ladder covers are provided on vertical ladders, means shall be provided to ensure that the covers do not slide when secured by the straps.

Cable ladder cover straps shall be provided as follows:

(a) one, 100 mm from each end of each lid;

(b) additional straps as required to ensure a maximum of 600 mm intervals between straps for 600 mm wide cable ladder;

(c) additional straps as required to ensure a maximum of 800 mm intervals between straps for other cable ladder widths.

7 Under track and under-road crossings

7.1 General

Under track crossings (UTX) and under road crossings (URX) shall be constructed with heavy duty uPVC or HDPE conduits of sufficient wall thickness to guarantee no loss of cross-sectional area and less than 10 % loss of diameter in any direction under track or road impact loadings.

The number of conduits to be provided in a UTX or URX and under access roads will depend on the cable route requirements in that area but provision should be made for the following, as applicable:

(a) Signalling and power cables should be in separate conduits to communication cables.

(b) High voltage cable route should be in a separately located cable route to signalling or communications cable. Separation should be in accordance with high voltage standards.

Telecommunications cable shall be installed in a separate conduit as per AS/CA S009.

Metallic air lines should be in a separate route.

7.2 Under track crossing

The RIM shall identify and assess the asset safety and reliability risks associated with the installation of UTX.

The RIM shall document the appropriate controls and practices required to minimise risks associated with UTX on its infrastructure, including:

(a) post installation inspections, if required;

(b) the defect reporting actions required to mitigate the risk of UTX failure during construction;

(c) any specific installation activities to mitigate risk associated with the construction of UTX on its infrastructure.

The design of new bored crossings should consider the local geotechnical conditions and the potential for surface deformation.

UTX shall be at 90° (±5°) to the tracks. UTX should be located at least two sleeper spacings from any rail joints.

UTX shall be a minimum of 2 m clear of the movable parts of switches and of the V-crossing of any points leads.

UTX conduits shall extend a minimum of 4 m beyond the outer rail on each side of the track except where the RIMs property ends within 4 m or there is a physical obstruction that precludes this requirement.

A cable pit shall be provided at each end of main cable route UTX conduits.

The RIM shall document the requirements for cable pits at the end of UTXs to ensure adequacy and safety.

Steel conduit shall not be used for a UTX under, or in the vicinity of, any electrified track.

7.3 Under-road crossing

When it is necessary to install a cable route under a roadway, construction should be planned to cause the minimum disruption possible to the users of the roadway.

The RIM should document the requirements for cable pits at the end of URXs to ensure adequacy and safety.

It is preferable if public access to URXs and associated pits can be avoided. By keeping pits within the RIMs boundary then safe access to the URX for maintenance is easier to achieve.

URX conduits shall extend under nature strips and pathways into the RIMs property on each side of the roadway to connect to a cable pit at each end of the URX that is wholly within the rail infrastructure manager's property.

Cable pits shall be installed in accordance with Section 8 of this standard.

Where the URX is wholly within the RIMs property, the cable pits shall be at least 2.4 m clear of the roadway edge.

Where the RIMs property is unfenced or where the URX is not wholly within the RIMs property, bollards shall be installed on the roadside of the pits to protect them from vehicular traffic.

8 Cable pits

8.1 Material

Cable pits and cable turning chambers should be made from precast concrete, concrete cast in situ, brick, concrete block, HDPE or other materials as approved by the RIM depending on size, location and the loading to which the pit cover will be subject.

Cable slack should be provided in the pits to assist with minor cable repairs.

8.2 Design

Concrete, concrete block and brick pits and cable turning chambers shall have a concrete floor of not less than 75 mm thick.

HDPE pits shall have structure ribbing to allow securing of the pit in the ground and provide additional structural strength. Side wall load rating shall comply with ANSI/SCTE 77.

Cast in situ concrete pits and cable turning chambers less than or equal to 1500 mm deep shall:

(a) be constructed with a minimum wall thickness of 100 mm with a layer of F82 galvanised mesh reinforcement;

(b) have reinforcement located to provide a minimum cover of 50 mm from the outside of the wall.

Cast in situ concrete pits and cable turning chambers deeper than 1500 mm shall:

(c) be constructed with a minimum wall thickness of 150 mm with two layers of F62 galvanised mesh reinforcement;

(d) have reinforcement with a cover of 50 mm.

Pits and cable turning chambers constructed from brick or concrete block shall include appropriate steel reinforcement.

The internal size of all pits and cable turning chambers shall provide for the minimum bending radius of the largest cable to be installed in them.

Where the pit is installed in a trafficable area, the pit itself shall be designed to sustain the repeated loads and impacts of traffic.

8.3 Depth

Pits more than 600 mm deep shall be large enough so maintenance personnel can safely stand and work within the pit clear of cables.

Sizes of pits shall comply with table 8.3.1

Table 8.3.1 Minimum pit diameter

Type of pit	Minimum diameter of pits	
	Depth up to 1500 mm	Depth over 1500 mm
Round	900 mm	1200 mm
Square	1000 mm x 1000 mm	1200 mm x 1200 mm
Rectangular	1200 mm x 700 mm	1450 mm x 850 mm

Pits associated with GST to location case interface shall have minimum dimensions of 600 mm x 600 mm.

The depth of pits and cable turning chambers shall be to suit the depth of the cable route.

The top of each pit or cable turning chamber shall be 100-200 mm above the surrounding ground level except on platforms, paved areas, pathways or roadways, sealed or unsealed, where the top of lids shall be flush with the surrounding ground level and the pit and lid shall be load rated to the vehicular or pedestrian load applying to the location.

8.4 Cable entry and exit

Cable entries into pits and cable turning chambers should be designed to prevent damage to cables during installation and eliminate the risk of cables bearing on sharp corners or edges after installation.

Cable entries into pits shall be through the sides only, not through the bottom of any pit.

Cable entries into pits and cable turning chambers shall have large radius rounded edges.

The ends of conduits shall be de-burred and chamfered.

To hold conduit or GLT securely in position, conduit ends or GLT shall be encased in concrete for a distance greater than 300 mm.

Communication, signalling and power cables shall be separated in accordance with AS 3000.

Main cables, communications cables and low voltage power cables shall not be installed in pits with high voltage power cables.

Pits and cable turning chambers should not undermine or deteriorate an embankment during periods of heavy rain.

8.5 Location

8.5.1 Cable pits

Cable pits for main cable shall be provided:

(a) at each end of main cable route UTX and URX;

(b) along buried cable route at intervals of not greater than 300 m;

(c) at interfaces of buried cable routes with other type cable routes;

(d) at buried cable route direction changes;

(e) a minimum of 3 m from the nearest rail of any track;

(f) clear of cess drainage.

Cable pits should be provided:

(g) at signal mast and gantry locations;

(h) at location cases and equipment rooms;

(i) at point machine locations;

(j) at level crossing locations;

(k) at all ends and major entry points to UTX, URX, through platforms and crossings;

(l) at locations away from trafficable areas;

(m) outside the danger zone as defined by the RIM.

8.5.2 Cable jointing pits

Cable jointing pits shall be provided:

(a) where jointing of cabling near signalling infrastructure is required;

(b) where jointing of high voltage cables is required.

Where practicable, cable jointing pit should be located close to vehicular access.

No other cables shall be placed in high voltage jointing pits.

8.5.3 Cable turning chambers

Cable turning chambers shall be installed in GLT, GST and cable ladder routes wherever cables are required to change direction sharply and:

(a) the minimum bend radius for the cable cannot be achieved within the cable route; or

(b) the cable is likely to bear heavily against sharp edges at the bend.

8.6 Drainage

Drainage shall be provided at the base of each pit and cable turning chamber.

Drainage shall include providing drainage pipes to the nearest approved railway drain or to a public stormwater drain or natural drainage course, where possible.

If no suitable drains exist a gravel drainage sump or pipe to the side of an embankment shall be installed where applicable.

Gravel drainage sumps shall consist of 20 mm aggregate with a minimum depth of 300 mm.

8.7 Cable supports

Cables shall be supported vertically with appropriate brackets at intervals not greater than 600 mm.

If brackets are not possible then cables shall be supported vertically in cable ladders.

8.8 Access

Methods of entry to and egress from the cable pit need to be safe and easily achieved.

To achieve this pits and cable turning chambers in excess of 1.2 m deep shall have either:

(a) rungs (constructed from galvanised steel rod or equivalent material);

i. cast into the wall at a maximum of 300 mm centres;

ii. a minimum 300 mm wide and 20 mm in diameter;

iii. positioned between 150 mm and 200 mm from the pit wall.

(b) a galvanised steel ladder fixed securely to the wall at the top and the bottom of the ladder.

8.9 Covers

All cable pits and cable turning chambers shall be provided with removable covers.

In platforms, other paved areas, sealed or unsealed roads and pathways covers shall be of a trafficable design in accordance with AS 3996.

Covers shall be provided with either:

(a) recessed sockets or eyes for lifting with appropriate tools; or

(b) recessed or retractable handles so that the cover can be removed without tools.

Except for covers in platforms, paved areas, sealed or unsealed roadways and pathways, covers shall be secured to pits and cable turning chambers with padlocks or similar to guard against theft and vandalism.

8.10 Installations

All pits shall be installed in accordance with the manufacturer’s installation instructions and RIM requirements.

Pre-cast pits and cable turning chambers shall be bedded on stabilised sand not less than 75 mm thick.

Protection against erosion around and adjacent to the pit and special drainage arrangements shall be provided where pits and cable turning chambers are installed on embankments.

9 Foundations

9.1 Materials

9.1.1 Ready mix concrete and stabilised sand

Except when otherwise approved by the RIM ready mixed concrete should be used in the construction of all concrete structures.

Ready mixed concrete and stabilised sand shall comply with AS 1379.

Concrete strength at 28 days shall be not less than 20 MPa.

Where use of concrete additives is required, approval shall be obtained from the RIM.

9.1.2 Site mixed concrete and stabilised sand

The materials for site mixed concrete and stabilised sand shall be kept free of foreign matter at all times.

Site mixed concrete shall have a minimum strength of 20 MPa.

Portland cement type GP to AS 3972 should be used.

Aggregate shall comply with AS 2758.1.

Mixing water shall be clean and free from substances that can damage concrete or steel.

Chemical admixtures or fly ash shall not be used in the concrete mix.

9.1.3 Concrete reinforcing

All concrete structures and pathways shall be reinforced with welded rust free steel mesh to AS 4671 and/or steel bar to AS 1302 to meet the requirements of the calculated loadings.

9.1.4 Concrete finish

Internal concrete surfaces shall be free of voids and steel trowelled to a smooth finish.

External concrete surfaces shall be finished to a non-slip wood trowelled finish.

Concrete edges and corners shall be chamfered to minimise chipping and breaking.

Concrete surfaces shall be level except where a slope is required to form a ramp or to disperse water.

9.2 Signals and gantries

9.2.1 Location

The RIM shall ensure that the location of signal and gantry foundations is documented in accordance with:

(a) the requirements of the signalling system;

(b) the requirements for clearance;

(c) the requirements of signal sighting.

Safe access to, and egress from, all signalling assets shall be provided.

A structural factor of safety of at least 3 shall be applied in the design of signal and gantry foundations.

9.2.2 Signal foundations

The foundations for post mounted signals should be of sufficient size, shape and depth in ground to support fully dressed signals:

(a) without the need to rely on staying, bracing or the ladder for support, at wind loads in accordance with AS 1170.2; plus

(b) two maintenance staff on the signal ladder or platforms at wind loads in accordance with AS 1170.2.

Ground mounted shunt signal foundations should:

(c) be capable of supporting the signal and any attached route indicators;

(d) have a minimum depth in ground of 600 mm and a minimum cross section of 350 mm diameter.

When constructing signal foundations on complex sites such as on ash banks or on the top of retaining walls approval shall be obtained from the RIM prior to drilling or boring track retaining walls to anchor signal foundations

Signal foundations should be precast concrete, cast in situ or bored.

Signal foundations shall not obstruct track drainage arrangements.

Hold down bolts should be cast in to enable the signal posts or ground mounted signals to be bolted on and removed without disturbing the foundations.

The signal post holding-down bolts should be installed vertically in the foundation castings.

The top surface of signal foundations should be completely level.

Cable entry conduits of not less than 50 mm diameter, should be cast into signal foundations.

The portion of signal foundations visible above ground should be neatly finished with smooth surfaces free of voids. Signal foundations shall have chamfered edges.

Square foundations should be parallel to the track.

For signals in cuttings, it could be necessary to cut back and shore the bank to provide space for the signal foundation. There is also a risk of erosion or subsidence of the bank or cutting due to the signal placement. If there is a risk of erosion or subsidence, concrete or brick retaining walls should be constructed.

In areas of solid rock, the signal post holding-down bolts should be grouted into the rock.

The rock should be excavated to a depth of at least 200 mm. A concrete cap shall be keyed into this to form the signal foundation to the required height relative to rail level.

Holding down bolts should be keyed a further 300 mm into the rock.

9.2.3 Gantry foundations

Gantry foundations shall be designed to:

(a) resist wind loadings, in the terrain category applicable to the location, at wind loads in accordance with AS 1170.2;

(b) support the gantry, signal cages, signals, walkway and handrail, incidental loadings from maintenance personnel and, where applicable, overhead wiring loads.

The RIM shall ensure that the requirements for the construction of all gantry foundations are documented on appropriate engineering drawings.

9.2.4 Drainage

Foundations shall not obstruct track drainage arrangements.

Alternative drainage arrangements could include drainage ducts through the foundations or ducts or channels around the foundations.

9.3 Location cases

9.3.1 General

This section sets out the basic requirements for foundations and associated concrete structures. Additional provisions could be necessary at difficult sites such as on high banks or in swampy areas.

Location cases shall be sited outside the danger zone. Where this cannot be achieved appropriate permanent barriers shall be provided to separate personnel from adjacent rail traffic.

Location cases shall have safe and practical access provided to the location case for maintenance and construction staff.

Clear access should be provided around the location case.

Cables should be installed in a manner that prevents sagging and having undue pressure at bends or on cable terminations in the location cases.

9.3.2 Foundations

Location cases shall be mounted on secure foundations.

The base of location cases shall be not less than 300 mm above the concrete area surrounding the location cases.

Location case foundations and location case platform foundations shall not:

(a) impede drainage;

(b) lead to scouring or erosion.

Concrete or brick retaining walls should be provided where necessary to form a secure level area for location case foundations.

Location case foundation design and placement should consider:

(c) potential environmental impacts;
(d) soil types;
(e) potential flooding risks.

9.3.3 Raised platforms

9.3.3.1 General

Where it is not practical to install concrete foundations for location cases such as on steeply sloping sites and over culverts, etc. raised metal platforms approved by the RIM shall be provided.

The platform shall comply with the relevant parts of AS 1657.

The platform shall be capable of weight of the location case(s) and the anticipated number of personnel expected to maintain the location at any one time.

9.3.3.2 Construction

The platform should be supported on metal posts.

The metal supporting posts shall be securely anchored in concrete foundations. Where the ground is sandy or uncompacted, foundations shall be strip footings.

The area under the raised platform shall be enclosed.

9.3.3.3 Cable entry

Conduits, troughs and trays should be securely fixed at ground and platform level.

Cables in the vertical plane should be secured at intervals of not greater than 600 mm.

Cable entries shall be encased in 100 mm diameter PVC or HDPE conduits or in steel troughing or in enclosed cable ladder.

9.3.3.4 Vegetation and rubbish control

The area under the raised platform can be at risk from the build-up of rubbish and the growth of grass or scrub that in turn could put location case contents and associated cables at risk in the event of fires, etc.

The area under and beyond the extremities of the raised platform shall be covered with 50 mm of concrete, extending radially out 1 m.

9.4 Telephones

Telephones should be mounted on a suitable post, equivalent to a 100 mm nominal bore pipe, bolted to a concrete foundation similar to that used for a dwarf signal.

9.5 Ground frames

Ground frame bases should consist of a concrete slab of not less than 150 mm thickness with suitable bolts cast into the slab for securing the ground frame in position.

Ground frame base bolts should be long enough to permit 25 mm of timber packing between the ground frame and the concrete.

The ground frame operating platform should consist of either a pre-cast concrete channel section or a steel fabrication with grid mesh or similar non-slip decking.

The minimum width of the platform should be 600 mm or the width of the ground frame plus 200 mm whichever is greater.

The minimum length of the platform should be 1.2 m.

A step at the end or one side of the platform should be provided.

Ground frames shall be sited outside of the structure outline as defined by the RIM. Where this cannot be readily achieved appropriate barriers should be provided to separate staff of the nearby hazard of moving rail vehicles.

9.6 Enlarged-formation pads

Enlarged-formation pads are provided for the permanent mounting of specialized line-side equipment, such as that required for signalling, communications, asset protection and related power supply systems (including solar arrays).

Pad locations and dimensions should be specified during the detailed design stage, to a standard determined by the RIM.

Pads should be installed close to the track at or about formation level.

A pad may be sited lower than the track formation but should have 300 mm freeboard above the 50-year flood level.

Road access should be provided for a minimum light rigid wheelbase truck onto all such pads for the purposes of testing and maintenance of the equipment.

The access layout should be ‘drive-on, drive-off’ without reversing.

The layout should provide adequate space for at least one vehicle parking.

Where some reversing is unavoidable, the access should be laid out so as to minimize the length of reversing required.

Culverts or other suitable safe road access should be provided across significant longitudinal drains to ensure wet-weather access into and out of the site.

Where enlarged-formation pads with vehicle access ramps are provided on raised embankments, the edges / limits of the vehicle roadway should be clearly demarcated for day- and night-time use (e.g. by road marker posts with chevrons / white reflectors, as appropriate).

The RIM shall undertake a risk assessment to ascertain the requirement for traffic protection.

Traffic bollards may be an effective form of traffic protection.

Traffic bollards shall:

(a) be constructed of 100 mm nominal bore heavy galvanised steel pipe to AS 1074;

(b) include caps and shall be concreted approximately 1 m into the ground;

(c) have a minimum height above ground level of 1.2 m;

(d) be finished in gloss white enamel.

Pads should be sited outside the structure outline, and where this cannot be readily achieved appropriate safety barriers should be provided to separate personnel from the hazard of moving trains.

10 Maintenance

The RIM shall assess the asset safety and reliability risks and implement appropriate preventative maintenance activities to ensure the integrity of the asset.

11 Decommissioning

11.1 General

The RIM shall:

(a) assess the asset safety and reliability risks associated with the decommissioning and disposal of buried routes;

(b) document the appropriate controls and practices required to minimise risks associated with decommissioning and disposal.

11.2 Cable routes

All equipment post footings up to 600 mm deep shall be removed completely.

All unrecovered and decommissioned cables shall be cut-off just below the natural ground surface. Markers may be placed to identify the location of decommissioned cables.

All depressions and excavations shall be filled and compacted to the levels of the surrounding ground.

The backfill used shall be consistent with the surrounding ground.

11.3 Cable pits

Cable pits shall be broken up and removed to at least 500 mm below ground level.

Cable pits shall be filled and compacted to the levels of the surrounding ground.

The backfill used shall be consistent with the surrounding ground.

11.4 Foundations

Signal gantry foundations shall be removed to a depth of 200 mm below the immediate adjacent ground level.

Equipment post footings up to 600 mm deep shall be removed completely.

Concrete slabs shall be removed entirely.

Perimeter footings shall be removed to at least 500 mm below ground level.

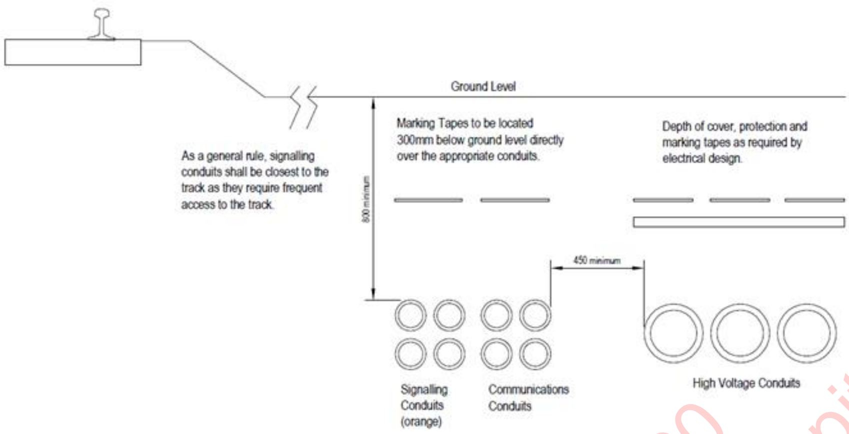
All depressions and excavations shall be filled and compacted to the levels of the surrounding ground.

The backfill used shall be consistent with the surrounding ground.

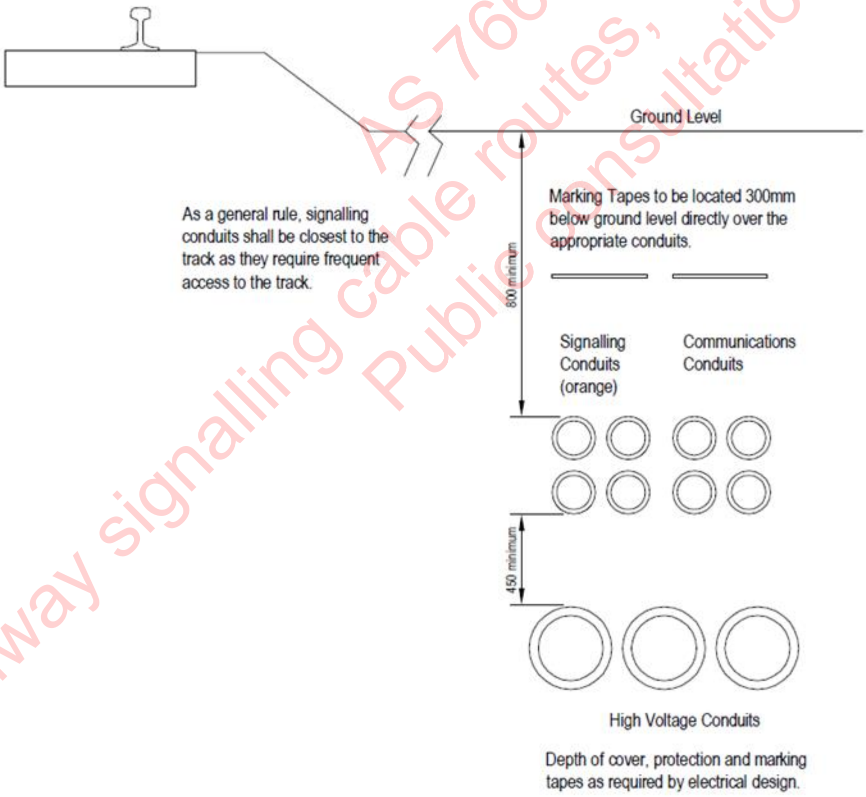
Appendix A Shared services trench

Normative

A.1 Horizontal separated power conduits



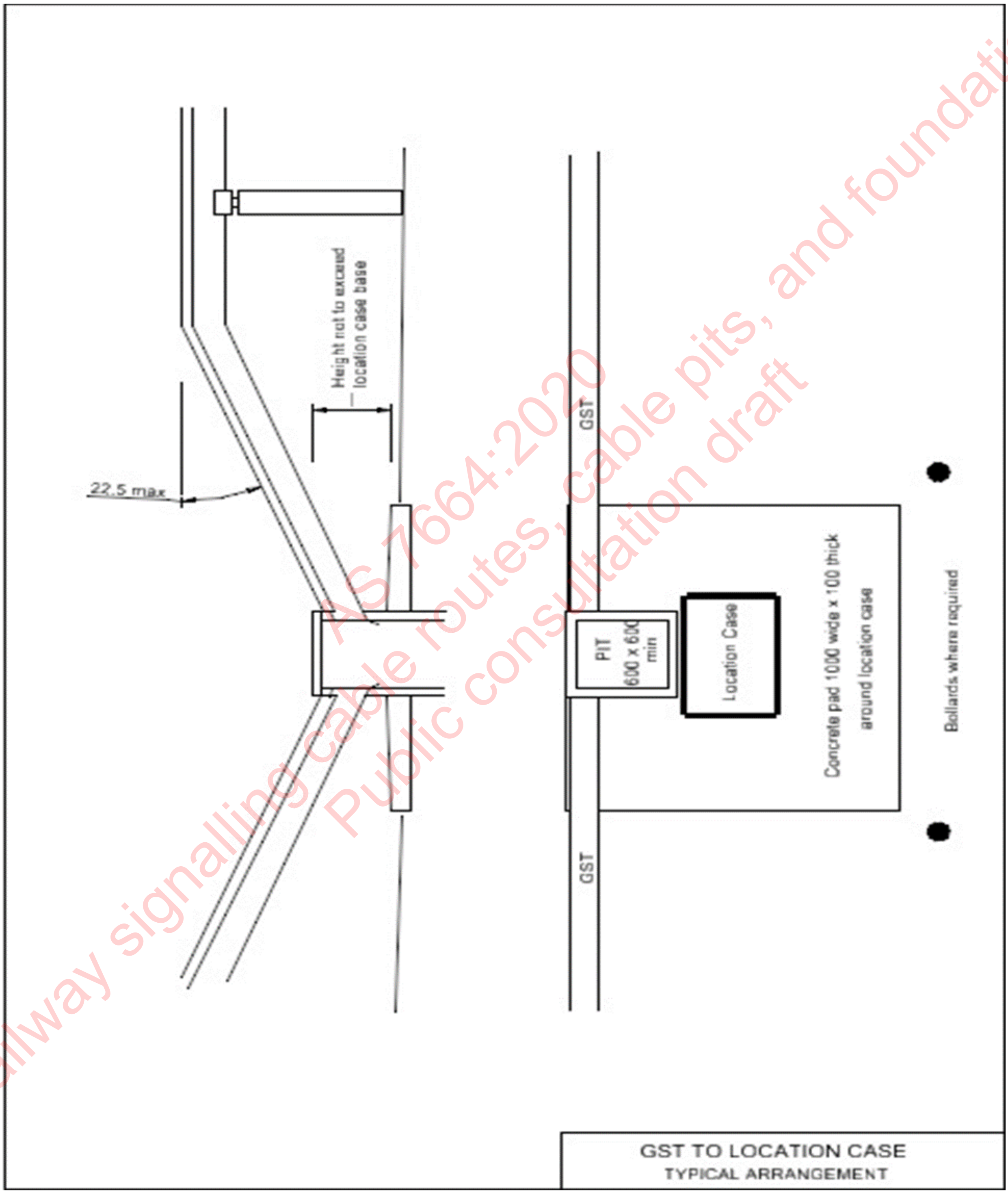
A.2 Vertically separated power conduits



Appendix B GST to location case

Normative

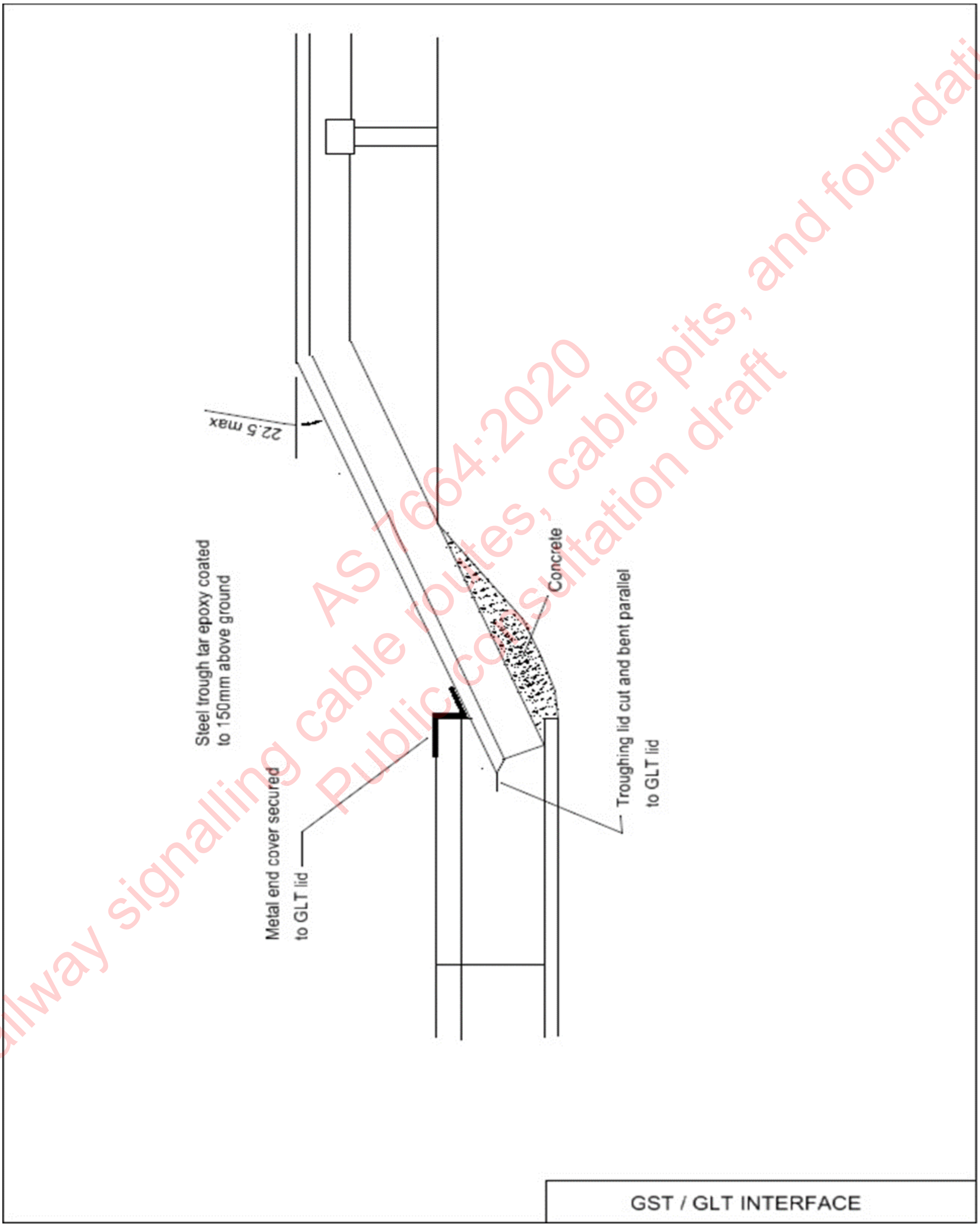
B.1 Typical arrangement



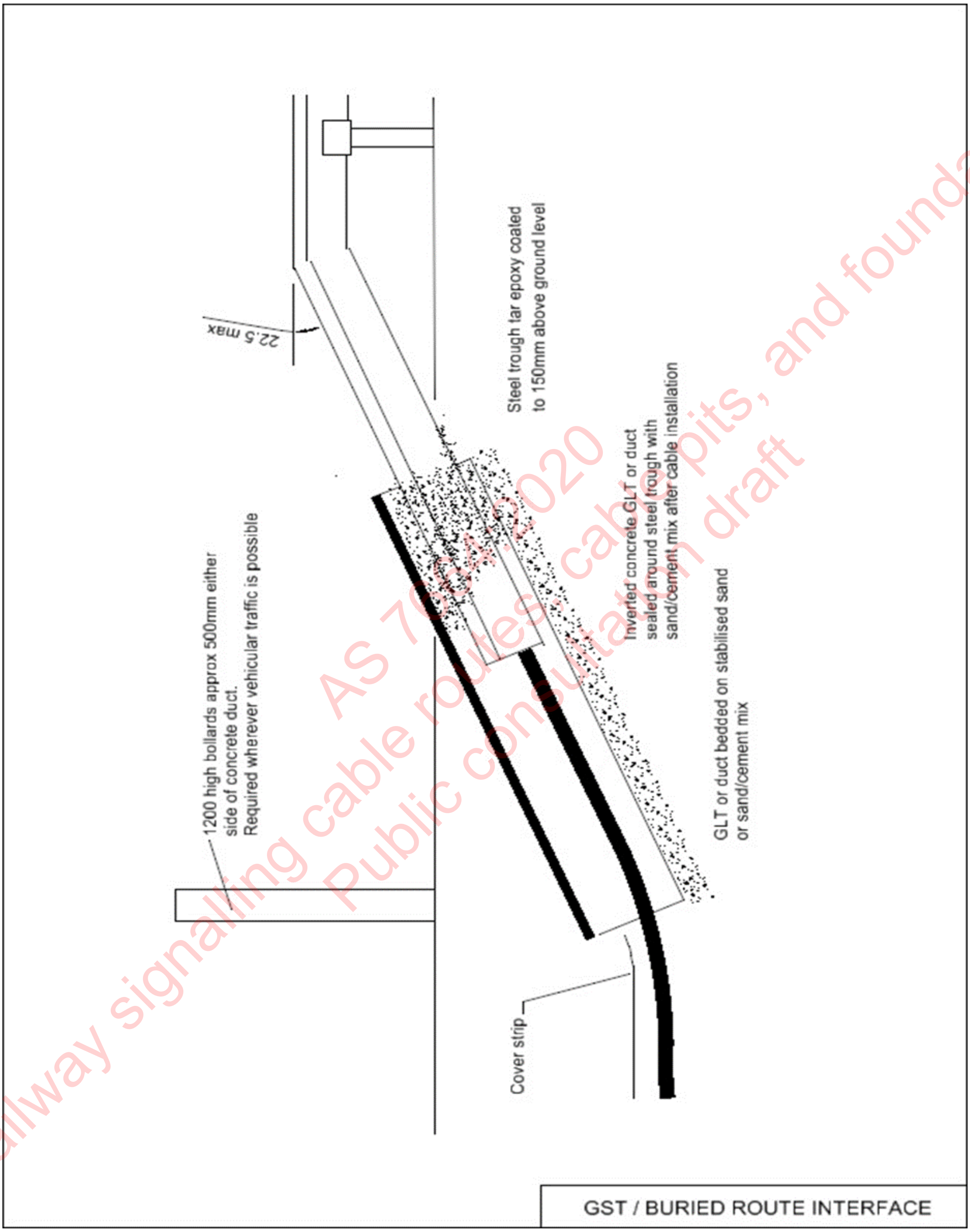
Appendix C GST transitions

Normative

C.1 GST to GLT interface



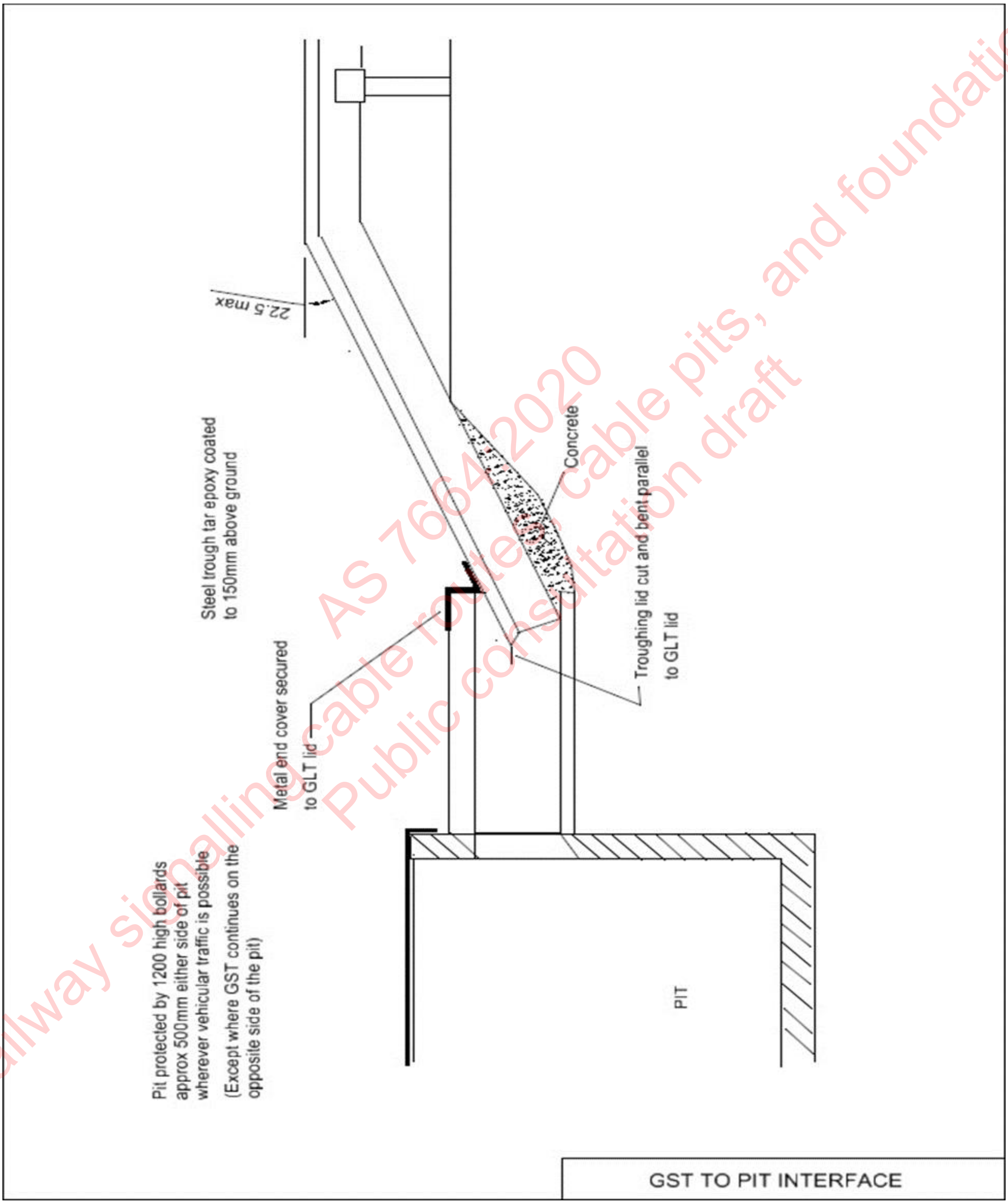
C.2 GST to buried route interface



Appendix D GST and pits

Normative

D.1 Pit interface



Appendix E Cable route selection criteria

Normative

When assessing a potential cable route the RIM should compare a minimum of 2 methods against each other across the criteria listed in Section 2.2.

An assessment should include a ranking system so that each criteria can be individually assessed. The final decision as to which method to use should take into account the individual and overall ranking for each method.

Below is a partial list of considerations for each criteria. This list should be expanded as required to suit each individual installation.

Criteria	Considerations
Cable type	Does the cable have any physical and functional requirements that could prevent installation?
Multidisciplinary consideration	Does the design and installation impede other disciplines / branches maintenance activities or future projects
Accessibility and maintainability	Services accessible during train running? Inspection access incl. through public areas? Maintenance line of sight to relevant equipment? Vehicle access to facilitate maintenance activities? Free access to track and other structures, including train crew and emergency services?
Alignment	Efficiency of alignment: Direct cable run, or multiple turns? Number of URXs and UTXs? Minimum length local cables? Impact of cable turns on other assets? e.g. embankments
Cable failure and repair	Maintenance plan: how will cables be replaced? Cable loops/slack for future re-termination? Temporary cable run option? Do inaccessible services have redundancy?
Security and cable protection	Public access minimised? Vandal/theft opportunity minimised? UV protection? Vermin/wildlife resilience?
Standards compliance	Existing RIM standards and policies? Diversity? EM separation? Trunk routes: High voltage? Separation of maintenance access? Electrical safety & construction safety
Infrastructure layout and aesthetics.	Compromises to urban design or landscape? Achieve preferred location of equipment rooms and housings? Impact on community amenity, e.g. pits in public access areas, visual clutter

Criteria	Considerations
	from obvious services transitions?
Other services and infrastructure	Impact to structures within and outside the rail corridor? Alignment with above and underground services, both internal and external?
Constructability	Project staging for combined services routing?? Construction risk and network operations risk during construction? Impact on occupation time? Expected productivity rates?
Environment and sustainability	Material & spoil disposal? Drainage & waterways, e.g. impact on water table, floodplain, acid sulphur soil etc. Flora/fauna impact incl. protected sites, environmental zones, removal of vegetation? Local environmental requirements?
Services	Transitions of cables from grade to a viaduct/cutting? Number of services, number of transition points? Design solution for services risers, ramps, at stations? Minimum cable bends? Cable Installation, inspection & replacement on riser?
Whole of life considerations	Whole of life cost effectiveness for its planned lifetime? Provision for upgrades during cable route lifetime? Provision for spares for planned future projects? Compromises or obstructions to future projects?

Appendix F Bibliography

The following referenced documents are used by this Standard for information only:

- AS 2041 Buried corrugated metal structures.
- AS 5000.1 Electric cables - Polymeric insulated, Part 1: For working voltages up to and including 0.6 / 1(1.2) kV.

About Rail Industry Safety and Standards Board

The Rail Industry Safety and Standards Board is a not for profit company limited by guarantee. Wholly owned by its funding members, RISSB is required to apply the whole of its income and assets to achieving the objects listed in its constitution.

RISSB is responsible for the development and management of Standards, Rules, Codes of Practice and Guidelines for the Australian rail industry.

For further information, visit www.rissb.com.au

RISSB Australian Standards Development Process

The Standards development process is rigorous and transparent.

Authors work with RISSB's Standards Development Managers and Development Groups to ensure that products are acceptable to industry. Standing Committees oversee this work and ensure that proper governance and process is followed. The products are exposed to the public and industry for comment and validated by an independent validator.

Once agreed by the Development Groups, Standing Committees and Validator, the drafts are passed to the RISSB Board for approval.

The same process is used in developing other RISSB products, although Guidelines are not exposed to the public for comment or validated, given their non-binding nature.

Standards Development and Accreditation Committee

RISSB is accredited by the Standards Development and Accreditation Committee (SDAC), and all Standards produced by RISSB since 31 July 2007 are published as Australian Standards.

The Standards Development and Accreditation Committee audits RISSB annually to ensure that RISSB's processes are in accordance with SDAC accreditation requirements.

Sales and distribution

Australian Standards developed by RISSB are sold and marketed through SAI Global. For further information, please visit www.saiglobal.com.

Financial members of RISSB are granted access with membership.

RAIL INDUSTRY SAFETY AND STANDARDS BOARD

ABN 58 105 001 465

For information regarding the development of Australian Standards developed by RISSB contact:

Rail Industry Safety and Standards Board

Brisbane Office
Level 4, 15 Astor Terrace
Brisbane, QLD, 4000

Melbourne Office
Level 4, 580 Collins Street,
Melbourne, Vic 3000

PO Box 518
Spring Hill, QLD, 4004

T +61 7 3724 000
E Info@rissb.com.au

For information regarding the sale and distribution of Australian Standards developed by RISSB contact:

SAI Global Limited
Phone: 13 12 42
Fax: 1300 65 49 49
Email: sales@saiglobal.com
http://infostore.saiglobal.com/store

ISBN: Enter ISBN.