TRANSPORT FOR NSW (TfNSW)

QA SPECIFICATION M924

MEASUREMENT OF SURFACE CRACKING BY ROADCRACK

REVISION REGISTER

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 1/Rev 0		New Specification.	D Svolos	July 2013
Ed 1/Rev 1	2.1 Annex A Annex B Annex E Annex M	Updated. Revised. Revised. Updated. Updated.	D Svolos	Dec 2013
Ed 1/Rev 2		Specification reference number changed from R424 to M924.	MCQ	22.11.18
Ed 1/Rev 3	Global	References to “Roads and Maritime Services” or “RMS” changed to “Transport for NSW” or “TfNSW” respectively.	DCS	22.06.20

Transport for NSW

QA SPECIFICATION M924

MEASUREMENT OF SURFACE CRACKING BY ROADCRACK

IC-QA-M924

VERSION FOR:
DATE:

CONTENTS

CLAUSE **PAGE**

FOREWORD

TFNSW COPYRIGHT AND USE OF THIS DOCUMENT

When this document forms part of a contract

This document should be read with all the documents forming the Contract.

When this document does not form part of a contract

This copy is not a controlled document. Observe the Notice that appears on the first page of the copy controlled by TfNSW. A full copy of the latest version of the document is available on the TfNSW Internet website: http://www.rms.nsw.gov.au/business-industry/partners-suppliers/specifications/index.html

REVISIONS TO PREVIOUS VERSION

This document has been revised from Specification TfNSW R424 Edition 1 Revision 2.

All revisions to the previous version (other than minor editorial and project specific changes) are indicated by a vertical line in the margin as shown here, except when it is a new edition and the text has been extensively rewritten.

PROJECT SPECIFIC CHANGES

Any project specific changes are indicated in the following manner:

(a) Text which is additional to the base document and which is included in the Specification is shown in bold italics e.g. ***Additional Text***.

(b) Text which has been deleted from the base document and which is not included in the Specification is shown struck out e.g. ~~Deleted Text~~.

TfNSW QA SPECIFICATION M924

MEASUREMENT OF SURFACE CRACKING BY ROADCRACK

1 GENERAL

1.1 INTENT

The automated collection of road pavement data for detecting and monitoring the severity and extent of cracking on a network of surfaced roads.

1.2 SCOPE

The work to be executed under this Specification consists of collecting data using line scan technology operated by a vehicle mounted with cameras and independent lighting source in accordance with Test Method TfNSW T2160 to:

(a) Detect and measure road cracking data by capture and analysis of images of the road surface;

(b) Analyse in real time the cracking data to classify type, extent and severity;

(c) Analyse and provide the processed data in the specified formats in intervals of 100 m.

1.3 STRUCTURE OF THE SPECIFICATION

This Specification includes a series of annexures that detail additional requirements.

1.3.1 Project Specific Requirements

The General and Specific requirements for the Works are included in Annexure M924/A.

Project general requirements and a sample Schedule of Work are detailed in Annexure M924/A.

1.3.2 Information Supplied by the Principal

The Principal will supply you with the information summarised in Annexure M924/B.

1.3.3 Measurement and Payment and Resolution of Nonconformities

The method of measurement and payment must comply with Annexure M924/B.

Acceptance of materials and work must be in accordance with Annexure M924/B.

1.3.4 Schedules of HOLD POINTS, WITNESS POINTS and Identified Records

The schedules in Annexure M924/C list the **HOLD POINTS** and **WITNESS POINTS** that must be observed. Refer to Specification TfNSW Q for the definitions of **HOLD POINTS** and **WITNESS POINTS**.

The records listed in Annexure M924/C are **Identified Records** for the purposes of TfNSW Q Annexure Q/E.

1.3.5 Planning Documents

The PROJECT QUALITY PLAN must include each of the documents and requirements listed in Annexure M924/D and must be implemented.

In addition, ensure that the relevant requirements in TfNSW Q are incorporated.

1.3.6 Technical Requirements

Technical requirements are described in Annexure M924/E.

1.3.7 Database Format

Database format is specified in Annexure M924/L.

1.3.8 Referenced Documents

Unless specified otherwise, the applicable issue of a referenced document, other than a TfNSW Specification, is the issue current at the date one week before the closing date for tenders, or where no issue is current at that date, the most recent issue.

Standards, specifications and test methods are referred to in abbreviated form (e.g. AS 2350). For convenience, the full titles are given in Annexure M924/M.

1.4 DEFINITIONS AND ACRONYMS

The following definitions and acronyms apply to this Specification:

Channel	The test strip scanned by one camera.
Counter Direction	The opposite direction of travel to the "Prescribed" direction (refer to RAMS – Lane Numbering).
Crack Detection Vehicle	Vehicle specially equipped with crack detection equipment (e.g. RoadCrack™).
GDA94	Geocentric Datum of Australia 1994 datum to be used for the Works.
Inner Wheelpath (IWP)	The wheelpath that is to the right of travelled lane.
Interval	The distance that data must be aggregated and reported in the database.
Invalid	Data that is outside the limits specified by the Principal.
Outer Wheelpath (OWP)	The wheelpath that is to the left of travelled lane.
Prescribed Direction	The direction of travel that TfNSW defines, by convention, as the standard direction for each of its roads (refer to RAMS – Lane Numbering).

Road Occupancy Licence	Allows the proponent to use a specified road space at approved times, provided certain conditions are met. The licence applies to the occupation of the "road space" only and does not imply permission or approval for the actual (physical) works being undertaken.
ROADLOC	The name given to the Linear Referencing System used by the TfNSW (refer to RAMS – Linear Referencing).
Traffic signal green light runs	Green light corridors on survey routes provided by the TfNSW Trasnsport Management Centre (TMC).
Wheelpath	That portion of the pavement that is subject to passage of and loading from heavy vehicle wheels during trafficking. There are two wheelpaths per trafficked lane (see also IWP and OWP).
XSP	Lane numbering convention (refer to RAMS – Lane Numbering).

2 EQUIPMENT

2.1 GENERAL

Measure and record data using a Crack Detection Vehicle with the equipment described in Test Method TfNSW T2160.

The minimum requirements for all equipment must be in accordance with Test Method TfNSW T2160. Ensure that measuring equipment is maintained in calibration and good working order.

Traffic control devices mounted on the vehicle (e.g. Signposting, lights, etc) and any other items required for the Works must also be provided to comply with Specification TfNSW G22.

2.2 LOCATION REFERENCING DEVICES

2.2.1 TfNSW Linear Referencing System (ROADLOC)

Reference all data to the TfNSW Linear Referencing System (ROADLOC). The features and terms used in the TfNSW Linear Referencing System are described in the document "RAMS – Linear Referencing".

The distance calculated for each ROADLOC LINK must be within the range:

TfNSW LINK LENGTH ± [the greater of 10 m or (0.5% x ROADLOC LINK LENGTH)].

The specific requirements for ROADLOC are described in Annexure M924/E.

2.2.2 Global Positioning (GPS)

When specified in Annexure M924/A, GPS is to be collected to supplement the location reference system.

The GPS coordinates recorded must reference the Geocentric Datum of Australia 1994 datum (GDA94).

The GPS equipment must have the capability specified in Table M924.1.

Table M924.1 – Minimum Equipment Requirements for GPS

Parameter	Requirements
Instrument Type	Differential GPS
Resolution	Data to be provided in decimal degrees either to double precision or with a minimum of 12 significant digits
Minimum Sampling Rate	10 Hz
Operating Temperature Range	0°C - 40°C
Repeatability	95% of readings within: - 2.5 m Horizontal - 5 m Vertical

The location of each data record must be identified by the horizontal and vertical coordinates.

If GPS is used as the primary method of Road Location Referencing, then the PROJECT QUALITY PLAN must include the procedure to validate the accuracy of GPS and the procedure to deal with areas where coverage is substandard. The PROJECT QUALITY PLAN must provide for analysis of GPS location to verify direction and lane identification entered by the operator.

2.3 SURFACE IMAGING (CRACKING)

The Crack Detection equipment must have the following capabilities:

(a) Survey a width of at least 2.4 m of the road lane being surveyed;

(b) Equipment modules used to collect the images must be positioned side by side to give equal coverage either side of the vehicle centre line;

(c) Determine crack length of at least 100 mm and crack width from 1 mm up to 8 mm width on each pavement surface type (i.e. sprayed chip seal, asphalt or concrete);

(d) Frequency of sampling must be synchronised to ensure a complete and undistorted image at the operational speed.

Each frame must be analysed in real time using algorithms proven by CSIRO to classify the type of cracking as Transverse, Longitudinal, Crocodile[i] or Non-crack and then determine for each crack type:

(i) The severity as the average width of the predominant crack in mm;

(ii) The extent (number of cracked frames in the Interval).

The PROJECT QUALITY PLAN must include the procedure for an operator to visually monitor the cracks detected by the each channel in real time to ensure that all channels are correctly functioning.

2.4 OPERATOR INTERFACE

The electronic data acquisition system of hardware and software must facilitate real time interaction with the operator to provide:

[i] Also known as alligator or fatigue cracking.

(a) Heading data;

(b) Events;

(c) Comments.

Events are instances encountered during the survey that may affect the data being collected and make it not typical of the road Interval. Use the Event Codes described in Test Method TfNSW T2160 to identify each data record affected by the Event. Events must be immediately recorded and locations referenced while the survey is in progress.

3 COLLECTION

3.1 GENERAL

The Works include initial Validation, survey of the roads using the Crack Detection Equipment, real time processing of data and storage during the survey and Close-Out.

Undertake the survey in accordance with this Specification and WHS and legal requirements. As part of the WHS requirements, include driver fatigue management and breaks of at least every 2 hours.

Ensure that all the requirements in Test Method TfNSW T2160 are incorporated into the PROJECT QUALITY PLAN and that the PROJECT QUALITY PLAN is implemented. The Inspection and Test Plan must nominate the proposed testing frequency to verify conformity of the item. The proposed testing frequency must not be less than the frequency specified in Test Method TfNSW T2160. Where a minimum frequency is not specified, nominate an appropriate frequency.

Carrying out the survey for the Principal does not automatically give you special privileges and all traffic laws must be obeyed.

Where the work requires testing of specially designated lanes (e.g. Bus lanes, Transit lanes), ensure that permission to test is granted in advance.

When specified in Annexure M924/A, the Operator must liaise with the TMC Operations Room during the survey for traffic signal green light runs.

Applications for “traffic signal green light runs” must be made at least 14 days prior to the proposed date of survey. The Principal is not responsible for delays that result should the proposed dates not be acceptable.

3.2 CONTRACT PROGRAM

Select the order to survey the roads to efficiently comply with the Specification.

The Contract Program must detail the roads to be surveyed by date, the equipment and personnel involved, and when data will be available to the Principal.

Ensure that the Contract Program makes allowance for:

(a) Meeting all WHS and traffic requirements;

(b) Avoiding lanes while the configuration is in a Tidal flow configuration or temporary reduced speed (e.g. School Zones).

(c) Kerbside lanes subject to parking that are sometimes inaccessible due to parked vehicles.

HOLD POINT

Process Held:	Commencement of survey.
Submission Details:	At least 7 days before the proposed date of commencement, provide the following: (a) Validation for each Crack Detection Vehicle, technician and driver. (b) The Contract Program.
Release of Hold Point:	The Principal will consider the submitted documents prior to authorising the release of the Hold Point.

At the period specified in Annexure M924/B, submit a written progress report to the Principal that includes:

(i) Progress against the Contract Program (e.g. a list of roads completed and current location);

(ii) Notification of any nonconformity with the approved PROJECT QUALITY PLAN (refer to TfNSW Q);

(iii) Progress with data processing;

(iv) Other issues.

3.3 VALIDATION

Within 5 days of commencing the survey, conduct a Validation test to demonstrate conformity of the PROJECT QUALITY PLAN, Crack Detection Vehicle, technician and driver. In addition, the Principal may require a Validation Test where:

(a) Nonconformity occurs in a Validation Test.;

(b) The PROJECT QUALITY PLAN, Crack Detection Vehicle, technician or driver is changed;

(c) Work does not comply with this Specification.

Test the Validation Site in accordance with Test Method TfNSW T2160 for each Crack Detection Vehicle, technician and driver. The Validation Site must meet the following criteria:

(i) Pavement surface that is typical of the network to be surveyed;

(ii) Contain all crack types and the full range of crack widths;

(iii) A length of at least 1.5 km;

(iv) Located where the pavement surface will not be altered for the duration of the survey.

WITNESS POINT

Process to be Witnessed: Validation test.

Submission Details:	At least 3 days notice of intention to test the Validation Site.

Validation Process

Select a uniform section of pavement at least 1.5 km in length and undertake five repeat runs in the Prescribed Direction. Data is processed into 100 m intervals and the predominant crack type is determined. A regression process is performed on the predominant crack type to determine R^2.

Acceptance for validation is $R^2 \geq 0.90$ for the predominant crack type.

Supply all the data collected from the Validation Site in a database as described in Annexure M924/L. All fields in the database must be populated with the actual data recorded.

The Principal will assess the repeat runs at the Validation Site for each Crack Detection Vehicle, technician and driver. The data submitted also forms the basis for assessing the Close-out in Clause 3.5.

3.4 SURVEY

3.4.1 General

The Crack Detection Vehicle must be operated in accordance with Test Method TfNSW T2160. Ensure that the correct speed range is maintained. Where "green light" runs are planned, liaise with the Transport Operations Room during the survey.

Use only combinations of Crack Detection Vehicle and driver that have satisfactorily completed the initial validation.

Reference all data records using the location reference system nominated in Clause 2.2.

Record the road surface temperature at least every hour together with the location reference.

3.4.2 Direction and Lane Identification

Test the lane that is specified in Test Method TfNSW T2160, except where the required survey lane(s) is nominated by the Principal in Annexure M924/B.

Reference the direction of survey (i.e. Prescribed or Counter Direction) and the actual lane surveyed during data collection in accordance with the document "RAMS – Lane Numbering". Update the lane whenever the vehicle deviates from the lane. Minimise deviation out of the nominated lane during a survey.

3.5 CLOSE-OUT

Notify the Principal of the date when the required field work has been completed (i.e. the survey completion date).

Within 14 days after the survey completion date, conduct Close-out by retesting the Validation Site (refer to Clause 3.3) with 5 consecutive runs for each Crack Detection Vehicle and driver used for the survey.

WITNESS POINT

Process to be Witnessed: Close-out.

Submission Details: At least 3 days notice of intention to Close-out and test the Validation Site.

HOLD POINT

Process Held:	Completion of survey.
Submission Details:	Within 5 days of completing Close-out and testing Validation Site, provide all the data of the road sections in the Database format and clearly identify each Crack Detection Vehicle, technician and driver.
Release of Hold Point:	The Principal will consider the correlation between the Close-out survey and the Validation Site for each Crack Detection Vehicle, technician and driver prior to authorising the release of the Hold Point.

4 REPORTING

4.1 GENERAL

Data reporting includes processing of data following the survey, quality verification, flagging, calculations, and storage of the data into the specified database format and supplying the data.

Reporting must commence within 5 days of the data being collected and must progress at a consistent rate thereafter.

Ensure that the following are performed:

(a) Data is reported at the nominated distance Interval (being 100 m) referenced from the start Node of each ROADLOC Link and progressing in the Prescribed Direction;

(b) Data collected in the Counter Direction has been processed and stored in the Prescribed Direction;

(c) The conformity of the data collected and processed during the survey is assessed against the PROJECT QUALITY PLAN;

(d) Data is appropriately flagged in accordance with Clause 5.2.

At completion of each survey, submit two (2) complete and final sets of all required data on DVD or CD.

Retain all data arising from the survey and the means of reprocessing the data for a period of 5 years from the completion date of each survey.

4.2 PROCESSING DATA

Process the data to provide the cracking data specified in Annexure M924/L. Ensure that only conforming data is used to determine and report the data items.

Use the computer analysis program developed for TfNSW to consistently:

(a) determine the cracking extent as the number of frames wherein that crack type is identified in the Interval;

(b) determine the crack severity as the average crack width of the crack type identified in each frame.

Where an Interval has more than one type of Event Code, report the worst case Event Code for the Interval (e.g. an Event Code that makes the data invalid takes precedence over others). Include the relative importance of Event Codes in the PROJECT QUALITY PLAN.

All data must be reported in the Prescribed Direction. Where the Counter Direction is surveyed, ensure that the data is adjusted so that it is correctly referenced and reported in the Prescribed Direction.

In addition, the following applies where multiple lanes in the same direction of traffic are also part of the survey:

(i) Any part of a lane that has not been tested (e.g. owing to deviation into another lane) must be recorded as "Missing Data";

(ii) Data from an adjacent lane must not be substituted to replace "Missing Data", unless approved otherwise by the Principal.

5 OTHER CONFORMITY REQUIREMENTS

5.1 GENERAL

Statistical analysis is generally used to assess conformity of the Works.

The Lot that is referred to in TfNSW Q corresponds to the data from a continuous run that has been collected.

Frames that are not collected, affected by "light flare" or dark are nonconforming and must not be included in analysis.

Data is nonconforming when it is derived from < 95% of the total possible sample for the Interval (i.e. less than 760 frames from a possible 800 in a 100 m Interval). Such data must be reported as "Missing Data".

"Missing Data" (i.e. -99) is nonconforming.

5.2 DATA FLAGS

All data that is processed into the required Interval must be flagged in the database by the Data Flags described in Table M924.2. Reasons for nonconformity include, but are not limited, to the following:

(a) Data collected that does not comply with the requirements of Test Method TfNSW T2160, and includes:

  (i) Outside the speed constraints;

  (ii) Data collected when the road surface was wet;

  (iii) Out of lane sections.

(b) Data collected through a lane with roadworks.

(c) Data where the LINK length does not conform.

(d) Data collected by an unaccredited Crack Detection Vehicle and driver.

Table M924.2 – Data Flags for Processed Data

Reason	Data Flag	Extent	Examples
Conforming data	A	Each Interval	
Nonconforming data	Z	Invalid data Each Interval	Roadworks Out of lane

5.3 NONCONFORMITY REPORTING

Submit a Nonconformity Report in accordance with TfNSW Q for all data that is nonconforming. The minimum requirements for the report are summarised as follows:

(a) Details of Nonconformity.

(b) Date.

(c) Road Number.

(d) Carriageway.

(e) Location Reference:

  (i) Link;

  (ii) Coordinates (where GPS is required).

(f) Direction and Lane affected.

(g) Reason for Nonconformity.

(h) Proposed rectification.

(i) Corrective action.

ANNEXURE M924/A – PROJECT SPECIFIC REQUIREMENTS

A1 EXTENT OF WORK

Minimum extent of test points collected is 95 % of total nominated lane kms (Clause 1.3.1).

Table M924/A.1 – Example of Schedule of Works

Road Name	Road No	Local Road Name	Link No	riageway C	Version No	Sectional P	Begin Offse	End Offset	tem Length	Start Description	Stert Location	End Description	End Location	Length
FIVE DOCK-DRUMMOYNE	395	GREAT NORTH RD, FIVE DOCK	30	A	2	PT1	0.18	0.581	0.401	START FLEX PAVEMENT	FIVE DOCK	LYONS RD	RUSSELL LEA	0.581
FIVE DOCK-DRUMMOYNE	395	BAYSWATER ST, DRUMMOYNE	110	B	1	PT1	0	0.474	0.474	LYONS RD	DRUMMOYNE	WESTBOURNE ST	DRUMMOYNE	0.474
FIVE DOCK-DRUMMOYNE	395	BAYSWATER ST, DRUMMOYNE	110	B	1	PT2	0	0.474	0.474	LYONS RD	DRUMMOYNE	WESTBOURNE ST	DRUMMOYNE	0.474
FIVE DOCK-DRUMMOYNE	395	BAYSWATER ST, DRUMMOYNE	110	B	1	PT3	0	0.42	0.42	LYONS RD	DRUMMOYNE	WESTBOURNE ST	DRUMMOYNE	0.474
FIVE DOCK-DRUMMOYNE	395	WESTBOURNE ST, DRUMMOYNE	120	A	1	PT1	0	0.149	0.149	THE ESPLANADE	DRUMMOYNE	MARLBOROUGH ST	DRUMMOYNE	0.149
FIVE DOCK-DRUMMOYNE	395	WESTBOURNE ST, DRUMMOYNE	130	A	1	PT1	0	0.147	0.147	HINKLER CT	DRUMMOYNE	VICTORIA RD	HUNTERS HILL	0.147

Table M924/A.2 – Other Requirements

Clause	Description	Required
2.2.2	Global positioning (GPS)	Yes / No
3.1	Traffic signal green light runs	Yes / No
3.3	Validation	Yes / No
3.5	Close-out survey	Yes / No

ANNEXURE M924/B – MEASUREMENT AND PAYMENT AND RESOLUTION OF NONCONFORMITIES

B1 MEASUREMENT

Table M924/B.1 – Project Requirements

Clause	Item Description	Project Requirement
1.3.1	Location of Work	As specified by the Principal
1.3.1	Schedule of Works detailing roads to be surveyed	The Linear References for the Start and End of each road Link to be surveyed. The total carriageway length for each Link. The list of Lanes to be surveyed by Road, Link, Carriageway, Direction and Length.
1.3.2	Information supplied by the Principal	A soft copy of the Link Summary for the relevant roads at the commencement of the Contract. An MS Access data base with a table containing the list of Lanes to be surveyed by Road, Link and Length. A soft copy of the MS Access database to be populated. Where GPS is required, a copy of the TfNSW road network model.
2.2	Location Referencing System(s) to be used	ROADLOC and GPS
3.2	Frequency of progress report	Each 2 weeks

B2 DISPOSITION OF NONCONFORMITIES

The Principal may accept rectification of data by reprocessing the data where you can demonstrate that the PROJECT QUALITY PLAN has not been followed in regard to processing the data.

Nonconformities in the data items may be accepted by the Principal, subject to a reduction in the quantity by an amount equal to the length that contains nonconforming data. The minimum extent of network surveyed that may be accepted by the Principal is specified in Annexure M924/A1.

B3 PAYMENT

Payment will be made for all costs associated with completing the work detailed in this Specification in accordance with the following Pay Item.

Where no specific pay items are provided for a particular item of work, the costs associated with that item of work are deemed to be included in the rates and prices generally for the Work Under the Contract.

The rate for this pay item may be subject to a "Rise and Fall" where provided in the Contract.

A lump sum price for any of these items will not be accepted.

Costs satisfying the requirements for Quality Assurance must be borne by you (e.g. validation processes). The costs of rectifying nonconformities must be borne by you.

Where the data is rejected because of its failure to meet the requirements of this Specification, all costs associated with rectification, including replacement or correction of the data and any extra costs incurred by you in respect of delays caused by such replacements, must be borne by you.

Missing Data or nonconforming data must be excluded from the quantity calculated as a basis for payment.

Table M924/B.2 – Pay Items

Pay Item No.	Description	Unit
M924P1	**Collection and reporting of Cracking data at 100 m intervals** Includes all costs associated with collection, processing, storage and reporting of Cracking extent, severity and type. The unit is lane kilometres. The quantity is the sum of the Interval lengths that have conforming data as determined by the Principal. The quantity includes the first series of 5 repeat runs at Close-out. Excludes the second and subsequent test of the Validation Site. Excludes the second and subsequent surveys at Close-out. Excludes nonconforming or rejected data.	**Lane km**

ANNEXURE M924/C – SCHEDULES OF HOLD POINTS, WITNESS POINTS AND IDENTIFIED RECORDS

Refer to Clause 1.3.4.

C1 SCHEDULE OF HOLD POINTS AND WITNESS POINTS

Clause	Type	Description
TfNSW Q	Hold	As specified.
Contract Documents	Hold	Certificate of Currency for each required Insurance.
3.2	Hold	Submission of the following information: (a) Validation details for each Crack Detection Vehicle, technician and driver; (b) Contract Program.
3.3	Witness	Validation Test.
3.5	Witness	Close-out (and Validation Test).
3.5	Hold	Submission of all the data of the road sections in Database format, clearly identifying the Crack Detection Vehicle, technician and driver.

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
2.1	Calibration records, as per Test Method TfNSW T2160, that include: (a) Light alignment; (b) Distance transducer. Maintenance records required in Test Method TfNSW T2160.
3.1	Validation for Crack Detection Vehicle, technician and driver.
3.3	Test data of Validation Site.
3.5	Test data at Close-out.
4.1	Data collected from Crack Detection Vehicle.

ANNEXURE M924/D – PLANNING DOCUMENTS

Refer to Clause 1.3.5.

The following documents are a summary of document that must be included in the PROJECT QUALITY PLAN. The requirements of this Specification and others included in the Contract must be reviewed to determine additional documentation requirements.

Clause	Description
2.2.2	Procedure to validate accuracy of GPS and deal with areas of substandard coverage and provision for analysis of GPS location
3.1	Requirements in Test Method TfNSW T2160
3.2	Contract Program
3.3	Validation test results
4.2	Relative importance of Event Codes

ANNEXURE M924/E – TECHNICAL REQUIREMENTS

E1 TFNSW LINEAR REFERENCING SYSTEM

Where the specified location referencing is ROADLOC, the Contractor must reference all data to the TfNSW Linear Referencing System called ROADLOC.

Ensure that the correct ROADLOC Nodes are selected. Reset the distance measured to zero directly adjacent to the identified Node.

The nominated lane surveyed must be identified in the database by the lane numbering convention described in the document "RAMS – Lane Numbering", as the Lane Code.

Where the survey is interrupted or stopped within a Link and GPS to the required accuracy is not available, recommence the survey at the Node preceding where the Incident was first encountered. Otherwise, recommence so that the complete data can be established.

E2 CARRIAGEWAY AND LANE CODE

Table M924/E.1 – Carriageway and Lane Codes

Carriageway Reference	Lane Reference
"A" Carriageways surveyed in the Prescribed and Counter Direction.	• Lane Code PT1, PT2, PT3, PT4, PT5, PT6. • Lane Code CT1, CT2, CT3, CT4, CT5, CT6.
"B" Carriageways surveyed in the Prescribed Direction.	• Lane Code PT1, PT2, PT3, PT4, PT5, PT6.
"C" Carriageways surveyed in the Counter Direction.	• Lane Code CT1, CT2, CT3, CT4, CT5, CT6.
"D" "E" "F" "G" "K" "L" Carriageways.	Lanes where length ≥ 100 m.

Carriageway Reference	Lane Reference
"R" "S" "T" "U" "V" "W" "X" "Y" Carriageways.	Generally not surveyed.
Exceptions (not generally surveyed)	• Lane Reference PLx, CLx, PRx, CRx that are < 100 m in length. • Parking bays where traffic calming devices create a parking zone. • Short bus bays or Bus lanes < 100 m. • Separate Bus Transitways. • Traffic devices.

E3 ALTERNATIVE PROCEDURE TO ADJUST RECORDS WITH DIFFERING LINK LENGTH

The following procedure is an option to fit the defined Node points.

The procedure is applied where the length surveyed is not exactly the same as the ROADLOC Link.

The residual length of lane that is less than the specified Interval (i.e. < 100 m) closes the Link and this is adjusted.

Where the Link length surveyed conforms to Clause 2.2.1, the LENGTH is adjusted using Scenario A, B or C as appropriate.

Where the Link length surveyed does not conform to Clause 2.2.1, use Scenario L.

Scenario A

Where the length surveyed and the ROADLOC length fall within the same Interval:

(a) Change the field "CH_TO" to the ROADLOC length.

(b) Record the field "LENGTH" as the length surveyed.

Example A.1: Surveyed length = 5.115, ROADLOC = 5.123

CH_FR	CH_TO	LENGTH
5.000	5.100	0.100
5.100	5.123	0.015 i.e. 5.115 - 5.100

Example A.2: Surveyed length = 5.147, ROADLOC = 5.123

CH_FR	CH_TO	LENGTH
5.000	5.100	0.100
5.100	5.123	0.047 i.e. 5.147 - 5.100

Scenario B

Where the measured length falls into the previous Interval (i.e. in Prescribed direction):

(a) In the last record for the Link:

(i) Change the field "CH_TO" to the ROADLOC length.

(ii) Record the field "LENGTH" as the length surveyed.

The record will then represent more than 100 m.

Example B.1: Surveyed length = 8.097. ROADLOC = 8.115

CH_FR	CH_TO	LENGTH
7.900	8.000	0.100
8.000	8.115	0.097 i.e. 8.097 - 8.000

Scenario C

Where the measured length falls into the next Interval:

(a) In the second last record:

(i) Change the field "CH_TO" to the ROADLOC length.

(ii) Change the field "LENGTH" to the length surveyed.

(iii) Include in the Comments field that the length surveyed exceeded the ROADLOC length.

(b) Report the Data Items over the actual Interval Length.

(c) Delete the last record.

Example C.1: Surveyed length = 7.715, ROADLOC = 7.690

CH_FR	CH_TO	LENGTH	Comments
7.500	7.600	0.100	
7.600	7.690	0.115 i.e. 7.715 - 7.600	Length exceeds by 0.025
~~7.700~~	~~7.715~~	~~0.015~~ Delete Last Record	

Scenario L: Nonconforming Length

Where the Link length surveyed does not comply with the distance tolerance specified in Clause 2.2.1, the Link is nonconforming and is reported as nonconformity:

(a) Flag the record in accordance with Clause 5.2.

(b) Include in the Comments field that the length measured exceeded the tolerance and the discrepancy.

(c) Make NO adjustment to the data.

(d) Ensure that the Nonconformity Report has been provided in accordance with Clause 5.3.

ANNEXURES M924/F TO M924/K – (NOT USED)

ANNEXURE M924/L – DATABASE FORMAT

L1 DATABASE FORMAT

Table M924/L.1 – Database Field Formats

FIELD NAME	DATABASE FIELD DESCRIPTION	FIELD FORMAT
FileName	The filename of the survey from the header information of the .RCX. This should be the same as the name of the .RCX file. Long filenames do not apply.	String
Roadwork	The RoadCrack vehicle encountered "roadworks".	
Outoflane	Due to "roadworks" or other reasons such as parked cars.	
Roadname	Name of road	
Date	Survey date	
Time	Start time of the survey	
Dirn	XSP Lane reference	String
Lane	Lane of the survey, as entered into the header by the Crew.	Integer (Byte)
Roan	Road Number of road surveyed.	Long Integer
Link	Link Number corresponding to the record	Integer
CC	Link Carriageway Code	
Cway	Link Carriageway Version number	
Ch_Fr	Distance (in km) in 100 m intervals starting at zero	
Ch_To	Distance (in km) from the "start" (in the prescribed direction) of the Link to the "end" (again in the Prescribed Direction) of the 100 m (or less) Interval.	
Length	Distance between Ch_To and Ch_Fr	
Chan	Number of Channels collecting data. Fully dependent on "WPath"	Field is not imported
Samp	Sampling rate "3" = 1 in 3; "4" = 1 in 4; "1" = 4 channels	Integer (Byte)
Temp	Surface Temperature measured by the temperature probe	Integer (Byte)
WPath	"L" – Left wheelpath data only, "R" – Right wheelpath data only, "B" – Both wheelpaths.	String
Dflag	Data Flag	
Ecode	Brief event description	Text
Comm	Additional information entered during testing. (out of lane, roadworks markers, custom features typed in by the crew)	String
Frames	Number of Frames analysed per channel in the Interval – 200 frames for 100 m	Integer
Tran_A	Number of Frames in the channel A (left wheelpath) exhibiting transverse cracking	Integer
TWidth_A	Average width of these transverse cracks.	Single
Long_A	Number of Frames in the channel A (left wheelpath) exhibiting longitudinal cracking	Integer
LWidth_A	Average width of these longitudinal cracks.	Single
Croc_A	Number of Frames in the channel A (left wheelpath) exhibiting crocodile cracking	Integer
CWidth_A	Average width of these crocodile cracks	Single
Straight_A	Number of Frames in the channel A (left wheelpath) exhibiting straight cracking (not a maintenance issue)	Integer
Other_A	Number of Frames in the channel A (left wheelpath) exhibiting a Non-crack feature	Integer
Tran_B	Number of Frames in the channel B (left wheelpath) transverse cracking.	Integer
TWidth_B	Average width of these transverse cracks	Single
Long_B	Number of Frames in the channel B (left wheelpath) exhibiting longitudinal cracking	Integer
LWidth_B	Average width of these longitudinal cracks	Single
Croc_B	Number of Frames in the channel B (left wheelpath) exhibiting crocodile cracking	Integer
CWidth_B	Average width of these crocodile cracks	Single

FIELD NAME	DATABASE FIELD DESCRIPTION	FIELD FORMAT
Straight_B	Number of Frames in the channel B (left wheelpath) exhibiting straight cracking (not a maintenance issue)	Integer
Other_B	Number of Frames in the channel B (left wheelpath) exhibiting a Non-crack feature	Integer
Tran_C	Number of Frames in the channel C (right wheelpath) exhibiting transverse cracking	Integer
TWidth_C	Average width of these transverse cracks.	Single
Long_C	Number of Frames in the channel C (right wheelpath) exhibiting longitudinal cracking	Integer
LWidth_C	Average width of these longitudinal cracks.	Single
Croc_C	Number of Frames in the channel C (right wheelpath) exhibiting crocodile cracking	Integer
CWidth_C	Average width of these crocodile cracks	Single
Straight_C	Number of Frames in the channel C (right wheelpath) exhibiting straight cracking (not a maintenance issue)	Integer
Other_C	Number of Frames in the channel C (right wheelpath) exhibiting a Non-crack feature	Integer
Tran_D	Number of Frames in the channel D (right wheelpath) exhibiting transverse cracking	Integer
TWidth_D	Average width of these transverse cracks	Single
Long_D	Number of Frames in the channel D (right wheelpath) exhibiting longitudinal cracking	Integer
LWidth_D	Average width of these longitudinal cracks	Single
Croc_D	Number of Frames in the channel D (right wheelpath) exhibiting crocodile cracking	Integer
CWidth_D	Average width of these crocodile cracks	Single
Straight_D	Number of Frames in the channel D (right wheelpath) exhibiting straight cracking (not a maintenance issue)	Integer
Other_D	Number of Frames in the channel D (right wheelpath) exhibiting a Non-crack feature	Integer
X_From	Start Horizontal “X” Coordinate	Double
Y_From	Start Horizontal “Y” Coordinate	Double
~~Z_From~~	~~Start Vertical “Z” Coordinate~~	~~Double~~
X_To	End Horizontal “X” Coordinate	Double
Y_To	End Horizontal “Y” Coordinate	Double
~~Z_To~~	~~End Vertical “Z” Coordinate~~	~~Double~~

ANNEXURE M924/M – REFERENCED DOCUMENTS

Refer to Clause 1.3.8.

TfNSW Specifications

TfNSW G10	Traffic Management
TfNSW G22	Work Health and Safety (Construction Work)
TfNSW Q	Quality Management System

TfNSW Test Methods

TfNSW T2160	Determination of Extent of Road Pavement Cracking by Crack Detection Equipment

TfNSW Guidelines

RAMS – Linear Referencing

RAMS – Lane Numbering

Road Occupancy Manual