

Ref:	NR/GN/TEL/30139
Issue:	1
Date:	06 March 2010
Compliance date:	N/A



Guidance Note

NR/GN/TEL/30139 The Survey and Design of Telecoms Cable and Route

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Published and Issued by Network Rail, Kings Place, 90 York Way, London. N1 9AG.

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Compliance date:	N/A

Issue Record

Issue	Date	Comment
1	6 March	First issue

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1 Purpose

This document provides guidance to the design and surveying of telecom cables and telecoms cable route.

2 Scope

This document provides guidance to the key aspects which should be taken into consideration when the Principal Contractor or a project is engaged with the design and surveying of telecoms cable and cable route. The practices detailed are based on those adopted by the FTN / GSM-R Project. The project should be clear in whether it is planning to follow this guidance in full or only in parts.

This document is split into two main components:

1. Cable and route survey;
2. Cable and route design.

References are made to other documentation which specifies the requirements for safety and construction.

3 Definitions

AC	Alternating current
AT	Auto Transformer
ATEH	Active Trackside Equipment Housing
BOP	Box On Post (for terminating up to 30 copper cable pairs)
BoQ	Bill of Quantities
BT	Booster Transformer
BTS	GSM-R Base Transceiver Station
Bump off location	Trackside location where the installers may temporary place pallets of troughing etc for installation.
CAT	Computer Aided-Tomography
CCTV	Closed Circuit Television
CRE	Contractor's Responsible Engineer
DBS	Directly Buried Sub-duct
DC	Direct current
DI-SAC	Double insulated super armoured optical fibre cable
DSL	Digital Subscriber Line
ELR	Engineer's Line Reference
FTE	Fast Transient Earth

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FTN	Fixed Telecommunication Network
GLT	Ground Level Troughing (same as SCT)
GPS	Global Positioning System
GRC	Glass reinforced Concrete
GRP	Glass Reinforced Plastic
GSM-R	Global System for Mobile communications for Railways
HDPE	High Density Polyethylene
LX	Level Crossing
M	Metres
MDF	Main Distribution Frame
MLoR	Master Line of Route
mm	Millimetres
MP	Mile Post (and metres) reference
NTPO	National Telecoms Project Office
OmniCom	High quality, point-referenced video of the track
OSGR	Ordnance Survey Grid Reference
PZT	Point Zone Telephone
PVC	Polyvinyl Chloride
Principal Contractor	Contractor responsible for the design and implementation of the cable route irrespective of whether the work is sub contracted or not.
RC	Return Conductor
REB	Relocatable Equipment Building
REC	Regional Electrical Company
RC	Return Circuit
RR	Relay Room
S&T	Signals and Telecommunications
SCT	Surface Concrete Troughing (same as GLT)
SLD	Surface Laid Duct (now discarded)
SPT	Signal Post Telephone
TOC	Train Operating Company
UFx	Under Farm Crossing
UFtX	Under Foot Crossing
uPVC	Unplasticised Polyvinyl Chloride
URX	Under Road Crossing

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UTX Under Track Crossing
ZHLS Zero Halogen, Low Smoke

4 Tools for Cable Route Survey

The surveyor should be fully equipped with all the necessary tools which will include:

- Measuring wheel;
- Mandrel;
- Gas Detector;
- Shovels;
- Approved CAT scanner;
- GPS Receiver;
- Duct rods;
- Keys;
- Tape Measure.

5 Cable Route Survey Data Capturing

5.1 Survey

The cable and cable route surveyor is expected to have a good general understanding of the cable route design rules or requirements which may include location of new trackside cabinets and cable diversity before visiting the site.

The purpose of the survey is to capture information on:

- The type and size of the existing cable route;
- The conditions of existing cable route and the work required to make it suitable to accommodate additional cables required by the project;
- The spare cabling capacity available in existing cable route and whether it is sufficient for the project;
- The works required to adopt the existing route to meet the design rules and requirements. This may include upgrading of the existing cable route to the next size, installation of a new parallel route, etc;
- The identification of fragile cables within the cable route;
- The identification of trackside hazards including environmental issues and ground contamination;
- The identification of access point and suitable bump off locations;
- The electrification type in the area (AC or DC) and transformer type (booster, auto, etc.)

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- If the cable route is in a green zone. If not record what measures are needed to create a green zone, include any lines which will be affected.

The survey data should be presented in an electronic format such as Excel or Word unless the project specifies other electronic formats.

The survey data should include digital photos to depict the extent of the work required, fixed structures and reference points along the route.

The surveyor should capture the information to a level where the designer for the cable and cable route will be able to provide the necessary works packages and the bill-of-quantity against the work. This would normally include sketches of the route with reference to the track layout and other reference points including:

- For mile posts, the distance between the route and the nearest running line should be recorded;
- For signal posts and gantries, record the structure's identification (alpha numerical reference);
- Record UTX, URX, UFX and level crossings;
- For signal and telecoms trackside cabinets, record their identification;
- Record railway buildings such as telephone exchange, REB, signal box sub-station, station (for station denote which is the up end and which is the down end) etc;
- Record the location of booster transformers, if present;
- For trackside telephones, record the type (e.g. SPT, PZT, etc.), the telephone number and all relevant information such as the signal number if it is a SPT, level crossing name if it is a crossing phone, etc.

5.2 Use of Survey Packages

To reduce the duration and cost of cable route surveys, surveyors may use Network Rail approved trackside video surveillance tools. In particular the surveillance tool may offer information such as:

- Areas where cable route already exists;
- The general condition of existing cable route and the extent of its concealment by ballast and vegetation;
- Suitable locations for installation of approved DI-SAC;
- Obstructions that would affect the construction of new cable route or the installation of cables into existing cable routes;
- Locations that require closer examination, for example, at stations, tunnels, viaducts and where route separation and physical diversity is required;
- Suitable locations for joints and distribution cabinets;
- Requirements for the main telecom cables to cross the track.

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6 Key Cable and Route Survey Aspects

This section details a comprehensive list of key items which the surveyor should pay attention to during the survey. Not all the items may be applicable to the cable and route being surveyed. The section has been ordered alphabetically for ease of use.

6.1 AC Area

In an AC electrified area, the surveyor should record the presence or absence of screening conductor. Screening conductor earth farms occur approximately once every 1 km. It may be difficult to locate a screening conductor earth farm beside the route, so the surveyor should search for an earth cable leaving the cable route and follow its path to a master earth rod pit. If it is a screening conductor earth farm the other end of the earth wire will be connected to the screening conductor with a tap joint.

6.2 Asbestos Cable Route

Contact with asbestos should be avoided unless work is in accordance with Control of Asbestos at Work Regulation 2002.

6.3 Assessment of Concrete Troughing Damage

Concrete trough and lid which has degraded or damaged beyond certain limits should be identified for replacement as defined below. In some cases it may be possible to cut off the damaged section and replace it rather than the entire section.

Trough and lid should be replaced if they exhibit any of the following:

- Exposed reinforcing;
- A hole penetrating right through (excluding knockouts) or broken corner. See Figure 1 and Figure 2;
- Signs of concrete crumbling;
- A crack in a lid which penetrates by more than 10%;
- A crack which goes completely through.

Where the damage is confined to less than 250 mm from the end of the 1000 mm lid, the damaged section may be machine cut and the remaining good section reused. However the reinforcement exposed by the cut should be treated with suitable bitumastic paint as required by NR/LS/CIV/039.

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Figure 1 – Damaged corner: replace



Figure 2 – Exposed reinforcing and damaged corner: replace

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Figure 3 – Unit cracked completely: replace

6.4 Ballast Boards

Record where ballast boards are required to prevent significant spillage of ballast or banks onto the troughing route.

Ballast board should be concrete, 300 mm high by 2,000 mm long and supported by two concrete posts or metal stakes per board.

Depending on the level of the ballast or size of the bank, ballast boards may be installed up to a maximum of three high (up to 900 mm high) with appropriately sized supports. In accordance with NR/WI/CIV/143, ballast boards installed to 900 mm high shall complete a Form A and Form B.

Where the surveyor comes across existing ballast boards which are supported by galvanised stakes, these should be checked for corrosion and replacements should be recorded where required.

6.5 Buried Troughing Route

No cable should be pulled through a buried troughing route and no buried troughing route should be rodded and proved. Record where the buried troughing route passes directly under sidings, behind buffers catch pits, run-offs, sand traps and any unusual geological formation or localised subsidence.

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Where buried troughing is full or cannot be accessed it should be replaced:

- If it is a main route, it should be replaced with a 6 way UTX or approved under-track bore.
- If it is a spur route, it should be replaced with a 4 way UTX at right angles to the track.

To install cables into a buried troughing route, the route should be excavated so that the troughing lids can be removed and the cables laid into the troughing route. Once the cables have been installed the lids should be replaced and the route buried and the ground surface reinstated. A buried services search in accordance with NR/L2/AMG/1020 should be carried out before conducting any excavation work.

6.6 Cable Route Covered By Ballast or Vegetation

6.6.1 Light Coverage of Ballast or Vegetation

For cable troughing route which only has a light coverage of ballast or vegetation a lid tilting tool may be used to tilt the troughing lid without the need to remove the coverage. The planned new cable can be inserted into the trough as the lids are tilted.

6.6.2 Ballast Clearance

Where track ballast covers the route, record its requirement for clearance using the classification in Table 1 on a per metre basis:

Ballast Covering Classification	Depth of Cover
Light	0 mm to 150 mm
Medium	151 mm to 300 mm
Heavy	> 300 mm

Table 1 - Ballast coverage classification

Clearance of high ballast shoulder and bank slippage to access the cable route should be recorded with the obstruction type and the classifications within Table 1.

6.6.3 Vegetation Clearance

Where vegetation covers the route, record its requirements for clearance using the classification in Table 2 on a per metre basis.

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Ballast Covering Classification	Depth of Cover
Light	Sparsely growing vegetation, with the troughing route still visible, e.g. grass, light brambles, twigs; includes light, overhanging foliage.
Medium	Continuous denser covering of troughing route with items such as heavy brambles, and heavier undergrowth; route typically obscured from view.
Heavy	Very dense covering of troughing route with items such as trees and large shrubs

Table 2 – Vegetation coverage classification

When surveying for vegetation clearance, consideration should be given to the likelihood of the increase in vegetation coverage when the work actually takes place. It will typically take several seasons for medium coverage to grow into heavy vegetation as defined in Table 2.

Permanently cutting back vegetation so that summer growth does not encroach onto new routes should be taken into account when surveying vegetation coverage.

6.7 Checking Cable Route Spare Capacity

The surveyor should have a clear understanding of the number, type and size of telecoms cables which the project is planning to install.

Where the existing cable route is to be used, the Surveyor should lift the troughing lids at 100 m intervals and in particular at T-pieces, throughout the entire length of the section, to determine whether there is sufficient capacity within the route to suitably accommodate the cables.

Where the existing route is completely buried under ballast or vegetation such that the condition of the route and lids cannot be readily assessed; record the size, the condition and spare capacity of the cable route where it enters and leaves the buried section.

6.8 Concrete Bases

Concrete bases for Distribution Cabinets and BOPs should be pre-cast concrete Small Location Case Bases to BRS-SC 32.

The Surveyor should ensure that, where possible:

- The locations selected for Distribution Cabinets and BOPs will allow existing tail cables to be reused;
- The Distribution Cabinets and BOPs are on the same side of the track as existing location cases.

Hard Standings around Distribution Cabinets and BOPs are only required where ground conditions or local terrain would create hazards whilst working at the cabinet or BOP. The hard standing should be built to the requirements of NR/GN/SIG/11821.

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6.9 Copper Cables

The following should be recorded during the copper cable survey:

- Centre to centre copper cable length with the addition of the following allowances:
 - a) 1% of the measured length for cable deviation within the route;
 - b) 3 metres for each cable end to be jointed;
 - c) 5 metres for each cable end to be terminated, except at large buildings where additional length may be required to reach the termination location.
- Direction of cable pull;
- The proposed locations for joints:
 - a) Joints should be at 1000m intervals.
 - b) This distance can be varied by a maximum of 10%.
 - c) Joints should be sited at the mouth of tunnels and not in tunnels.
 - d) Where joints are required inside a tunnel they should be of an approved mechanical joint type to ensure that gas or petrol equipment is not used in the tunnel.
- The requirement for an additional joint at UTXs, URXs, UFXs, UFtXs and platform duct routes as required to facilitate cable pulling.
- The proposed positions of sheath gaps.
- The proposed positions of Distribution Cabinets and BOPs.
 - a) New cabinets should be more than 2.5m from adjacent structures.
 - b) Tail cables should be less than 100m.
 - c) A maximum length of 250m is permitted for tail cables under certain circumstances.
 - d) Where possible locate cabinets and BOPs on the same side as existing cases.
- The proposed positions of termination boxes in tunnels.
- Entries to buildings.
- Details of the electrification system.
- The presence of existing earth systems.
- Presence of screening conductors in AC electrified areas.
- Any instances of Parallelism (i.e. where the section runs parallel to National Grid power lines for more than 1 km).

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6.10 Crossings

6.10.1 Under Road Crossings / Level Crossings

Assess the ducts as per **6.36**.

Where there is insufficient capacity or where there are signs of subsidence install a new under road crossing. If there are signs of subsidence report this to Network Rail immediately.

6.10.2 Farm Crossings

If there is sufficient capacity and the troughing lids can be lifted to install the cables then the route should be used.

Install buried C/1/9 troughing, extending 2 metres either side of the crossing to bring the cable route to the surface if there isn't the capacity or access to the existing route.

Where vehicles are to pass over the crossings, the route should be double lidded.

6.10.3 Under Track Crossing

The Project may specify that under-track boring techniques can be used to install a under-track crossing.

If the UTX is a "S" Type and there is sufficient space then a short, lubricated telecoms cable should be pulled through to test the UTX and the test cable checked for any scratches or cuts. If any damage to the sheath is found then a new UTX should be installed, otherwise the UTX can be used for the new cable.

Where a new UTX is required under a siding, GLT should be installed to the requirements of NR/GN/SIG/11210 Appendix 2A05.

6.10.4 Foot Crossing Routes Including Hard Surfaced and Through Yard Walkways

If the current route is buried, but the troughing lids can be accessed and lifted then the new cable should be laid in the route through lifting the lids.

If the lids are not accessible or the route is full then a new route should be installed as detailed in 'Part b' - Farm Crossings.

6.11 Deployment of DBS

DBS is not to be deployed as either directly buried or surface-laid cable protection due to Network Rail's withdrawal of using DBS due to economic grounds.

The Surveyor should therefore not record the installation of DBS (or SLD) for the protection of cables except for short runs where it is to be buried under occupation crossings or vehicle entry points.

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6.12 Deployment of DI-SAC

For the purposes of this guidance document DI-SAC is deemed to be a form of cable route. The installation requirements of DI-SAC, including interfaces with various route features, are set out in NR/GN/TEL/30140. Notably, the bending radius of DI-SAC is 12 times its diameter and must not be exceeded.

6.12.1 Particular Requirements

The Surveyor should take particular account of the requirements below:

- DI-SAC should not directly or indirectly hinder, impair or obstruct the operational railway, in particular, access paths, refuges, retaining walls, point rodding and signal wire runs, and other cable runs such as tail cables to on-track equipment.
- DI-SAC should not be able to be placed onto any railway line by miscreants acting without tools.
- DI-SAC should maintain a reasonably straight line in order for it to aesthetically blend into its surroundings.
- DI-SAC should promote efficient cable repair or replacement.
- DI-SAC should not constitute a tripping hazard.

6.12.2 Installation

The Surveyor should specify installation of the DI-SAC as far from the track as practicable but within the limits set out in Section 6.25. Where there is existing troughing on the same side of the track, then the DI-SAC should be installed as close to the existing troughing as practicable, and on the side furthest from the track, to avoid creating an additional tripping hazard.

The nature of DI-SAC facilitates it being installed into existing troughing where appropriate and the decision on whether to deploy DI-SAC should take this into account. For example, over a 2 kilometre stretch of track 30% of the existing cable route may need little renovation but the other 70% may require more renovation than is economically viable. In this instance it is sensible to install DISAC over whole the 2km and place it into the good (renovated) 30% of the route.

6.13 Earthing for Lineside Cabinets

Earth rods to form FTE should be installed for trackside cabinets which accommodate active equipment.

6.14 Earth Systems

The Surveyor should record suitable locations for new earth farms where required, and the locations of any existing earth farms. The Surveyor should comply with the following requirements when selecting a location for a new earth farm or FTE: