



AUSTRALIAN RAIL TRACK CORPORATION LTD

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Discipline

Engineering Standard - NSW

Category

Electrical

Title

Underground Cable - Location Recording

Reference Number

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Document Control

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About This Standard

This publication sets out the requirements for the recording of relevant survey data for newly installed cable routes for high voltage AC and 1500 volt DC traction cables owned by the Australian Rail Track Corporation.

This publication also applies to the recording of survey data for deviations to existing cable routes and maintenance repairs.

Document History

Primary Source – RIC Standard EP 20 00 04 06 Version 1.0

List of Amendments –

ISSUE	DATE	CLAUSE	DESCRIPTION
1.1	11/03/2005	Disclaimer	Minor editorial change

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1 Introduction

During the construction of new underground cable routes it is imperative that the precise details of the high voltage underground cable location is recorded. The details are to be recorded over the entire cable route in respect to existing features and permanent reference marks. This applies to all aspects of the cable route including sections laid direct in the ground, in ground line troughing, in elevated troughing including cable trays or cable ladders, in ducts and in conduits.

Any alterations or additions resulting from maintenance or construction activities affecting the cable or the cable route shall similarly be recorded.

The data is required to :

- record and document the installation of the cable, thus facilitating the location of the cable at a later date for cable repairs and searches for underground services.
- enable the cable to be accurately and efficiently shown on the Australian Rail Track Corporation's (ARTC) High Voltage Service Maps.
- allow compilation of route details for cable histories and future planning.
- facilitate cable fault locations.

The recording of survey data for maintenance repairs may in some instances be supplanted by manual measurement and data recording when the repairs can positively and accurately be tied to permanent structures or features previously shown on the original cable route survey and the cable remains in the original route position.

2 Cable Location Data Recording

The data shall be recorded by the means of a detailed survey performed along the route of the cable. The survey should be of a traverse and radiation nature along the route of the cable, recording the details as set out below in **Sections 2.1** and **2.2**. The survey should be controlled and adjusted from state survey control marks and benchmarks or to approved Railway survey control marks of which the Integrated Survey Grid (ISG) and / or Map Grid of Australia (MGA) and Australian Height Datum (AHD) co-ordinates are known. Alternative methods of survey producing the same results may be approved by ARTC's Manager Engineering Design.

2.1 Survey Details

The accuracy of the survey shall be within 100mm in horizontal and 50mm in vertical with respect to the local survey control marks and infrastructure.

The survey is to be adjusted to ISG or MGA and AHD over the whole route.

2.1.1 Horizontal Control

The survey shall be tied to either State survey control marks or approved Railway control marks at intervals of 0.5 to 1.0 km along the route of the survey for both horizontal and vertical control purposes. The survey shall be adjusted to close on these control marks along the route. In cases where survey control marks cannot be located or are not available , then approved State or Railway control marks shall be

placed and coordinated onto ISG or MGA and AHD.

A minimum of three survey control marks must be used to provide Horizontal adjustment.

2.1.2 Vertical Control

Levelling shall be equivalent to fourth order accuracy, either connected to state survey marks and bench marks or to approved Railway survey control marks.

2.2 Underground Cable Details

The following information shall be recorded using the preferred identification codes shown in **Appendix 1**.

- The location of the cable at all bends and at intervals not exceeding 10 metres along straight runs. This is to include the relative level on the top of the protection slab where installed or the top of the conduit or duct, etc. or where direct laid the top of the cable and the natural surface level at these points.
- Where the cable is laid in elevated, ground line or in-ground troughing, the location of all bends and the troughing at intervals not exceeding 30 metres along straight runs. For ground line and in-ground troughing it is necessary to include the relative level on the top of the troughing and the natural surface level at these points.
- Diagrams (cross sections) are to be provided to indicate the configuration of cables in the trench, ducts, troughing, cable pits, tunnels and at points where cables cross. Where cables are in ducts, cross sections are to be provided at both start and finish of the ducts. Cross sections are to be drawn by looking along the cable route in the direction away from Central. Where the cable routes are cross-country the cross sections are to be drawn looking along the cable route in the direction away from the point of supply. For examples of standard cross sections see **Appendix 2**.
- The location of any cable pits, manholes etc. and where a change to the configuration of the cable occurs in the trench. This is to include the relative level at the top of these structures and or the relative level on top of the protection slab where installed or the top of the conduit or duct etc. and the natural surface at these points.
- Where cables cross over one and other in a trench, the location of these intersections and the relative level of both cables and the natural surface level are to be provided.
- Locations of any joints in the cable together with the relative level of the protection covering the joint and the natural surface levels at these locations.
- Where other services cross the trench their location, depth and details of the service, eg. "150 mm Cast Iron Pipe", is to be recorded. The depth is to be provided as a relative level on the top of the service, on the cable protection slab and the natural surface at the location.
- Where cables pass under tracks, the location of the tracks and a level on the

tracks is to be recorded.

- The location of other structures and features within 4 metres of the centre line of the cable trench is to be recorded. Examples of other structures and features are transmission line poles, manholes, buildings, and fences etc.
- Where the cable is located on Railway land in the electrified area and within 10 metres of the track, the location of Overhead Wiring Structures (OHW) structures is to be recorded (**Note:** where a track control mark (TCM) has been placed, this mark should be used for measurement).
- Where the cable is in public roads/footways the location of the kerb lines, street corners and building lines are to be provided on the side of the roadway nearest to the cable trench.
- Survey field notes are to be provided with sketches of the area through which the cable route passes.
- Other details such as the date of the survey, the date of the cable installation, general description of the work and details of the cable laid, ie voltage, type, size, etc. (eg. 19/33 kV, 3 core, 150 [sq. mm.](#)), must be provided.

2.3 Documentation of Survey Work

2.3.1 Field Notes

Details of the survey are to be recorded in standard field books with all necessary documentation, diagrams and sketches (size 200 x 120 mm) provided. The field books, diagrams, sketches and printouts of electronic field books etc. will form part of the final documentation and will become the property of the Australian Rail Track Corporation.

Details of the survey control marks used and any horizontal and vertical adjustments of the traverse are to be documented and provided.

A listing of feature codes to be used for the survey is shown in **Appendix 1**.

A coordinate listing of the survey is required. As the survey is adjusted to ISG or MGA and AHD datum the format of the listing will be; Point No., easting, northing, relative level, point code and comments.

The listing shall be maintained in an electronic format. Each list file of survey data shall be an ASCII file and of fixed record format. The data supplied shall be as indicated in **Appendix 3** (an example the fixed data file listing) and **Appendix 4** for the format of the fixed data (space delimited).

A paper plot is required to accompany each list file. The plot shall be suitably annotated to indicate the cable route and detail. The plot is to be signed as work executed and a record of the cable installation.

2.3.2 Photographs

Photographs are required, generally at approximately 30 metre intervals along the cable route to provide visual documentation of the cable installation. Additional photographs are required to show changes in section or configuration of cables in trenches or troughing; at locations where cables enter or leave duct systems and where the crossing of other services occur. Photographs are to be taken along the cable route in the same direction (preferably looking away from Sydney), with the exception being at the ends of ducts, etc. In these instances photographs will be taken looking towards the ducts, etc. from the exposed ends.

Photographs are to be clearly marked to identify the location along the route where they were taken and the direction facing (ie. back to Sydney).

The photographs are intended to support and enhance the recording documentation and are not intended to replace the drawing of cable cross sections as required elsewhere in this standard.

**Polaroid photographs will not be accepted
as a photographic record.**

2.3.3 Progress Reporting and Co-ordination

All survey work shall be completed within 2 days of the installation of the cable. The survey shall be completed prior to the back filling of the trench but after installation of the cable. This is to ensure accurate depth and location of the cable is adequately recorded. Copies of field notes, annotated plot and coordinate list file shall be provided to the Australian Rail Track Corporation.

3 Appendix 1

These codes may be varied with the approval of the Manager Surveying, ARTC Engineering design.

Code descriptions.

CODE	DESCRIPTION	CODE	DESCRIPTION
ANT	Antenna or aerial	NS	Natural surface
AWN	Awning	MH	Manhole
ATTCH	Attachment	OHWS	OHW structure
BEND	Cable bend	POLE	Pole RAC transmission line
BOB	Bottom of bank	PLV	Power pole low voltage
BDY	Boundry lines	PM	Permanent mark
BLD	Building	PP	Peg pole (peg location)
BM	Bench Mark	P66	Power pole 66kV
CL	Centreline	P33	Power pole 33kV
CLP	Council pole	P11	Power pole 11 kV
CB	Cable	P2	Power pole 2kV
CBJ	Cable joint	PIT	Pit
CBT	Cable trench	PIPE	Pipe (CI, EW, Concrete)
CG	Change of grade	PNTS	Points (rail)
CK	Creek	RL	Rail
CNR	Corner	RLTT	Rail tramway
CONT	Contact wire (OHW)	SIGN	Sign hording
CATY	Catenary wire (OHW)	SHRUB	Shrub
CR	Cable repair	SIG	Signal
DUCT	Conduit & duct	SIGBRG	Signal bridge
EB	Edge of bitumen	SSM	State Survey Mark
EST	Elevated steel troughing	STR	Structure
ET	Edge of track	RSN	Ramset nail in structure
ETR	Edge of trees	TCM	Track control mark
FCE	Fence	TRAV	Traverse station
GATE	Gate	TOB	Top of bank
GLT	Ground line troughing	TREE	Tree
GRATE	Grate (drainage)	UCT	Underground conc. troughing
GUY	Guy pole	VENT	Vent
HT	Height (miscellaneous)	X1	Crossarm (top)
INTN	Intresection of power lines	X2	Crossarm (second)
KB	Kerb	X3	Crossarm (other)
KL	Kerb line	XOVR	Crossover (rails)
LIGHT	Light on pole	ULX	Under line crossing
NRL	Negative rail		

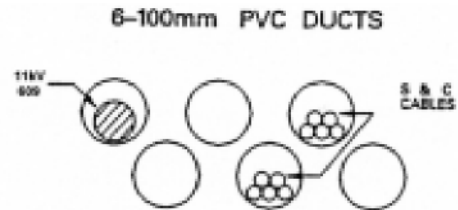
4 Appendix 2

Examples of Standard Cross Sections

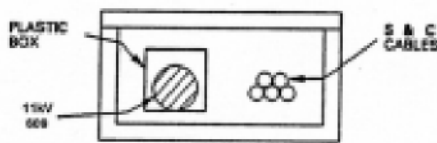
These examples are indicative of suitable recording practice only. Approval of the configurations shown shall not be inferred.



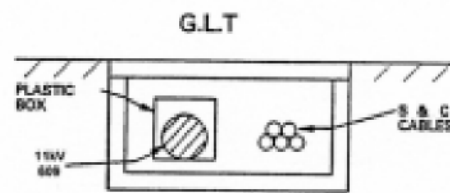
**CABLES LAID UNDERGROUND
PROTECTED BY DANGER SLABS**



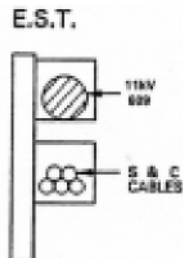
**CABLES LAID UNDERGROUND
IN DUCTS**



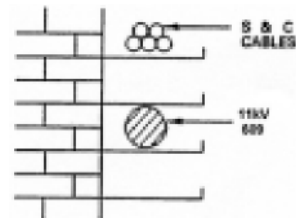
**CABLES LAID IN CONCRETE TROUGHING
WHICH IS BURIED UNDERGROUND**



**CABLES LAID IN CONCRETE
GROUND LEVEL TROUGHING**

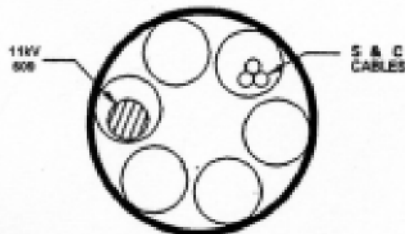


**CABLES LAID IN ELEVATED
TROUGHING**



**CABLES LAID IN SHELVES
ATTACHED TO WALLS**

6-100mm PVC DUCTS
1-400mm CONCRETE PIPE



**CABLES LAID IN
UNDERTRACK CROSSING**

5 Appendix 3

Example of Fixed Data Format

CIVIL Job SDR00164 Date 04/07/97
File
Job details 04/07/97 WESTMEAD - DETAIL SURVEY OF 33 kV CABLE ROUTE

ADJACENT TO SUB.

PNT	EASTING	NORTHING	RL	Code	Comments
1	298441.975	1257676.541	25.973	CB	CL CABLE
19	298270.734	1257675.979	21.532	CB	CL CABLE
20	298249.822	1257671.752	21.860	CNR	CORNER
21	298250.080	1257670.370	21.941	FCE	FENCE
25	298390.207	1257677.345	24.018	FCE	FENCE
26	298416.057	1257681.133	25.492	POLE	GUY POLE
27	298433.378	1257676.753	25.632	FCE	FENCE
28	298433.182	1257676.033	25.623	POLE	POLE 135
29	298440.685	1257675.933	26.029	POLE	POLE 134
32	298440.489	1257698.140	28.812	RSN	RSN 25+5
33	298350.261	1257681.534	24.134	POLE	POLE 5W
35	298341.120	1257707.378	26.266	POLE	POLE 135
36	298341.578	1257704.178	27.177	RL	1 ST RAI L
39	298271.660	1257679.060	23.411	POLE	POLE 5W
40	298266.683	1257680.698	24.888	ULX	UNDER TRACK XING
41	298255.631	1257681.722	25.932	NRL	NEGATIVE RAIL
42	298234.805	1257679.746	25.682	NRL	NEGATIVE RAIL
43	298237.728	1257678.660	25.563	ULX	UNDER TRACK XING
44	298234.291	1257682.084	26.391	RL	RAI L
45	298239.817	1257675.641	23.585	CNR	CORNER S
46	298249.341	1257676.557	23.652	CNR	CORNER S
47	298236.396	1257702.562	25.135	ULX	UNDER TRACK XING
48	298232.355	1257700.277	25.288	NRL	NEGATIVE
49	298232.695	1257697.473	26.093	RL	1 ST RAI L
50	298233.543	1257706.849	25.167	POLE	POLE 137

6 Appendix 4

Required Format For Survey Data

Fixed Record Format (Space Delimited)

XXXXX XXXXXXXXXXXXX XXXXXXXXXXXXX XXXXXXXX XXXXX XXXXXXXXXXXXX

5CHR 2X 12CHR 2X 12CHR 2X 9CHR 2X 6CHR 2X 25CHR
(numeric) (numeric 3 decimal places) (alpha) (alpha)
(integer)