TRANSPORT FOR NSW (TfNSW)

QA SPECIFICATION M922

MEASUREMENT OF ROUGHNESS, RUTTING AND TEXTURE BY LASER PROFILOMETER

REVISION REGISTER

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Transport for NSW

QA SPECIFICATION M922

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IC-QA-M922

VERSION FOR:
DATE:

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CLAUSE **PAGE**

FOREWORD

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REVISIONS TO PREVIOUS VERSION

This document has been revised from Specification TfNSW R422 Edition 1 Revision 3.

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 M922

MEASUREMENT OF ROUGHNESS, RUTTING AND TEXTURE BY LASER PROFILOMETER

1 GENERAL

1.1 INTENT

The automated collection of road pavement data is for monitoring the roughness, rutting and texture condition of a network of surfaced roads. The Specification is not intended for testing construction sites.

1.2 SCOPE

The Work to be executed under this Specification consists of collecting data using a Laser Profiler to:

(a) Measure road roughness data by direct measurement of the longitudinal profile of the road surface according to Test Method TfNSW T187 or Austroads Test Method AG:AM/T001;

(b) Measure rutting data by direct measurement of the transverse profile of road surface according to Austroads Test Method AG:AM/T009;

(c) Measure texture data by direct measurement of the road surface according to Austroads Test Method AG:AM/T013;

(d) Analyse and report the processed data at the required Intervals.

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 requirements for survey work on the road network are included in Annexure M922/A.

Project requirements are detailed in Annexure M922/A. A Schedule of Work will be provided to the details indicated in Annexure M922/A.

1.3.2 Information Supplied by the Principal

The Principal will supply you with the information listed in Annexure M922/B.

1.3.3 Measurement and Payment and Resolution of Nonconformities

The method of measurement and payment must comply with Annexure M922/B.

Acceptance of materials and work must be in accordance with Annexure M922/B.

1.3.4 Schedules of HOLD POINTS, WITNESS POINTS and Identified Records

The schedules in Annexure M922/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 M922/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 M922/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 M922/E.

1.3.7 Data Specifications

The relevant data specifications are described in Annexure M922/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 M922/M.

1.4 DEFINITIONS AND ACRONYMS

The terms “you” and “your” mean “the Contractor” and “the Contractor’s” respectively.

The following definitions and acronyms apply to this Specification:

Accreditation Loop The lengths of road tested as part of the TfNSW’s accreditation process (refer to Test Method TfNSW T187).

Close-out Close-out survey is the retesting, at completion of survey, of the Validation Site (refer to Clause 3.3). Correlation analysis must meet the criteria set out in Clause 3.5.

Counter Direction The opposite direction of travel to the “Prescribed” direction (refer to RAMS – Lane Numbering).

GDA94 Geocentric Datum of Australia 1994 to be used for the Works.

Heavy Articulated Truck Index (HATI)	Used to highlight road sections that provide a poor ride to occupants of heavy articulated trucks. Refer to the technical paper: Hassan R, McManus K, Cossens I, "Development of HATI – Heavy Articulated Truck Index", 22nd ARRB Conference, Canberra Australia, 2006.
Inner taut wire (ITW)	Measure of rutting in the IWP.
Inner Wheelpath (IWP)	The wheelpath that is to the right of travelled lane.
Interval	The distance that data is to be aggregated and reported in the database.
Invalid	Data that is outside the limits specified by the Principal.
IRI	International Roughness Index determined using a quarter car model.
IRIH	The IRI derived by applying the half-car model to a profile created from a point by point average of the two wheelpath profiles.
Laser Profiler (Profilometer)	A device for producing a series of numbers related in a well-defined way to a true profile. Roughness measuring devices, other than mechanical response-type devices and most static devices, are commonly referred to as profilometers.
Mean Profile Depth (MPD)	Measure of Mean Profile Depth for an Interval.
Non-contact	A term to describe a system of measuring where there is no physical contact between the instrument and the object being measured, e.g. accelerometers and laser sensors are capable of measuring a road surface profile without physical contact with the road surface.
Outer taut wire (OTW)	Measure of rutting in the Outer Wheelpath (OWP).
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 TfNSW (refer to RAMS – Linear Referencing).

Roughness	A condition parameter which characterises deviations from the intended longitudinal profile of a road surface with characteristic dimensions that affect vehicle dynamics, ride quality and dynamic pavement loading. A measure of surface irregularities with wavelengths between 0.5 m and 50 m in the longitudinal profile of one or two wheelpaths in a traffic lane, reported in dimensionless units as either International Roughness Index (IRI, m/km) or as NAASRA Roughness Meter Counts (NRM, counts per kilometre) for the lane. The consequence of irregularities in the longitudinal profile of a road with respect to the intended profile.
Rutting	A form of pavement deformation being a longitudinal depression in a road surface, usually located in a wheelpath.
Texture	The surface irregularities of the road pavement surface.
Traffic signal green light runs	Green light corridors on survey routes provided by the TfNSW Transport 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 Laser Profiler with the following equipment:

(a) Location referencing devices (e.g. measure linear distance, determine geographical position);

(b) At least eleven (11) non-contact laser sensors that are synchronised to sample at a frequency independent of vehicle speed;

(c) Ancillary equipment located and configured to be capable of producing the required data (e.g. accelerometers);

(d) A reliable electronic data acquisition system of hardware and software to facilitate real time data capture and real time interface with the operator.

The Laser Profiler must have been assessed as being fit for purpose by the Principal. The minimum requirement for all equipment is according to Test Method TfNSW T187 or Austroads Test Methods AG:AM/T001, AG:AM/T009 or AG:AM/T013, as appropriate. 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 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 M922/E1.

2.2.2 Global Positioning (GPS)

When specified in Annexure M922/A, GPS details must be collected to supplement the location reference system.

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

The GPS equipment must have the capability specified in Table M922.1.

Table M922.1 – 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.

Include in the PROJECT QUALITY PLAN 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 SENSORS

2.3.1 Longitudinal Profile Sensors (Roughness)

The Laser Profiler must measure simultaneously the two longitudinal wheelpaths.

The longitudinal frequency of sampling must be sufficient to reliably calculate roughness in terms of International Roughness Index (IRI).

2.3.2 Transverse Profile Sensors (Rutting)

Determine Rutting from transverse pavement profile measured using all non-contact laser sensors over a width of at least 3.0 m. Correct the transverse extent and the Rutting measure where non-pavement features are measured (e.g. kerbs, shoulder encroachment).

2.3.3 Texture Sensors

Determine Texture from measurements using two sensors; report Sand Patch Texture Depth (SPTD), Sensor Measured Texture Depth (SMTD) and Mean Profile Depth (MPD) in each path.

2.4 OPERATOR INTERFACE

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

(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 appropriate Event Codes described in Test Method TfNSW T187 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

Data collection includes initial validation (as per Test Method TfNSW T187), survey of the roads using the Laser Profiler, real time processing of data and storage during the survey, and Close-out.

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

Ensure that all the requirements in Test Method TfNSW T187 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 data and must not be less than the frequency specified. Where a minimum frequency is not specified, nominate an appropriate frequency.

When specified in Annexure M922/A, supply the TfNSW Accreditation Certificates[i] for each Laser Profiler, driver and operator combination proposed for the Work. The Accreditation Certificates must be no more than 4 months old at the commencement of each survey.

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

[i] Two certificates are required for each driver and operator team to allow for interchanging roles. Arrangement for TfNSW Accreditation can be obtained from the Principal.

Where required to minimise stopping during the survey, apply to the Principal for times proposed for specific traffic signal green light runs. Also, where the work requires the testing of specially designated lanes (e.g. bus lanes, Transit Lanes), ensure that permission to test is granted in advance.

When specified in Annexure M922/A, the Operator will liaise with the Transport Management Centre (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

The Contractor must select the order in which 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 WHS and traffic requirements;

(b) Time taken to process applications (e.g. traffic signal green light runs);

(c) Conditions for the traffic signal green light runs (refer to Clause 3.1);

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

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

At the period specified in Annexure M922/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 Clause 5);

(iii) Progress with data processing;

(iv) Other issues;

(v) The Program of Work must indicate a date to supply the final data to meet the time line specified by the Principal.

3.3 VALIDATION SITE

When specified in Annexure M922/A, for each Laser Profiler, driver and operator combination proposed to carry out the survey, supply all the most recent data in the Primary database that was collected from the Accreditation Loop. All fields in the database must be populated with the actual data recorded (i.e. includes roughness, rutting, texture, Heavy Articulated Truck Index (HATI)). The data submitted forms the basis for assessing Close-out in Clause 3.5.

The nominated Validation Site is the same site as the Accreditation Loop.

HOLD POINT

Process Held:	Commencement of survey.
Submission Details:	At least 7 days before the proposed date of commencement, provide the following details: (a) The Accreditation details for each Laser Profiler, driver and operator combination; (b) The Contract Program; (c) The data from the Validation Site for each Laser Profiler, driver and operator combination in the required database specification.
Release of Hold Point:	The Principal will consider the submitted data prior to authorising the release of the Hold Point.

3.4 SURVEY

3.4.1 General

The Laser Profiler must be operated according to Test Method TfNSW T187. Ensure that the correct speed range is maintained. Where traffic signal green light runs are planned, liaise with the TMC Operations Room during the survey.

Use only combinations of Laser Profiler, driver and operator that have current TfNSW Accreditation Certificates. The Accreditation does not relieve the Contractor of the need to ensure that the survey is performed according to the Specification.

Reference all data records using the Location Referencing System nominated in Clause 2.2.

3.4.2 Direction and Lane Identification

Test the lane that is specified in Test Method TfNSW T187, except where the required survey lane(s) is nominated by the Principal in Annexure M922/E.

Reference the direction of survey (i.e. Prescribed or Counter) and the actual lane surveyed during data collection according to 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

When specified in Annexure M922/A, within 28 days after the collection completion date, conduct Close-out by retesting the Validation Site (refer to Clause 3.3) with 5 consecutive runs for each Laser Profiler, driver and operator combination used for the survey.

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

WITNESS POINT

Process to be Witnessed: Close-out.

Submission Details: At least 3 days notice of intention to re-survey the Validation Site.

HOLD POINT

Process Held:	Completion of collection work for the survey.
Submission Details:	Within 5 days of completing the re-survey of the Validation Site, provide all the data of the road sections in the Primary Database format and clearly identify the Laser Profiler, and driver and operator teams.
Release of Hold Point:	The Principal will consider the correlation (i.e. using r^2) between the Close-out survey and the Validation Site for each Laser Profiler, driver and operator combination prior to authorising the release of the Hold Point.

Where a Correlation Coefficient does not meet the criteria in Table M922.2, the data collected by the Laser Profiler, driver and operator team is nonconforming.

Table M922.2 – Conformity Criteria

Data Item	Correlation Coefficient (r^2)
Roughness	≥ 0.95
Rutting Inner wheel path	≥ 0.90
Rutting Outer wheel path	≥ 0.90
Texture between wheelpaths	≥ 0.90
Texture outer wheel path	≥ 0.90

4 REPORTING

4.1 GENERAL

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

The process must commence within 7 days of the data being collected and must progress at a consistent rate thereafter. Progressively supply data collected no later than fourteen days after collection in the field in the Primary Database format.

Ensure that the following are performed:

(a) The Start and End Node for each Link that is recorded during the survey is adjusted to the spatial representation of the road system provided by the Principal;

(b) Data is reported at the nominated distance interval as referenced from the start Node of each ROADLOC Link and progressing in the Prescribed Direction;

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

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

(e) Data is appropriately flagged according to Clause 5.2.

At completion of each survey, submit two (2) complete and final sets of all required data on DVD or CD to meet the time line specified by the Principal.

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 DATABASE SPECIFICATIONS

4.2.1 Primary Database

Supply the required data in the Primary database which has been aggregated and location referenced at distance Intervals of 100 m, except for the residual length to close on the end Node.

The "Primary" database specification is provided in Annexure M922/L1.

4.2.2 Secondary Database (Option)

When specified in Annexure M922/A, and the Principal accepts the optional Pay Item M922P5, supply the required data in a separate "Secondary" database. The "Secondary" database must have data aggregated and location referenced at distance Intervals of 20 m, except for the residual length to close on the end Node.

The "Secondary" database specification is provided in Annexure M922/L2.

4.3 PROCESSING DATA

Process the data to provide the data items described in Table M922.3. Ensure that only conforming data is used to determine and report the data items.

Where an Interval has more than one type of Event Code, report the worst case Event Code with the Interval (e.g. an Event Code that makes the data nonconforming 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 that is defined by TfNSW. 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:

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

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

Table M922.3 – Requirements for Data Items

Data Item	Requirements
Roughness	Analyse the longitudinal profile in each path and determine the roughness data for each Interval in accordance with Test Method TfNSW T187. Where required, convert IRI_L_{hc} to NAASRA Roughness counts per kilometre in accordance with Test Method TfNSW T187 or Austroads Test Method AG:AM/T001.
Rutting	Analyse measurements from all sensors across the transverse profile and determine the rutting data for each Interval in accordance with Austroads Test Method AG:AM/T009. Use the 3.0 m simulated taut wire placed across the full profile width to determine Rutting. Ensure that Rutting is restricted to the pavement wearing surface and does not include off pavement measurements.
Texture	Analyse the texture data in the two longitudinal paths and determine the Texture data for each Interval in accordance with Austroads Test Method AG:AM/T013. Report the texture data as Mean Profile Depth (MPD), Sand Patch Texture Depth (SPTD) and Sensor Measured Texture Depth (SMPD).
Heavy Articulated Truck Index (HATI)	Analyse the Laser Profiler data and determine the HATI parameter based on the procedure by Hassan R, McManus K, Cossens I, "Development of HATI – Heavy Articulated Truck Index", 22nd ARRB Conference, Canberra Australia, 2006.

5 CONFORMITY

5.1 GENERAL

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

The Lot that is referred to in Specification TfNSW Q corresponds to the data collected from a continuous run using the same Laser Profiler, driver and operator team.

A data item is nonconforming when the data item is derived from < 90% of the total possible number of readings that should be collected in the Interval. Such data must be reported as "Missing Data".

All "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 M922.4. Reasons for nonconformity include, but are not limited to, the following:

(a) Data collected that does not comply with the requirements in TfNSW Test Methods, and includes:

  (i) Outside the speed constraints;

  (ii) Data collected when the road surface was too 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 combination.

Table M922.4 – Data Flags for Processed Data

Reason	Data Flag	Extent
Conforming data	A	Each Interval
Link length nonconformity	L	Each Interval in the Link affected to be flagged
Nonconforming data (Invalid data) other than a "Link length" nonconformity	Z	Each Interval

5.3 NONCONFORMITY REPORTING

Submit a Nonconformity Report according to 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 M922/A – PROJECT SPECIFIC REQUIREMENTS

A1 EXTENT OF WORK

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

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

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

Table M922/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 M922/A.2 – Other Requirements

Clause	Description	Required
2.2.2	Global positioning (GPS)	Yes / No
3.1	Accreditation	Yes / No
3.1	Traffic signal green light runs	Yes / No
3.3	Validation	Yes / No
3.5	Close-out survey	Yes / No
4.2.2	Secondary database	Yes / No
4.3	Reporting of HATI at 100 m intervals	Yes / No

ANNEXURE M922/B – MEASUREMENT AND PAYMENT AND RESOLUTION OF NONCONFORMITIES

B1 MEASUREMENT

Table M922/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 Primary database. • 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 for 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 M922/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 Items.

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 each 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. Accreditation and validation processes). The costs of rectifying nonconformities must be borne by you.

You must arrange for Accreditation with TfNSW and pay any charge for the service provided. Accreditation is not part of the Contract and all costs must be borne by you.

Where the data is rejected due to nonconformity, 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 will be excluded from the quantity used as a basis for payment.

Table M922/B.2 – Pay Items

Pay Item No.	Description	Unit
M922P1	**Collection and reporting of Roughness data at 100 m Intervals.** Includes all costs associated with collection, processing, storage and reporting of Roughness data. Excludes Intervals that are nonconforming. 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 is not the length measured by the vehicle.	**Ln km**
M922P2	**Collection and reporting of Rutting data at 100 m Intervals.** Includes all costs associated with collection, processing, storage and reporting of Rutting data. Excludes Intervals that are nonconforming. 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 is not the length measured by the vehicle.	**Ln km**
M922P3	**Collection and reporting of Texture data at 100 m Intervals.** Includes all costs associated with collection, processing storage and reporting of Texture data. Excludes nonconforming or rejected data. 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 is not the length measured by the vehicle.	**Ln km**

Pay Item No.	Description	Unit
M922P4	**Reporting of HATI at 100 m Intervals.** Includes all costs in addition to M922P1 associated with processing, storage and reporting of HATI data. Excludes Intervals that are nonconforming. 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 is not the length measured by the vehicle.	**Ln km**
M922P5	**Reporting of Roughness at 20 m Intervals (Optional Item)** Includes all costs in addition to M922P1 associated with processing, storage and reporting of data at 20 m Intervals. Excludes Intervals that are nonconforming. 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 is not the length measured by the vehicle.	**Ln km**

ANNEXURE M922/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.
3.3	Hold	Submission of the following details: (a) Accreditation details for each Laser Profiler, driver and operator combination; (b) Contract Program; (c) Data from Validation Site for each Laser Profiler, driver and operator combination in the required database specification.
3.5	Witness	Re-surveying Validation Site.
3.5	Hold	Submission of all data of road sections in Primary Database format, clearly identifying the Laser Profiler, and driver and operator teams.

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 required as part of TfNSW Test Methods.
3.1	Accreditation certificates for driver and operator teams.
3.3	Validation Site data from Accreditation Loop.
3.5	Close-out data from Accreditation Loop.
4.1	Data collected from Laser Profiler prior to any processing.

ANNEXURE M922/D – PLANNING DOCUMENTS

Refer to Clause 1.3.5.

The following documents are a summary of documents 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 T187
3.2	Contract Program
4.3	Relative importance of Event Codes

ANNEXURE M922/E – TECHNICAL REQUIREMENTS

E1 ROADLOC 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 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, the LENGTH is adjusted using Scenario A, B or C as appropriate.

Where the Link length surveyed does not conform to Clause 2.2, 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 the 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, the Link is nonconforming and is reported as a nonconformity (refer to Clause 5):

(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 according to Clause 5.3.

E3 CARRIAGEWAY AND LANE CODES

Table M922/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	Test all lengths that appear in the schedule
“R” “S” “T” “U” “V” “W” “X” “Y” Carriageways	Test all lengths that appear in the schedule, including ramps
Exceptions (not generally surveyed)	• Parking bays where traffic calming devices create a parking zone. • Short Bus bays or bus lanes < 50 m. • Traffic devices. • Separate Bus Transitways.

ANNEXURES M922/F TO M922/K – (NOT USED)

ANNEXURE M922/L – DATABASE FORMAT

L1 PRIMARY DATABASE FORMAT

The data parameters required are described in the following table.

Table M922/L.1 Primary Database Field Formats

FIELD NAME	DATABASE FIELD DESCRIPTION	FIELD FORMAT	
PKEY	Primary Key (unique) – Calculated as: STRING [(Road Number * 10,000,000) + (Link * 1,000) + (CH_FR)] & "Survey Number" & "XSP Lane Reference" & "Data Flag"	Text	20
ROAN	Road Number	Number	Integer
LINK	Link number	Number	Integer
CH_FR	Distance from start of Link to start of the Interval (km)	Number	Float
CH_TO	Distance from start of Link to end of the Interval (km)	Number	Float
LENGTH	Length of Interval (km). Calculated CH_TO – CH_FR	Number	Float
CC	Link Carriageway Code	Text	1
CWYV	Link Carriageway Version	Number	Integer
DIRN	Direction surveyed (P or C)	Text	1
LCODE	RAMS XSP Lane reference	Text	3
CCODE	Contract Code – defined by Principal	Text	5
SCODE	Supplier Code – defined by Principal	Text	5
REGO	Survey Vehicle Registration Number	Text	10
OPERATOR	Operator's Identification (Initials)	Text	4
DATE	Survey date	Date	dd/mm/yyyy
TIME	Survey time	Time	hh:mm:ss
SPEED	Mean vehicle speed for Interval (km/hr)	Number	Integer
SNUM	Survey number for Link (sequential from A to Z)	Text	1
DFLAG	Data Flag	Text	1
ECODE	Event Code	Text	1
COMM	Comments	Text	68
IRI_O	IRI Roughness value (outer quarter car)	Number	Float
IRI_I	IRI Roughness value (inner quarter car)	Number	Float
IRI_L	IRIH Roughness value (lane half car)	Number	Float
ROUGH	NAASRA roughness in NRM counts/km for Interval	Number	Float
RUTWO_5	Outer taut wire (OTW) % ≤ 5 mm rut depth	Number	Integer
RUTWO_10	5 mm rut depth < OTW % ≤ 10 mm rut depth	Number	Integer
RUTWO_15	10 mm rut depth < OTW % ≤ 15 mm rut depth	Number	Integer
RUTWO_20	15 mm rut depth < OTW % ≤ 20 mm rut depth	Number	Integer
RUTWO_25	20 mm rut depth < OTW % ≤ 25 mm rut depth	Number	Integer
RUTWO_30	25 mm rut depth < OTW % ≤ 30 mm rut depth	Number	Integer
RUTWO_35	30 mm rut depth < OTW % ≤ 35 mm rut depth	Number	Integer
RUTWO_40	35 mm rut depth < OTW % ≤ 40 mm rut depth	Number	Integer
RUTWO_X	OTW % > 40 mm rut depth	Number	Integer
RUTWO_A	OTW average rut depth (mm)	Number	Float
RUTWO_SD	OTW std deviation rut depth (mm)	Number	Float
RUTWI_5	Inner taut wire (ITW) % ≤ 5 mm rut depth	Number	Integer

FIELD NAME	DATABASE FIELD DESCRIPTION	FIELD FORMAT	
RUTWI_10	5 mm rut depth < ITW % ≤ 10 mm rut depth	Number	Integer
RUTWI_15	10 mm rut depth < ITW % ≤ 15 mm rut depth	Number	Integer
RUTWI_20	15 mm rut depth < ITW % ≤ 20 mm rut depth	Number	Integer
RUTWI_25	20 mm rut depth < ITW % ≤ 25 mm rut depth	Number	Integer
RUTWI_30	25 mm rut depth < ITW % ≤ 30 mm rut depth	Number	Integer
RUTWI_35	30 mm rut depth < ITW % ≤ 35 mm rut depth	Number	Integer
RUTWI_40	35 mm rut depth < ITW % ≤ 40 mm rut depth	Number	Integer
RUTWI_X	ITW % > 40 mm rut depth	Number	Integer
RUTWI_A	ITW average rut depth (mm)	Number	Float
RUTWI_SD	ITW std deviation rut depth (mm)	Number	Float
SPTDC	Sand Patch Texture Depth – Centre of wheelpaths	Number	Float
SPTDP	Sand Patch Texture Depth – Passenger wheelpath	Number	Float
SMTDC	Sensor Measured texture Depth – Centre of wheelpaths	Number	Float
SMTDP	Sensor Measured texture Depth – Passenger wheelpath	Number	Float
MPDC	Mean Profile Depth – Centre of wheelpaths	Number	Float
MPDP	Mean Profile Depth – Passenger wheelpath	Number	Float
HATI	Heavy Articulated Truck Index	Number	Float
X_From	Start Horizontal “X” Coordinate	Number	Float
Y_From	Start Horizontal “Y” Coordinate	Number	Float
~~Z_From~~	~~Start Vertical “Z” Coordinate~~	~~Number~~	~~Float~~
X_To	End Horizontal “X” Coordinate	Number	Float
Y_To	End Horizontal “Y” Coordinate	Number	Float
~~Z_To~~	~~End Vertical “Z” Coordinate~~	~~Number~~	~~Float~~

L2 SECONDARY DATABASE FORMAT

Data must be aggregated and reported at Intervals of 20 m.

The data parameters required are described in the following table.

Table M922/L.2 Secondary Database Field Formats

DATABASE FIELD DESCRIPTION	FIELD NAME	FIELD FORMAT	
Primary Key (unique) – Calculated as: STRING [(Road Number * 10,000,000) + (Link * 1,000) + (CH_FR)] & “Survey Number” & “XSP Lane Reference” & “Data Flag”	PKEY	Text	20
Road Number	ROAN	Number	Integer
Link number	LINK	Number	Integer
Distance from start of Link to start of the Interval (km)	CH_FR	Number	Float
Distance from start of Link to end of the Interval (km)	CH_TO	Number	Float
Length of Interval (km). Calculated CH_TO – CH_FR	LENGTH	Number	Float
Link Carriageway Code	CC	Text	1
Link Carriageway Version	CWYV	Number	Integer
Direction surveyed (P or C)	DIRN	Text	1
RAMS XSP Lane reference	LCODE	Text	3
Contract Code – defined by Principal	CCODE	Text	5
Supplier Code – defined by Principal	SCODE	Text	5
Survey date	DATE	Date	dd/mm/yyyy

DATABASE FIELD DESCRIPTION	FIELD NAME	FIELD FORMAT	
Survey time	TIME	Time	hh:mm:ss
Mean vehicle speed for Interval (km/hr)	SPEED	Number	Integer
Survey number for Link (sequential from A to Z)	SNUM	Text	1
Data Flag	DFLAG	Text	1
Event Code	ECODE	Text	1
Comments	COMM	Text	68
IRI Roughness value (outer quarter car)	IRI_O	Number	Float
IRI Roughness value (inner quarter car)	IRI_I	Number	Float
IRIH Roughness value (lane half car)	IRI_L	Number	Float
NAASRA roughness in NRM counts/km for Interval	ROUGH	Number	Float
Start Horizontal “X” Coordinate	X_From	Number	Float
Start Horizontal “Y” Coordinate	Y_From	Number	Float
~~Start Vertical “Z” Coordinate~~	~~Z_From~~	~~Number~~	~~Float~~
End Horizontal “X” Coordinate	X_To	Number	Float
End Horizontal “Y” Coordinate	Y_To	Number	Float
~~End Vertical “Z” Coordinate~~	~~Z_To~~	~~Number~~	~~Float~~

ANNEXURE M922/M – REFERENCED DOCUMENTS

Refer to Clause 1.3.8.

TfNSW Specifications

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

TfNSW Test Methods

TfNSW T187	Measurement of Ride Quality of Road Pavements by Laser Profiler

TfNSW Guidelines

RAMS – Linear Referencing

RAMS – Lane Numbering

Road Occupancy Manual

Austroads Test Methods

AG:AM/T001	Pavement Roughness Measurement with an Inertial Profilometer
AG:AM/T009	Pavement Rutting Measurement with a Laser Profilometer
AG:AM/T013	Pavement Surface Texture Measurement with a Laser Profilometer