UGL REGIONAL LINX

SURVEY

CRN-SPC-CVL-713026361-1226

CRN CP 211

LINKING COMMUNITIES. CONNECTING CUSTOMERS.

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Document Control

Function	Position	Name	Date
Approver	A&E Manager	Lucio Favotto	24/12/2021

Revision	Issue Date	Revision Description
1.2	13/12/2021	UGLRL Operational Standards Template applied
2.0	24/12/2021	First approved and issued UGLRL version

Summary of changes made from previous version

Section	Summary of change
All	This document is based on the previous rail infrastructure maintainer (RIM). Full revision history is available on request from UGLRL.

1 Scope and Application

This Specification sets out requirements for survey, including equipment, calibration, survey accuracy and data requirements.

It is applicable for all surveys conducted on the Country Regional Network (CRN).

2 References

2.1 Australian and International Standards

ISO 17123 and all relevant parts applicable to the CRN Standards.

AS7634:2017 – Railway Infrastructure – Survey

Unless otherwise specified, all references relate to the latest standard versions, including amendments and relevant superseding standards.

2.2 CRN Documents

All references to CRN documents are part of the CRN Standards document suite.

CRN CS 210 - Track Geometry and Stability

CRN CM 212 - Survey

CRN CP 212 – Contract Survey

2.3 Other References

Inter-Governmental Advisory Committee on Surveying and Mapping Standards and Practices for Control Surveys (SP1).

Surveyor General's Directions

T HR TR 13000 ST – Railway Surveying

3 General Description and Requirements

This specification provides guidance on:

- type and accuracy requirements of survey equipment used in surveys for UGLRL CRN purposes,
- calibration requirements of survey equipment for use in surveys for UGLRL CRN purposes,
- additional check measurements that must be carried out
- the format of observations and measurements that must be delivered in addition to any project specific deliverables.

The following requirements are extracted from CRN Standard CRN CS 210

- The location of track infrastructure shall be established by Track Control.
- Track Control shall be established from UGLRL CRN Survey Control
- All surveys for CRN purposes shall be established using Map Grid of Australia (MGA) and Australian Height Datum (AHD). Alternative systems shall only be used with the approval of the Principal Track and Civil Engineer.

The requirements will ensure consistency in the provision of survey information and provide an auditable trail to ensure demonstrable integrity of the survey data delivered.

The requirement to use SP1Inter-Governmental Advisory Committee on Surveying and Mapping Standards and Practices for Control Surveys (SP1) ensures that practices employed by UGLRL CRN are consistent with those widely accepted by the industry.

4 Control Surveys

UGLRL CRN is required to maintain a network of survey control marks within the rail corridor. This control network is connected to the NSW state survey infrastructure. To ensure the integrity of surveys carried out for rail purposes, the CRN Control Network shall be surveyed as specified in Table 1 using equipment calibrated to meet the requirements of Table 2.

Activity	Requirements
Horizontal Angle Measurement	• Electronic Total Stations only to be used. • Least Count – 1” • Standard Deviation ≤ 1.5” • Observe 6 full arcs to each target • Observations may be carried out at any time • Residuals from mean of any direction within each set not to exceed 6”
Distance Measurement	• Electronic Total Stations only to be used. • Standard Deviation ≤ ± 2mm + 3ppm • Distance to be recorded with each horizontal direction observation. • Temperature to be recorded to 1°C. • Pressure to be recorded to 0.1hPa/1mB. • Atmospherics to be entered into instrument at time of observation.
Differential Levelling	• Electronic Digital Level only to be used. • Instrument accuracy ≤ 1.5mm (Standard Deviation per 1km double run levelling) • Maximum misclosure for forward and reverse levelling ≤12$\sqrt{d}$ (d – Distance in Kilometres) • All control stations to be double levelled.
Control survey by Global Navigation Satellite Systems (GNSS)	• As per SP1 Guideline for Control Surveys by GNSS.

Table 1 - UGLRL CRN requirements for Control Surveys

Equipment	Calibration Requirements
Total Station	- Calibration within twelve months prior to date of observations. - Calibration to include additive constant, cyclic error and scale error.
Digital Level	- Calibration within twelve months prior to date of observations - Vertical Collimation test (two peg test) to be completed within 3 months prior to observation.
GNSS	- As per the Surveyor General's directions
Equipment	- Thermometer least count 1°C and calibrated within 6 months prior to observation. - Barometer least count 0.1hPa/1mB and calibrated within 6 months prior to observation. - Levelling staff to be calibrated within twelve months prior to date of observations. - Staff bubble to be calibrated within six months prior to date of observations (within 10' of vertical).

Table 2 - UGLRL CRN Instrument calibration requirements for Control Surveys

5 Survey for Track Control Marks

UGLRL CRN provides a network of Track Control Marks. The Track Control Marks are used primarily to provide a permanent recovery monument to the current design alignment of the track. Track Control Marks shall be surveyed as specified in Table 3 using equipment calibrated to meet the requirements of Table 4.

All Track Control Marks shall be installed from a closed traverse.

The Track Control traverse should incorporate all major and minor control marks along the railway corridor for the length of the traverse.

Activity	Requirements
Horizontal Angle Measurement	• Electronic Total Stations only to be used. • Least Count – 1” • Standard Deviation ≤ 1.5” • Observe 1 full arc to each target (face L + face R). • Observations may be carried out at any time.
Distance Measurement	• Electronic Total Stations only to be used. • Standard Deviation ≤ ± 2mm + 3ppm. • Distance to be recorded with each horizontal direction observation. • Temperature to be recorded to 1°C. • Pressure to be recorded to 0.1hPa/1mB. • Atmospherics to be entered into instrument at time of observation.
Differential Levelling	• Electronic Digital Level only to be used. • Instrument accuracy ≤ 1.5mm (Standard Deviation per 1km double run levelling) • Maximum misclosure for forward and reverse levelling ≤12√d (d – Distance in Kilometres) • All Track Control Marks to be double levelled or checking of one way digital-level measurement using total station trigonometric heighting

Table 3 - UGLRL CRN requirements for survey of Track Control Marks

Equipment	Calibration Requirements
Total Station	- Calibration within twelve months prior to date of observations. - Calibration to include additive constant, cyclic error and scale error.
Digital Level	- Calibration within twelve months prior to date of observations - Vertical Collimation test (two peg test) to be completed within 3 months prior to observation.
Equipment	- Thermometer least count 1°C and calibrated within 6 months prior to observation. - Barometer least count 0.1hPa/1mB and calibrated within 6 months prior to observation. - Levelling staff to be calibrated within twelve months prior to date of observations. - Staff bubble to be calibrated within six months prior to date of observations (within 10’ of vertical).

Table 4 - UGLRL CRN instrument calibration requirements for survey of Track Control Marks

6 Survey for track, infill and other infrastructure

This section describes the requirements for surveys other than Survey Control and Track Control. The aim of this part of the specification is to provide consistency with all surveys undertaken on the CRN. Survey undertaken for other than Control Surveys or survey of Track Control Marks shall be conducted as specified in Table 5 using equipment calibrated to meet the requirements of Table 6.

Activity	Requirements
Horizontal Angle Measurement	- Electronic Total Stations only to be used. - Least Count – 1” - Standard Deviation ≤ 1.5” - Observe 1 full arc (2 faces) to each infrastructure clearance point (e.g. platform coping, bridge abutment, etc.). - Observe minimum one face only to track and other minor detail. - Observations may be carried out at any time.
Distance Measurement	- Electronic Total Stations only to be used. - Standard Deviation ≤ ± 2mm + 3ppm - Distance to be recorded with each horizontal direction observation. - Temperature to be recorded to 1°C. - Pressure to be recorded to 0.1hPa/1mB. - Atmospherics to be entered into instrument at time of observation.
Levelling	- Electronic Digital Level only to be used. - Instrument accuracy ≤ 1.5mm (Standard Deviation per 1km double run levelling). - Maximum misclosure for forward and reverse levelling ≤12√d (d – Distance in Kilometres). - Track and other minor detail may be levelled by trig heighting. - Infrastructure clearance points may be levelled by trig heighting by agreement with Principal Surveyor. - Critical clearance points must be checked.
Topographic surveys using GNSS Real Time Kinematic (RTK)	- This method is not suitable for track surveys. The positional accuracy achieved shall be suitable for the project deliverables and is the responsibility of the surveyor.
3D point clouds using laser scanners and digital cameras	- Project dependent with approval from Principal Surveyor.
Surveys for GIS applications	- Project dependent with approval from Principal Surveyor.

Table 5 - UGLRL CRN requirements for “other” infrastructure survey

Equipment	Calibration Requirements
Total Station	- Calibration within twelve months prior to date of observations. - Calibration to include additive constant, cyclic error and scale error.
Digital Level	- Calibration within twelve months prior to date of observations - Vertical Collimation test (two peg test) to be completed within 3 months prior to observation.
GNSS	- As per the Surveyor General's directions.
Laser Scanners. Digital Cameras, GIS data capture	- It is the responsibility of the surveyor to ensure that their equipment and the methods they employ in measurement and processing will achieve the required project accuracy.
Equipment	- Thermometer least count 1°C and calibrated within 6 months prior to observation. - Barometer least count 0.1hPa/1mB and calibrated within 6 months prior to observation. - Levelling staff to be calibrated within twelve months prior to date of observations. - Staff bubble to be calibrated within six months prior to date of observations (within 10' of vertical).

Table 6 - UGLRL CRN instrument calibration requirements for "other" infrastructure survey

7 Checks

In addition to any checks that are carried out by the surveyor to ensure the veracity of data the following checks shall be measured and recorded as specified in the Data Formats section of this specification.

1. At each Control Station occupied for the purpose of observing radiations, two Control Stations are to be observed to confirm the orientation of the observation set.
2. A minimum of two points preferably Track Control Marks (or other well-defined points if no Track Control Marks are available) shall be radiated from two Control Stations. The two points double radiated shall be positioned approximately midway between the two Control Stations from which they were radiated.
3. All radiations to Track Control Marks or other infrastructure clearance points (e.g. Platform copings, bridge abutments, etc.) shall be checked by independent means. An acceptable method is to independently measure a join between the Track Control Mark or infrastructure clearance point and another Track Control Mark or infrastructure clearance point or other radiated point. The check measurement shall be recorded electronically. All check measurements shall be recorded electronically in the field.
4. The check measurement shall be compared with the calculated join. The comparison shall have a tolerance of □ 5.5mm (unless otherwise agreed with the Principal Track and Civil Engineer). That is, any check measurement that differs from the calculated distance by more than 5.5mm (or other tolerance agreed with the Principal Track and Civil Engineer) shall be investigated and the discrepancy corrected. A report shall be provided detailing the measured and calculated distances and the results of any investigation.
5. The Reduced Level of all Survey and Track Control marks is to be checked. This check is to be achieved by:
    - In the case of Survey Control Marks –

Two-way digital levelling of all Survey Control Marks in closed loops. Each Survey Control Mark shall be a change point for both forward and backward level runs. Differences in reduced level of any Survey Control Mark of more than 3.5mm shall be investigated and eliminated. The final mean

adjusted reduced level of the Survey Control Mark shall be assigned to the mark in preference to the reduced level obtained from the Total station observations.

– In the case of Track Control Marks –

One-way levelling is required as a minimum. The one-way levelling must close between Survey Control Marks. The check is achieved by comparing the reduced level obtained by Total Station observations with the level obtained by digital levelling. Differences in reduced level of greater than 5.5mm shall be investigated and eliminated. Once checks have been achieved and errors eliminated, the final reduced level shall be assigned to the Track Control Marks giving due regard to the relative accuracies of the Total Station and Digital Level observations.

Adjacent closed loops shall overlap with a minimum of two common points. The common points shall include one Survey Control Mark plus at least one other sound mark such as either a Survey Control Mark or Track Control Mark.

6. None of these requirements should reduce the general requirements of good survey practise.

8 Data Formats

All data supplied shall be provided electronically in a format suitable for review by the CRN Principal Surveyor.

9 Deliverables

In addition to any deliverable required for a survey project, the following data shall be supplied.

Separate field data files shall be supplied as follows:

- One electronic file containing a rail survey control report. As a minimum the report will confirm horizontal and vertical standards that have been achieved as per SP1. Network adjustment details will be provided and network diagrams.
- One electronic file suitable for CAD and survey software import. Data imported shall be Track Control Marks, Rail Survey Control, all rail tracks measured and the position of other infrastructure. The electronic file will have suitable layering.
- One electronic file containing final, reduced levels of Survey Control Marks and Track Control Marks. The format will be as per CRN standards and to the satisfaction of the Principal Surveyor.
- A report detailing calibration status of all instruments and equipment used.