TRENCHING, LAYING AND HAULING IN OF COMMUNICATION CABLES

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I DOCUMENT AUTHORISATION

FUNCTION	NAME	TITLE & DIVISION	SIGNATURE	DATE
Compiled by :	F Nel	Senior Engineer, Project Services	*Signed F Nel*	27/03/2008
Reviewed by :	BG Nel	Technologist, Quality Assurance	*Signed BG Nel*	27/03/2008
Authorised by :	M Nuttall	Divisional Manager, Transmission	*Signed M Nuttall*	27/03/2008

II DISTRIBUTION

Once updated, a copy of the latest revision will be published in the document management system in use. E-mail to this effect will be sent to the relevant personnel or heads of department.

III DOCUMENT CHANGE HISTORY

ISSUE NO.	DATE ISSUED	HISTORY DESCRIPTION
1.1	September 2002	5 additions, deletions and changes to clause. Updated subclause 3.1.9 (b) and added (c)
2.00	March 2006	Document converted to ISO format and minor changes
3.00	September 2006	Included in Section 6 – SANS 10340-2 Installation of Telecommunication Cables Part 2 : Outdoor Fibre Optic Cables
4.00	January 2008	Updated specification. Change preferred cable position. Change cable markers

IV CHANGES SINCE LAST REVISION

CLAUSE	DESCRIPTION
2.1	Delete within 2,5 and inserted 3.0. Delete centre line and inserted centre line of the nearest brack
2.6	Delete SABS specifications
3.	Delete clause 3 and insert new clause 3

V ABBREVIATIONS, ACRONYMS AND DEFINITIONS

ABBREVIATIONS AND ACRONYMS	DESCRIPTION
AASHO	Measurement of Soil Density
APL	Aluminium Polythene Laminate
HDPE	High Density Polyethylene
PVC	Polyvinyl Chloride (common plastic material)
SANS	South African National Standards

DEFINITIONS	DESCRIPTION
None	

VI RELEVANT DOCUMENTATION

The following drawings and specifications will be supplied by Transnet Freight Rail and must be read in conjunction with this specification.

APPLICABLE

DOCUMENT NO.	DESCRIPTION	LOCATION
SANS 32:1997 and SANS 121:1999 /	Hot-dip (Galvanized Zinc Coatings)	Must be obtained by Tenderer
SANS 1034-2	Installation of Telecommunication Cables part 2 : Outdoor Fibre Optic Cables	Must be obtained by Tenderer

RELEVANT

DRAWING NO.	DESCRIPTION	LOCATION
H0180300	Method of Marking Communications Cables Using Cable markers	Multi Design
H0180400	Route Marker for Telecommunication Cables	Multi Design

1. SCOPE

1.1 This specification covers the criteria to be adhered to when installing telecommunication cables for Transnet Freight Rail either by hand or mechanical means.

1.2 The cable characteristics will be covered in separate specifications.

2. TRENCHING AND LAYING OF CABLES

2.1 The cable must be laid directly in the ground on the property of Transnet between the fence line and track formation, 3,0 metres from the centre line of the nearest brack. The exact location will be decided at the site inspection and/or as shown on the attached line or trench route plans.

2.1.1 Cable laying on the formation, especially bank formations must be avoided to ensure the integrity of the formation. This will only be allowed in exceptional circumstances at the discretion of the Project Manager, in which case the nearest edge of the trench shall be a minimum distance of 2,5 metres from the centre line of the track. Cables must not be laid on the formation for distances more than 0,5 km without the prior approval of the Project Manager. Cable trenches on the formation must not be left open for longer than 24 hours.

NOTE: *The formation is defined as being three metres from the centre line of the nearest track.*

2.1.2 Cables that are crossing waterways may be placed behind headwalls of culverts and on bridges, by arrangement with the Project Manager.

2.1.3 In tunnels, cables shall be positioned in the ducts or sleeves provided, or if these do not exist, the cable must be positioned to ensure maximum safety from passing trains and from persons tampering with the cable.

2.1.4 Spur cables to telecommunication equipment located on the formation must, where possible, be at right angles to the track. The cables must be properly protected and marked as specified in clause 3 of this specification.

2.1.5 **In station areas**

2.1.5.1 Cables may be laid in station platforms and in special cases suspended on platform walls but only by arrangement with the Project Manager.

2.1.5.2 No trenches shall be left open unless properly barricaded.

2.1.5.3 The safety and free access of passengers and personnel must be assured at all times.

2.1.5.4 No coloured or white warning lights shall be displayed in view of train personnel.

2.1.5.5 The trench backfill must be consolidated to not less than 93% of modified AASHO maximum dry density and the surface restored to conform to the existing materials and standard of construction.

2.1.6 Cables may not be laid in maintenance service roads without the prior approval of the Project Manager. The Contractor may be required to deviate the service road to the satisfaction of the Project Manager. The backfilling of trenches must be consolidated and the surface made good to conform to the original condition of the road.

2.1.6.1 No trench must be left open for more than seven (7) days.

2.1.6.2 Danger signs and barricades must be erected.

2.1.7 Table drains and waterways must be left free from obstructions. If catchwater drains or mounds are intersected by cable excavations, temporary arrangements shall be made to provide other means of diverting water to keep it out of cuttings.

2.1.8 Ballast, if disturbed, must be left clean and packed to its original profile.

2.2 The cable must be laid at the following minimum depths measured to the bottom of the cable :

2.2.1 In soil and soft ground : 800 mm .

2.2.2 In ash : 800 mm . The cable must be surrounded with 300 mm of approved soft soil.

2.2.3 In difficult rock conditions i.e. shale, sandstone, laterite (ouklip), calcrete (limestone) a trench of 400 mm is required. Sharp edges in the trench must be removed, and the trench must be soft-soiled with 150 mm of approved material before cable laying is commenced. The soft-soil must pass through a 12 mm riddle. No ducting will be required over the cable, but the trench must be carefully backfilled with approved material and the flow of the any water checked by means of a band placed at an angle across the top of the trench. In dolomitic areas or in areas where the railway line is cutting in and the dip of the substrata is towards the line, the excavations shall be kept dry. Backfilling shall be to not less than 93% of modified AASHO maximum dry density. If cables are laid by cable laying machine, the cut in the ground must be closed and sealed so as to exclude water. Where a depth of 200 mm can be obtained, the cable can be placed in ducting and surrounded by concrete up to ground level.

2.2.4 In solid rock

Alternative (i) 200 mm

The cable must be protected by approved HDPE pipes or similar approved protection, covered with a 150 mm thick layer of concrete. The mixture of which shall be 1:3:5 and shall contain no mine dump sand.

Alternative (ii)

In concrete troughing. Concrete mixture as in alternative (i) the trough must be filled with approved grit. The Project Manager must approve the troughing.

Alternative (iii)

The cable may be supported and enclosed by approved HDPE pipes on concrete pedestals, grouted into the rock surface. The height of the pedestals shall be determined by the contour of the rack face to ensure a minimum clearance of 200 mm . The pedestals must be spaced at regular intervals and will be dependent on the rigidity of the cable and ducting, ensuring the safety of the cable against damage and preventing any sagging that might occur. The concrete mixture shall be as in alternative (i).

The tenderer must quote for all three alternatives, subclause 2.2.4(i); (ii) (iii) where applicable. The method which will be adopted, shall be at the discretion of the Project Manager.

(a) At depths less than 400 mm, the cable shall be protected with approved HDPE pipe.

(b) In service roads no cables shall be laid at a depth less than 600 mm. Approved HDPE pipe must be fitted from a point 2 metres before entering and a point two metres after leaving the road. 150 mm of soft-soil must surround the cable at a depth of between 600 m to 800 m, 75 mm above and below the cable.

(c) Next to the ballast, i.e. on the formation : 400 mm below formation level. The cable must be protected with an approved HDPE pipe for its whole length on the formation.

(d) No deviation from the above will be accepted.

2.2.5 The tenderer must quote unit rates for each depth of trenching. These rates will apply for any additional work only, as no adjustment of quantities will be granted for ground conditions not properly investigated.

2.2.6 The prices requested to be submitted by the Contractor must include the prices for excavating, backfilling and compacting the trench where this method of laying the cables is adopted.

2.3 The quotations submitted by tenderers must include the cost of the following :

2.3.1 The removal of vegetation where the execution of work requires this to be done.

2.3.2 Crossing provincial and municipal roadways including the cost of restoring the road surface to its original standard by the authority concerned and the preparation and submission of drawings required.

2.3.3 The tenderer must quote for all additional items not specifically shown in the attached route drawings or schedules of materials, but required for the successful laying and protection of the cables.

2.4 The base and sides of all trenches must be suitably levelled before cables are laid. Where trenches are dug in rocky ground or in solid rock, the base of such trenches must be free from jagged rock to avoid puncturing of the sheath.

2.4.1 Depending on ground conditions, joints must be buried at a depth corresponding to the cable depth but a minimum depth of 200 mm above the joint closure must be ensured. The cable must be protected up to and over the joint closure where necessary.

2.4.2 Laying of the cable, or sub duct, must not be undertaken before the Project Manager or his deputy has inspected the trench. The Project Manager or his deputy will inspect a trench length of approximately 2 000 metres at a time (1 000 metres within station limits, on the formation and in confined areas) and will require notice seven (7) days in advance of the date that the trench is expected to be ready.

2.4.3 The cable must be laid within three (3) days and the trench backfilled calculated from the date of inspection, or within twenty-four (24) hours for trenches on the formation and in public areas.

2.5 Direct laying is preferred to physical trenching and the tenderer must give full particulars of the methods and equipment to be used as described in clause 5 of this specification.

2.5.1 Before direct laying or mechanical trenching is commenced the Contractor must do a thorough inspection with the aid of ground penetrating radar or similar device, to prevent the severing or damaging of any existing underground services.

2.5.2 The Contractor shall guarantee that the correct cable/duct depth is maintained throughout, regardless of undulating ground or ground conditions.

2.5.3 Depth checks will be made during the final inspection.

2.6 The Contractor's attention is particularly drawn to allowing sufficient slack in the cable at the following places to allow for any future eventualities.

2.6.1 At joints — A 5 metre overlap in each length or cable (before jointing).

2.6.2 At bridges — A 5 metre loop at both ends of the bridge.

2.6.3 At level crossings — A 5 metre loop on both sides of the road.

2.7 Where trenches are excavated on the formation, on the slopes of embankments, or on the slopes and floors of cuttings other than in rock, they shall be backfilled to the level of the ground or earthworks before the trenching was commenced. On completion of the laying of cables or pipes in trenches, filling material of approved soil, earth or gravel, shall be placed in layers not exceeding 200 mm in loose thickness before compaction, and each layer shall be compacted by a mechanical rammer, or other approved powered tool, to not less than 93% of modified AASHO maximum dry density. Where necessary, water shall be added to obtain the specified compaction. Each layer shall be completed before the next layer is commenced. The contractor shall be responsible for ensuring that no damage is caused to the cable of pipe from the filling and compaction, and shall take such steps as are necessary to prevent any damage, including the provision of concrete slabs or other approved means of protection. No trenching whatsoever may be undertaken on the formation or holes dug in the formation without authority from the Project Manager who will arrange the necessary supervision and inspection.

2.7.1 Where trenches are excavated in rock, the contractor shall dispose of the excavated material as directed by the Project Manager. Approved material for backfilling shall be obtained from sources approved by the Project Manager.

2.7.2 Where trenches are excavated elsewhere, excluding dolomitic areas, normal soil consolidation methods may be employed provided any backfilling on the trench will not obstruct or divert the natural water flow in such a way as to lead to erosion. Freedom from erosion of the trench itself and freedom from erosion caused by the trench must be guaranteed. In dolomitic areas backfilling shall not be less than 90% of modified AASHO maximum dry density.

2.7.3 The contractor will be responsible for repairing erosion of the backfilled trenches that occurs up to the end of the guarantee period at his own cost.

2.7.4 Where soil-creting (soil cement mix) is required, it must be provided on a 1 to 14 basis.

2.8 Particular care must be taken when laying the cable that the outer sheath is not damaged in any way, i.e. the cable must not be dragged along the ground nor be allowed to come into contact with sharp objects. Cable rollers must be used. The rollers must be spaced at regular intervals at distances dependent on the rigidity of the cable and its safe passage.

2.9 As certain types of sheathing or covering become hard and brittle at temperatures below 10 °C, no attempt must be made to lay cables when the ambient temperature falls below this limit.

2.10 The replacement of made-up and concreted surfaces such as roads, pavements, platforms, hydroseeded of grass surfaces, grass sodding etc., necessitated by trenching, must be arranged by the contractor and the cost thereof included in the tender price.

2.11 Any damage caused by the Contractor to buildings, made-up surfaces, water mains, catchwater drains, mounds, etc., must be restored to the original standard, at the Contractor's own cost.

2.12 Particular attention is directed to the requirement that no permission will be granted to trench beneath any railway tracks without Spoornet supervision.

2.13 All cables crossing beneath railway tracks and roads must be enclosed in 100 mm diameter SANS Class 6 PVC pipes. Where more than one length of pipe is required to complete the crossing, the pipes must be properly joined. The ends must be suitably closed against soil and water entry after the cable has been hauled in.

It will not be necessary to lay spare pipes unless this is requested by the Project Manager.

2.13.1 All pipes laid beneath railway tracks and roads must be laid with their tops at a minimum depth of 600 mm below formation or road levels.

2.13.1.1 Cables laid on the formation at track crossings must be protected by HDPE ducting up to a point where it enters the pipe crossing the tracks.

2.13.2 Where pipes are laid beneath tracks, the pipes must extend at least 3 metres beyond the centre line of the first and last track. Pipes must never end under the ballast.

2.13.3 Where pipes are laid beneath roads, the pipes must extend for a minimum distance of 1,5 metre on either side of the road or sidewalk.

2.13.4 When crossing existing pipes or cables, ducting must be fitted to extend one metre either side of such cables or pipes.

2.13.5 All pipes that are laid must be graded for water drainage and the minimum grade required is 1 in 300.

2.13.6 Under tarred roads or hard standing areas, cable must be piped at full depth.

2.14 The laying of cable in eroded ground must be avoided. Where it is not possible to do so, the cable must be laid in the formation on receipt of approval from the Project Manager.

Where cables have to cross bridges, culverts and ditches or go through tunnels, the following requirements must be met :

2.14.1 On bridges, the cable and associated duct route must be such that, in the event of the bridge being widened, demolished or rebuilt, it must be possible to remove the cable and associated ducting from the bridge without having to cut the cable. On new or proposed concrete bridges, a concrete duct with covering slabs will be provided to accommodate the cable. Over existing concrete bridges where no concrete duct has been provided, the cable must be run in galvanised metal ducting which must be properly secured to the concrete at two metre intervals. This ducting must be positioned to avoid damage to the cable by objects protruding from train wagons.

2.14.2 Where cables cross steel bridges, ducting supporting the cable must be used and must be securely clamped to the bridge at such intervals that it will support the cable effectively without any tendency to sag. The cable and ducting on concrete and steel bridges must be protected against damage by objects falling from trains either by an inverted galvanised channel iron over the cable and ducting or, alternatively, tenderers may propose a more economic means of meeting this requirement, e.g. positioning the cable and ducting such that bridge structures act as protection.

2.14.3 Tenderers must state how they propose to clamp ducting to girders and anchor ducting to concrete bridges and also the proposed protection against falling or protruding objects.

2.14.4 Expansion joints in duct protection or support metal work must be provided for on piers or wherever expansion of the bridge or rails has been allowed for. The expansion gap in the ducting (min. 20 mm) must be covered with a clamped split hose of approved material.

2.14.5 Expansion chambers must be provided for on the following basis :

(i) Bridges up to 50,0 metres — Nil
(ii) Bridges 50,0 metres — 150 metres — 1
(iii) Bridges longer than 150 metres — 2

Cable slack must be left in the chamber without exceeding the minimum bending radius of the cable. The expansion chambers must be approved by the Project Manager.

2.14.6 Where cables have to cross culverts and ditches, the following methods of crossing them should be considered in the given order of preference :

2.14.6.1 Trench under ditch or watercourse, if the safety of the cable can be ensured by this method. Ducting must be used. The cable must further be protected by stone paving or a concrete slab, should any further danger of erosion exist.

2.14.6.2 Enclose cable in metal duct and support duct on inverted steel rail (to be supplied by Transnet Freight Rail) over ditch or watercourse. Where the exposed rail length exceeds 3,0 metres, the rail must be supported on concrete or steel plinths with substantial foundations at intervals not greater than 3,0 metres. The duct must be securely clamped to the rail at intervals of not greater than 1,5 metres. The rail must be founded 1,5 metres into either side of the culvert or ditch wall. The height of the suspended rail and ducting must be above the archway of the culvert. The trench entering the walls of the water-course must be protected against erosion, by stacking stones on the slope with cement grouting to retain them.

2.14.6.3 Where cables have to cross on the side of a culvert owing to the impracticability of carrying out subclauses 2.14.6.1 or 2.14.6.2 above, such cables must be protected by ducting, effectively suspended or secured to the culvert at maximum intervals of 2,0 metres. Ducting must be used from the point where the cable leaves the trench depth to the point where it reaches the trench depth again.

The ducting must be suspended or secured on the culvert above the top of the soffit or archway. Durapipe bends or bends of similar material must be used to lead the cable from the base of the trench to the ducting, or anywhere where heavy bends in the ducting are required.

Tenderers must supply details of the above proposed methods of crossing culverts and ditches. Tenderers are to note that under no circumstances will a variation order be considered for extra costs where the ground formation is such that cable is required to be laid at a depth greater than the specified minimum, or where difficulty is encountered owing to flood waters, etc., obstructing progress.

2.14.7 Where cables have to pass through tunnels they must be enclosed in metal ducting supported on and affixed to inverted L shaped brackets attached to the wall of the tunnel at intervals not exceeding 1,5 metres and at a height safe from objects protruding from train wagons. The cable route through the tunnel must be such that it presents no obstruction to people entering refuge alcoves in the wall of the tunnel (see subclause 2.1.3).

2.15 Cable creeping in pipes, pipe and chamber systems or ducts on slopes and inclines must be prevented. Details of the tenderer's proposed method to prevent creeping of the cables must be submitted with the tender.

2.16 All mild steel ducting installed must be galvanised in accordance with specification Number SANS 32:1997 and SANS 121:1999. Where ducting made from a metal other than mild steel is proposed, tenderers must furnish information on anti-corrosive protection and mechanical strength of such ducting.

2.16.1 The metal ducting must have a minimum wall thickness of 2,0 mm and a tensile strength of not less than 310 mPA . The ducting where exposed as on bridges, culverts and in tunnels must enclose the cable completely and be of a design which does not permit the ready ingress of water.

2.16.2 All brackets, clamps, saddles or other fittings in tunnels and on culverts or bridges must be galvanised in accordance with specification number SANS 32:1997 and SANS 121:1999.

2.16.3 No alterations to bridges and tunnels such as making of holes, the firing of bolts, screws etc., or the welding of material will be allowed without the prior authority of the Project Manager. Details of how the Contractor proposes to overcome obstructions such as tunnels, rock outcrops and ravines, must be supplied.

2.16.4 To avoid stray currents flowing into steel bridge structures, the ducting enclosing the cable crossing the bridge must be electrically insulated in such a manner that the bridge and sections of ducting over the length of the bridge are effectively electrically isolated from the sections of ducting entering the ground. Detailed drawings of the proposed method must be submitted.

3. CABLE MARKING

3.1 Due to theft and vandalism, no visible cable markers shall be deployed. Joints, spurs and direction changes must be indicated by passive transponders placed directly above the cable (buried).

3.2 The cartesian co-ordinates of all transponders placed must be recorded in the detailed as-built drawings.

4. HAULING CABLE IN PIPE AND CHAMBER SYSTEMS

4.1 Before any length of cable is hauled into an existing or new pipe and chamber system, the Contractor shall verify that it takes up the route position allocated to it.

4.2 The cable shall be hauled into pipes or sub ducts by hand or means of a winch and hauling jig. All the necessary hauling gear shall be supplied by the Contractor.

4.3 The Contractor must at his own expense ensure that all pipes are cleared of material, which may damage the cable. A mandrill must be used for this purpose.

4.4 The direction of hauling shall be such that the clockwise end (**RED**) is jointed to the anti-clockwise end (**GREEN**) of the preceding length. Where a length is required to be hauled in the reverse direction, the cable length must be redrummed to ensure that the correct ends are facing each other after the cable has been hauled in.

4.5 Where it is necessary to haul the cable through a break in the pipeline, precautions shall be taken to avoid damage to the cable. This requires the cable to be manhandled at all such points to ensure that there can be no possibility of damage to cables from pipe edges.

4.6 If the Contractor during the course of his duties as specified is required to work in any manhole whether or not constructed by him, he will be responsible to pump out any water and clean the manhole at his expense, before commencing with work, and on completion of the work.

4.7 During the process of hauling in extruded metal-sheathed cables, a pressure gauge shall be attached to a Schrader valve fitted on the inner drum cable end and shall be checked to confirm that the pressure has been maintained and leaks have not developed. In the case of APL sheathed cables the air pressure need not be maintained during the hauling process. The cable shall be re-pressurised after the hauling process and the pressure allowed to stabilise. The pressure shall be checked before jointing is commenced to conform that the sheath has not developed leaks during the hauling process.

4.8 Sufficient slack shall be left in the jointing chamber to ensure that the joint can be correctly positioned in the chamber. Where a cable or sub duct has been hauled through two sections of pipe without having to be jointed in the intermediate manhole it shall be bent into position to rest on cable supporting hangers or brackets in the intermediate manhole.

4.9 Non-armoured metal sheathed cables shall not be lubricated with petroleum jelly during the hauling process. Lubrication of Polymer sheath cable is only permitted by using talcum powder, graphite powder or approved cable lubricating fluids.

5. DIRECT LAYING OF COMMUNICATION CABLES

5.1 General

5.1.1 The Contractor must submit a complete plan and procedure for the direct burial of copper or optical fibre cable, using a direct laying or mole ploughing machine. The procedure will include a complete description of the machinery (hardware) to be used.

5.1.2 The Contractor must submit the qualifications of the operator(s) to be employed, including the level of training (certification) for this type of installation.

5.1.3 The Contractor must submit the workflow to be employed during the direct burial of the communications cable.

5.2 Machinery Requirements

5.2.1 The machinery must be fitted with an automatic cable tension control equipment, to avoid any stresses on the cable as it is laid into the ground and ensure a proportionate unreeling process.

5.2.1.1 The Contractor must submit details of the control devices intended to be used, for approval by the Project Manager.

5.2.2 The machine must, where applicable, be equipped with a vibrating plough-share, which vibrates in a vertical direction to loosen the soil and secure that the fine sand content falls to the bottom of the trench surrounding and protecting the cable.

5.2.2.1 The cable laying section (cable chute) has to be vibration-free and shall be equipped with free wheeling rollers suitable for all types of cable including fragile coaxial and fibre optic cables.

5.2.2.2 The minimum bending radius of the cable chute shall be one (1) metre to allow for all sizes and types of cable.

5.2.2.3 The cable chute shall be split in two parts, so that one section can be re moved manually, in case the plough strikes an obstacle, and the cable can be removed without damaging it.

5.2.3 The cable drum mounting shall be fitted with a mechanical drum brake and be capable to accommodate cable reels up to 3 000 mm in diameter and 5 000 kg of mass.

5.2.3.1 The direct laying machine must remain in a proportionate balance, even when the cable reels have 0% of its original length remaining on the drum.

5.2.4 The machine should be equipped with an attachment, which allows to move the cable chute side-ways in both directions to enable direct burial operation close to fences and boundaries (off-set burial).

5.2.5 The machine has to be equipped with guide rollers and a roller quadrant, to avoid damage to cables while unreeling.

5.2.6 A claxon has to be installed near the cable chute operator, so that the driver can be warned in case of an unexpected obstacle.

5.2.7 The lifting mechanism has to have enough power to raise the tracks of the dozer from the ground. This ensures the capability of the machine to always secure the required cable laying depth.

5.2.8 All operations of the machine must be carried out hydraulically.

5.2.9 The machine should have sufficient capacity to guarantee a cable laying depth of 1 500 mm, a laying diameter of 50 mm and a daily cable laying speed of 5000 linear metres at maximum depth.

5.2.10 A marker tape must be installed, at the discretion of the Project Manager, 300 mm above the cable. This is generally only required in station and built-up areas, however the Project Manager will decide whether this is a requirements in the section between stations.

END OF DOCUMENT