

SCANNER surveys for Local Roads

User Guide and Specification

Volume 4

Technical Requirements for SCANNER Survey Data and Quality Assurance

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Acknowledgement

This SCANNER User Guide has been developed from the SCANNER specification used in 2009. It incorporates many detailed changes based on experience of using the SCANNER specification in 2005/06 2006/07 and 2009, the TTS specification before that in 2003/04 and 2004/05 and a wide range of comments from interested parties. It includes the results of research on developing SCANNER commissioned on behalf of the UK Roads Board.

The previous SCANNER specifications were based on the original "TRACS Type Surveys for the Principal Road Network – Specification and Advice Note" produced for the UK Roads Board by the Chris Britton Consultancy and TRL Limited.

Throughout the development of the TTS and SCANNER specifications, considerable assistance and support has been given by members of the SCANNER Implementation Group, including local authority representatives, by TRL Limited, by the Chris Britton Consultancy, by SCANNER survey contractors, by Halcrow, by Nick Lamb Consultancy Ltd and by UKPMS developers.

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Foreword

This document is one of a series of five describing the requirements for SCANNER Surveys (Surface Condition Assessment of the National Network of Roads). It replaces the revised SCANNER specification first published in March 2006, and subsequent updates of February 2007 and 2009.

The five Volumes are:

1. Introduction to SCANNER surveys
2. Advice to Local Authorities – Procuring Surveys
3. Advice to Local Authorities – Using SCANNER Survey Results
4. Technical requirements – SCANNER Survey Data and Quality Assurance
5. Technical requirements – SCANNER Survey Parameters and Accreditation

This volume 4, SCANNER Survey Data and Quality Assurance, defines the technical requirements for the services to be provided by the survey contractor, including the Survey Data and the requirements for Quality Assurance procedures to ensure the Services are consistent and reliable. It also includes the specifications for audit processes, monitoring, calibration, and requirements for repeat surveys.

Volume 1 provides a brief introduction to the requirements for SCANNER surveys, and is intended to be read as a free standing document, as well as providing an overview of the other four volumes. It includes a glossary of terms and a list of the SCANNER parameters as annexes.

Volume 2 contains advice to Local Authorities about procuring SCANNER surveys under the SCANNER Specification and is to be read in conjunction with the other documents. It includes advice on preparing contact documents, inviting bids, assessing tenders and managing contracts. It includes a model contact document as an annex.

Volume 3, Using SCANNER data, explains the background to SCANNER Surveys and gives further guidance on the interpretation of processed SCANNER data. It contains advice on receiving and using SCANNER data, interpreting the results for local asset management and maintenance, producing and understanding performance indicators, and reporting NRMCS results.

Volume 5, Technical requirements for SCANNER Survey Parameters and Accreditation defines the technical requirements for the parameters provided by the machine developer, including acceptance and consistency testing and accreditation. It describes the requirements for accreditation of the Equipment. It also describes the requirements for consistency testing and for the reporting and delivery of data from SCANNER accredited surveys.

1 Introduction

1.1 Scope and Content

- 1.1.1 This volume 4 of the User Guide for SCANNER surveys on local roads, “SCANNER survey specification and quality assurance”
- (a) Defines the technical requirements for the surveys
 - (b) Defines the technical requirements for the Survey Data
 - (c) Defines the technical requirements for processing the Survey Data
 - (d) Defines the requirements for Quality Assurance, including monitoring, calibration and repeat surveys and the requirements for independent (third party) audit.
- 1.1.2 Terms are defined in a Glossary in Volume 1 of this User Guide, “Introduction to SCANNER surveys”.

2 Survey Procedures

2.1 General requirements

- 2.1.1 The Employer specifies the road network over which SCANNER accredited surveys are required. The Contractor carries out the surveys on those roads in accordance with this Specification, and any other requirements of the Employer, and supplies the SCANNER accredited Survey Data to the Employer.
- 2.1.2 The surveys may only be carried out by Survey Equipment which has passed an Acceptance test and has a currently valid accreditation certificate, as defined in Volume 5. If specifically requested, the Contractor provides the Employer and any appointed Auditor with a copy of a valid accreditation certificate covering the dates when the Employer's survey work was undertaken.
- 2.1.3 Where the Survey Equipment is unable to, or is likely to be unable to, provide valid survey data over any part of the Employer's road network for any reason, the Contractor agrees with the Employer the procedures to exclude invalid data and, if necessary, to provide alternative survey results from those parts of the Employer's road network.
- 2.1.4 The Employer owns the results of the survey, the survey data and the results of any data processing carried out by the Contractor.
- 2.1.5 The Employer requires the Contractor to make the survey data available to the relevant national authority for statistical monitoring purposes.

2.2 Survey Planning and Routeing

- 2.2.1 The Employer provides the Contractor with a list of the Sections that are to be surveyed. The Employer provides the following information for each Section, including:
- (a) The Road Number and /or name (if available)
 - (b) The Section Label (unique identifier)
 - (c) A label describing each Section Start Point
 - (d) The National Grid co-ordinate (OSGR) of the Section Start Point
 - (e) A label describing the Section End Point
 - (f) The National Grid co-ordinate (OSGR) of the Section End Point
 - (g) The Section Length
 - (h) A description of the Section and/or a map showing the location of the Section.
 - (i) Information defining connectivity between sections (e.g. unique numerical codes for start and end of sections).

- (j) Any additional information the Contractor may require to prepare for the Surveys of the Employer’s road network

<p>Note(1): Within links of contiguous sections, that can be physically driven, all sections should be designated to have the same direction. The Contractor should discuss lengths where this requirement has not been satisfied with the Employer before commencing the survey.</p>
<p>Note(2): Alternative arrangements have been made in Scotland where Scottish local authority road networks have been derived from the National Street Gazetteer, and the contractor is given freedom to select the roads to be surveyed, subject to meeting the overall coverage requirements and not revisiting locations within a prescribed period, depending on the specified frequency of survey.</p>

- 2.2.2 If SCANNER or TTS surveys have previously been carried out on the Employer’s Network the Employer may provide (at the Employer’s discretion) the “fitted” survey routes provided by the Contractor that carried out a previous survey. If previous fitted survey routes are provided, the Employer will also provide details of any changes that have been made to the network since the previous surveys were carried out. However, the Contractor is responsible for ensuring that any previously fitted survey routes remain suitable and appropriate for the surveys carried out by the Contractor.
- 2.2.3 The Contractor divides the Employer’s network into a set of Survey Routes for the purposes of carrying out the Surveys. Due to the large quantity of raw data to be collected, no individual Survey Route may be more than 100km long.
- 2.2.4 A Survey Route comprises an ordered list of one or more “Survey Lanes”. Each Survey Lane is identified by a Section label; a lane Direction Indicator; a traffic lane; start Chainage and end Chainage. Each survey lane also has a start location marker label, and the Survey Route has an end location marker label.
- 2.2.5 In most cases a survey lane is likely to extend along the entire length of a Section, but this is not a specific requirement.
- 2.2.6 A Survey Route may include “dummy” survey lanes, of possibly unspecified lengths, to represent parts of the route to be taken by the Survey Equipment over which data are not collected or is not required. For example, the distance across a roundabout may be a dummy survey lane as the Survey Route may have to cross over one or more roundabouts even though SCANNER surveys are not required on roundabouts
- 2.2.7 The Contractor prepares map-based and/or textual descriptions of the planned Survey Routes before commencing the Surveys. The description includes an estimate of the total length of the Employer’s road network that is to be surveyed. Each planned Survey Route is identified by a

unique Survey Route label. The Contractor provides all this information to the Employer and may be required to provide it to the Auditor.

2.3 The Survey

- 2.3.1 The Contractor carries out surveys of each Survey Route using the accredited Survey Equipment.
- 2.3.2 The surveys are carried out in the direction of normal traffic flow.
- 2.3.3 The surveys are carried out in the left-most traffic lane, unless otherwise agreed with the Employer. Where there are a significant number of parked cars the survey follows the left most path taken by normal traffic flow.

Location Referencing

- 2.3.4 The Survey is undertaken so that all Survey Data are reported in relation to distance travelled within Section. This is achieved through the identification of Section Start points.
- 2.3.5 Section Start points are identified to the level of accuracy specified in Section 3.3, which defines requirements for locating Section Start Points where:
 - (a) OSGR co-ordinates are provided by the Employer for the Section Start Point
 - (b) Section Start Points are to be recorded manually
- 2.3.6 Where Section Start Points are to be recorded manually the locations of these Section start points may be marked physically on or adjacent to, the road, or may be associated with specific features located on the Employer's Network. The Contractor agrees which features (for example speed restriction signs and junctions) are associated with the starts of Sections with the Employer before starting the Survey. Where no specific overriding guidance is provided by the Employer for the manual identification of Section Start Points, the following paragraphs provide further general guidance on the location of Section Start points.

Guidance on the Location of Section Start (change) Points

- 2.3.7 Where the feature is a road sign (identified by the Employer) the section change point is defined as the position marked by a line extending transversely across the traffic lane from the position of the road sign.
- 2.3.8 At the approach to roundabouts the section change point is defined as the position marked by the give way markings crossing the end of the approach road – see Figure 2.1.
- 2.3.9 When leaving roundabouts the section change point is defined as the position that would be marked by a line denoting the start of the exit road – see Figure 2.1

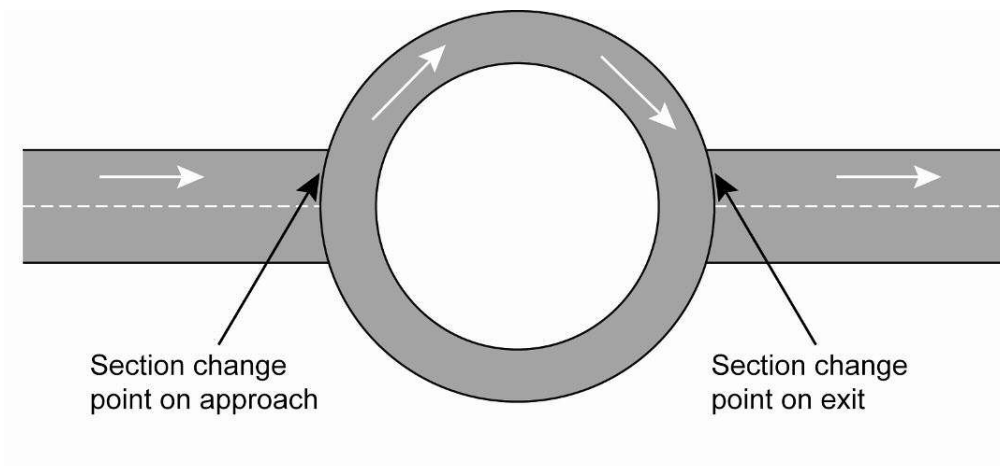


Figure 2.1 Section change points at roundabouts

2.3.10 At junctions or crossroads where turning right or left the section change point is defined as the end of the approach road – see Figure 2.2.

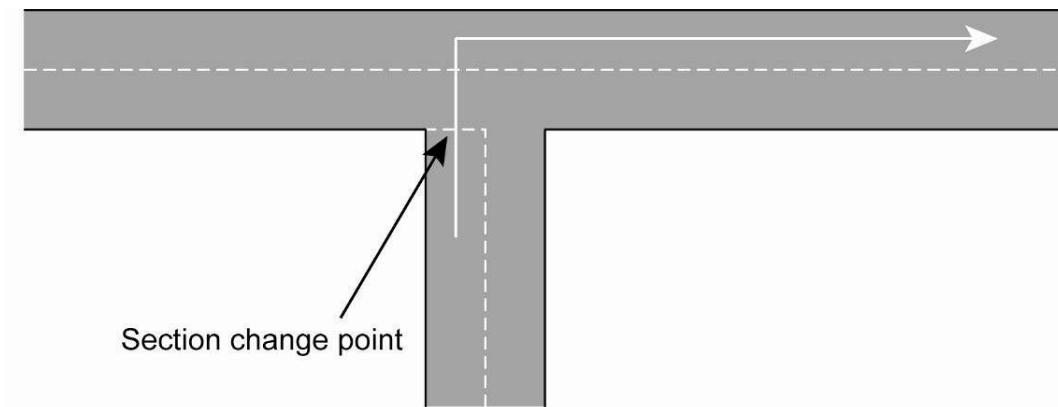


Figure 2.2 Section change point when turning right or left at junctions or crossroads

2.3.11 When turning off the main carriageway the section change point is defined as the start of the exit road – see Figure 2.3

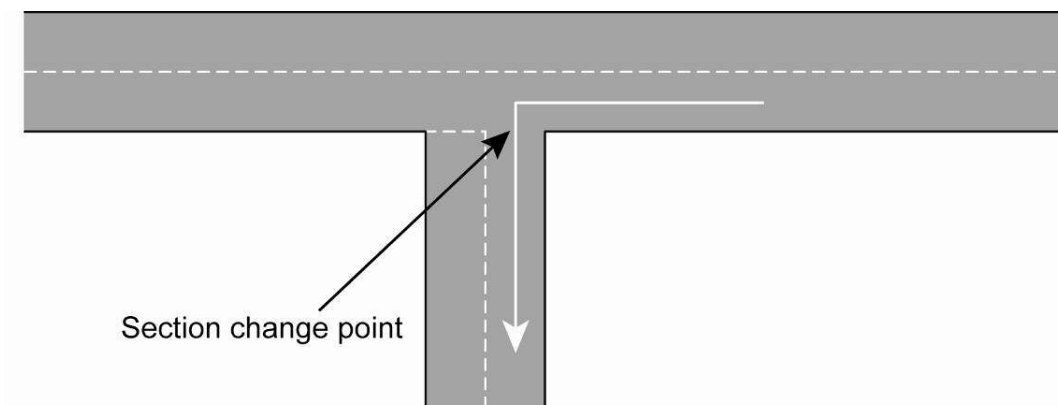


Figure 2.3 Section change point when turning right or left at junctions or crossroads, off the main carriageway

2.3.12 At crossroads, where going straight across, the section change point is defined as the centre of the junction – see Figure 2.4.

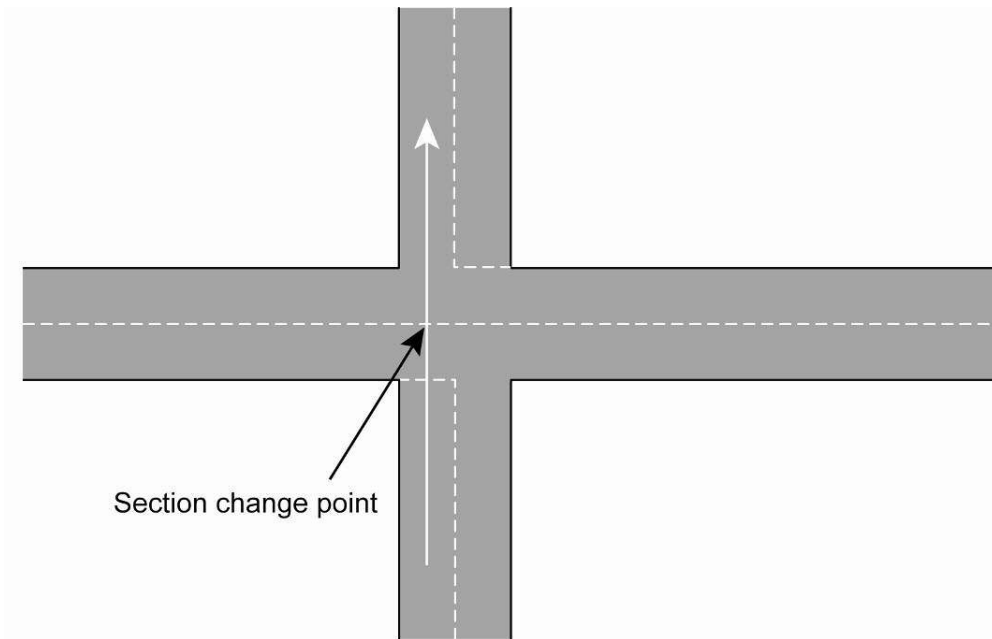


Figure 2.4 Section change point when going straight across junctions

2.3.13 At slip roads the section change points are defined as the start of the slip road and end of the slip road (often coinciding with the start or end of the intermittent lane marking in the nearside), see Figure 2.5.

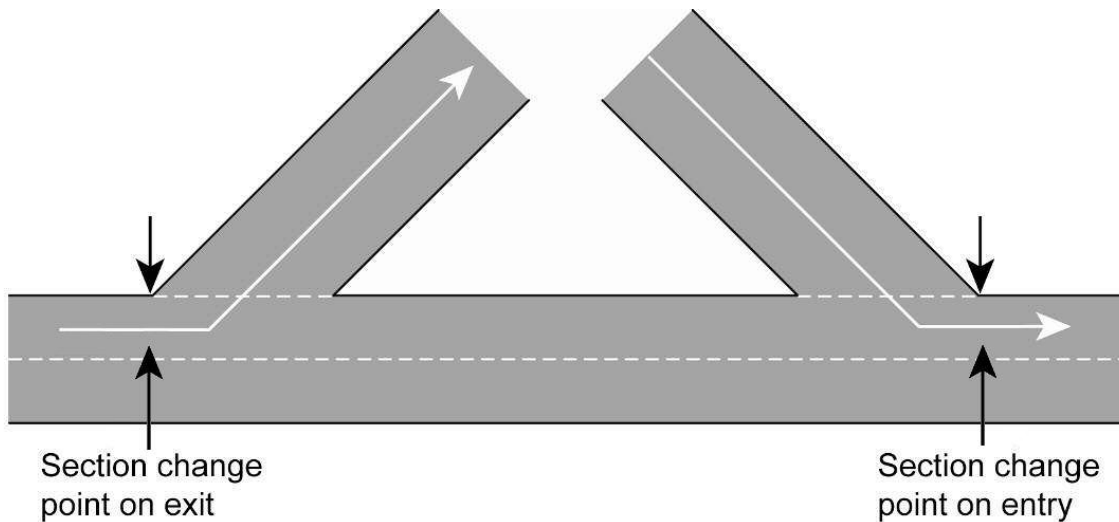


Figure 2.5 Section change points at slip roads

2.4 Recording Survey Conditions

2.4.1 The Contractor uses appropriate techniques during the survey to monitor the occurrence of conditions that could lead to invalid data.

2.4.2 Occasionally it may be necessary for the Survey Equipment to deviate from the planned Survey Route for a short length as a result of obstructions in the path of the Survey Equipment (for example as a result

of temporary road works). The Contractor records the occurrence of such deviations in the Survey Data with a “Deviation Flag”.

- 2.4.3 The Contractor reports such deviations from the Survey Route in the SCANNER RCD, if provided.
- 2.4.4 Survey Data collected during deviations from the Survey Route may be considered invalid in terms of the specified Coverage requirements. Deviations caused by lengths of parked vehicles where the normal traffic flow would be around these vehicles (e.g urban areas with long lengths of parked cars) would not normally require recording with the deviation flag. (See section 2.4.2).
- 2.4.5 The Contractor provides and uses a suitable facility on the Survey Equipment to identify and record lengths containing features placed in or on the road surface for the purposes of traffic control (e.g. speed humps and traffic “chicanes”). The Employer may (at the Employer's discretion, and before the Contractor commences the Surveys) require the Contractor to use this facility during the Surveys to monitor for the presence of these features.
- 2.4.6 Where these features are present the Contractor records their presence in the Survey Data and identifies any of the parameters of the Survey Data that would be affected by these features (for example longitudinal profile) as invalid.
- 2.4.7 The invalid data arising from such features does NOT contribute to the coverage requirements. (i.e. these lengths are disregarded before calculating the coverage achieved by the Contractor). Coverage is therefore calculated on the length of the network surveyed EXCLUDING these lengths.

3 Survey Data

3.1 General Requirements

- 3.1.1 Survey Data is data measured in a SCANNER accredited survey before processing to produce SCANNER Raw Condition Data (RCD) and/or SCANNER HMDIF. The Employer does not normally require access to the Survey Data, but retains ownership of them.
- 3.1.2 The Contractor has the capability of delivering the Survey Data in two formats, as SCANNER RCD and as the SCANNER HMDIF.
- 3.1.3 Raw Condition Data (RCD) is data in a format that enables the Accreditation Tester and the Auditor to carry out detailed checks on the operation of the Survey Equipment. The format for SCANNER RCD is defined in Volume 5. The Employer does not normally require access to the SCANNER RCD, but retains ownership of them.
- 3.1.4 HMDIF is the UKPMS Highway Maintenance Data Interchange Format, a file format that enables the results of a SCANNER survey to be loaded to a UKPMS compliant system. The format for SCANNER HMDIF is defined in the SCANNER HMDIF specification which can be found on the PCIS website (www.PCIS.org.uk). The Employer normally requires the results of a SCANNER accredited survey to be delivered as SCANNER HMDIF (i.e. as a UKPMS compliant HMDIF file).
- 3.1.5 The Employer or the Auditor may specifically request the Contractor to supply SCANNER RCD for Quality Assurance, Audit or other purposes from a particular survey before the Contractor commences that survey. In which case, the Contractor also delivers the results of the survey (the Survey Data) in a SCANNER RCD format file.
- 3.1.6 The Employer or Auditor may specify the content of the SCANNER RCD file in terms of which data are included in the file or which is not included. (For example the Employer or Auditor could request the longitudinal profile, rutting and crack data, but not require the texture profile and geometry data).
- 3.1.7 Although the Employer may require the delivery of the Texture Profile within the SCANNER RCD, the primary use of these data are for Accreditation Testing and Audit. The delivery of Texture Profile data will place significant data handling requirements on the Contractor. Therefore the Employer or Auditor should only request raw texture data to meet a specific predefined purpose, and from no more than one texture measurement line at a time.
- 3.1.8 The SCANNER HMDIF contains values derived from the SCANNER RCD or Survey Data. The data processing methods applied to obtain the HMDIF must meet the minimum requirements defined within Section 4.

- 3.1.9 In order to calculate the derived parameters it is necessary that a run-in be provided in the Survey Data so that the derived parameters can be calculated for the entire Survey length of interest. The minimum length of run in to calculate the derived parameters is 100m. However, for some Equipment a longer run in may be necessary for the Equipment to stabilise. It is the Contractor's responsibility to provide a sufficient run in for all surveys (longer than 100m if necessary).

3.2 Coverage

- 3.2.1 There are three separate requirements for reporting the extent of survey coverage:
- (a) To inform the Employer of the coverage of detailed measurements and derived parameters for road maintenance management.
 - (b) To inform the Employer of the extent of measurements to support road condition reporting (e.g. for performance indicators or national surveys).
 - (c) To inform the Employer of the extent of survey completion for payment.
- 3.2.2 The requirements for reporting the coverage of individual measurements are set out in sections 3.3 to 3.12.
- 3.2.3 The requirements for reporting the overall coverage are set out in section 4.7.
- 3.2.4 The requirements for reporting coverage for payment are set out in section 4.7.

3.3 Location referencing

- 3.3.1 The Contractor references all data collected during the Survey uniquely in relation to distance travelled within Section and Lane. The accuracy of the Location Referencing must be unaffected by operating speed or by road geometry.
- 3.3.2 The Contractor agrees the method for locating each Section start point with the Employer before commencing the survey. The requirements for the accuracy of the location of each Section start point depend on the method of identifying each Section start point. The Employer may require that different methods be applied for different Section start points on the Employer's Network.
- (a) Where the Section start points are identified automatically (for example for Accreditation Testing), the Contractor locates the Section start points accurate to within $\pm 1.0\text{m}$.

- (b) Where the Section start points are reported using National Grid Co-ordinates provided by the Employer the Contractor locates the Section start points accurate to within $\pm 5.0\text{m}$.
- (c) Where the Section start points are identified manually (e.g. the “push button” technique), the Contractor locates the Section start points accurate to within $\pm 5.0\text{m}^*$.

*Note: At routine survey speeds the vehicle will be moving at several metres per second (50kph is 14m/s). Therefore $\pm 5.0\text{m}$ accuracy is practically difficult to achieve using push button techniques, and may only be achieved using a “right of way” video record and manual correction, post survey. Therefore methods based on or National Grid Co-ordinates are recommended for routine surveys of the network.

- 3.3.3 The requirements for accuracy of location of the section Start points apply to the location of all section Start Points after the Contractor has carried out any necessary route fitting (Section 4).
- 3.3.4 For elapsed distances within a section of up to 1,000m from the recorded start of a section, the Contractor references the longitudinal position of all data measured within the section to within $\pm 1.0\text{m}$ from the recorded start of the section.
- 3.3.5 For elapsed distances within a section greater than 1,000m from the recorded start of a section, the Contractor references the longitudinal position of all data measured within the section to within $\pm 0.1\%$ from the recorded start of the section.

3.4 3-Dimensional Spatial Co-ordinates

- 3.4.1 The Contractor measures the 3-Dimensional Spatial Co-ordinates of the position of the Survey Equipment during the Survey at points separated by no more than 5m of distance travelled.
- 3.4.2 The Contractor reports the 3-Dimensional Spatial Co-ordinates as OSGB36 National Grid Co-ordinates and Altitude, where the Altitude measurement describes the Altitude of the surface of the road being surveyed.
- 3.4.3 The Contractor may derive OSGB36 National Grid Co-ordinates from measurements of position obtained using an automated method, possibly based on satellite technology* such as the Global Positioning System (GPS) operated by the United States Department of Defense. Such systems typically provide location data in the form of Longitude and Latitude related to a generalised description of the Earth such as the WGS84 Ellipsoid.
- 3.4.4 The Ordnance Survey historically provided a means of transforming the measurements from satellite-based systems to OSGB36 National Grid Co-ordinates through the OSTN97 (for position) and OSGM97 (for altitude) transformations. More recently, these have been enhanced and replaced

by the Definitive Transformations OSTN02 and OSGM02. The OSTN97, OSGM97, OSTN02 and OSGM02 transformations are the only acceptable methods for the provision of OSGB36 National Grid Co-ordinates from GPS measurements.

*Note: Satellite based location measurements are susceptible to signal loss and increased positional error under certain conditions, for example those encountered in built-up or forested areas. The Survey Equipment is required to have the capability to compensate for these errors arising from signal loss such that National Grid Co-ordinates and Altitudes are provided under all survey conditions to the required level of accuracy. Often this requires the use of an inertial measurement system to compensate for signal loss. Nevertheless, to allow for imperfections in the system that is applied to compensate for signal loss, the accuracy requirements are defined in terms of the availability of the signal from which the co-ordinates and altitude are derived. As the accuracy of the compensated position measurement is likely to decrease in areas of signal loss, the accuracy requirements are lower in such areas.

- 3.4.5 The Survey Equipment is required to provide an indication of signal availability so that areas of possibly reduced accuracy can be monitored. The accuracy of the Survey Equipment in the measurement of National Grid Co-ordinates is assessed in the Accreditation Testing, where the capability of the system to provide accurate measurements in areas of low signal availability is investigated. If the Accreditation Testing shows that the capabilities of the system are limited under certain conditions then restrictions may be applied such that Survey Data are labelled as invalid under those circumstances.
- 3.4.6 For position measurements acquired within 100m lengths where there is signal availability for greater than 70% of the 100m length, the Contractor reports the OSGB36 National Grid Co-ordinates with accuracy such that 95% of the measured positions lie within $\pm 2\text{m}$ of the true position.
- 3.4.7 For position measurements acquired within 100m lengths where there is signal availability for less than 70% of the 100m length, the Contractor reports the OSGB36 National Grid Co-ordinates with accuracy such that 95% of the measured positions lie within $\pm 10\text{m}$ of the true position.
- 3.4.8 For all position measurements, the Contractor reports the OSGB36 National Grid Co-ordinates with accuracy such that the error between the measured position and the true position never exceeds 50m.
- 3.4.9 For altitude measurements acquired within 100m lengths where there is signal availability for greater than 70% of the 100m length, the Contractor reports the altitude measurements with accuracy such that 95% of the measured altitudes lie within $\pm 5\text{m}$ of the true altitude.

- 3.4.10 For altitude measurements acquired within 100m lengths where there is signal availability for less than 70% of the 100m length, the Contractor reports the altitude measurements with accuracy such that 95% of the measured altitudes lie within $\pm 10\text{m}$ of the true altitude.
- 3.4.11 For all altitude measurements, the Contractor reports the altitude measurement with accuracy such that the error between the measured altitude and the true altitude never exceeds 50m.
- 3.4.12 The Contractor reports the availability of the signal from which the 3-Dimensional Spatial Co-ordinates have been derived with each reported National Grid Co-ordinate.
- 3.4.13 Where the Survey Equipment is unable to meet the accuracy requirements the Contractor labels the 3-Dimensional Spatial Co-ordinate data as invalid.
- 3.4.14 The Contractor monitors the coverage of National Grid Co-ordinates achieved in the surveys. Invalid measurements will result in reduced survey coverage where coverage is defined as the total length within any predetermined length over which valid measurements are provided. The Contractor reports any survey lengths greater than 1km over which less than 95% by length of valid National Grid Co-ordinate measurements could not be delivered to the Auditor.
- 3.4.15 If required by the employer the Contractor carries out repeat surveys of these lengths until either a sufficient length of valid National Grid Co-ordinates are delivered from that length, or the Employer agrees to accept the survey results without the National Grid Co-ordinate coverage.
- 3.4.16 The Contractor provides the Employer (and the Auditor, if the Auditor requests it) with a summary report of the coverage achieved (Section 4.7) in the measurement of National Grid Co-ordinates, including altitude. This report is provided as a comma delimited text file including:
- (a) The total length surveyed within each Section of the Employer's road Network,
 - (b) The total length within each Section for which the Contractor is unable to provide valid National Grid Co-ordinates.
 - (c) The locations within each Section of the Employer's road Network over which the Contractor is unable to provide valid National Grid Co-ordinates, including altitude.

3.5 Road Geometry

- 3.5.1 The Contractor measures Gradient, Crossfall and Radius of Curvature using the Survey Equipment at points separated by no more than 0.5m of distance travelled.
- 3.5.2 The Contractor averages the measurements over 5m and reports the average measurements at 5m intervals.

- 3.5.3 The Survey Equipment is required to measure gradient over the range of at least $\pm 20\%$.
- 3.5.4 The Contractor reports the measured gradient with accuracy such that:
- (a) 95% of the differences between the measured gradient and the true gradient fall within $\pm 1.5\%$ (gradient), or $\pm 10\%$ of the true gradient, whichever is greater.
 - (b) The difference between the measured gradient and the true gradient never exceeds $\pm 6\%$ (gradient).
- 3.5.5 The Survey Equipment is required to measure crossfall over the range of at least $\pm 20\%$.
- 3.5.6 The Contractor reports the measured crossfall with accuracy such that:
- (a) 95% of the differences between the measured crossfall and the true crossfall fall within $\pm 1.5\%$ (crossfall), or $\pm 10\%$ of the true crossfall, whichever is greater.
 - (b) The difference between the measured crossfall and the true crossfall never exceeds $\pm 6\%$ (crossfall).
- 3.5.7 The Survey Equipment is required to measure radii of curvature over the range of at least $\pm 2000\text{m}$.
- 3.5.8 The Contractor reports radii of curvature greater than $+2000\text{m}$ as $+2000\text{m}$ and reports radii of curvature less than -2000m as -2000m .
- 3.5.9 The accuracy of the equipment will be assessed using the measure of curvature (defined as $1/\text{radius of curvature}$). The Contractor reports the measured curvature with accuracy such that:
- (a) 65% of the differences between the measured curvature and the true curvature fall within 0.0015 m^{-1} .
 - (b) 95% of the differences between the measured curvature and the true curvature fall within 0.003 m^{-1} .
 - (c) The difference between the measured curvature and the true curvature shall never exceed 0.005 m^{-1} .

3.6 Average Speed

- 3.6.1 The Contractor measures the average operating speed during the Survey at intervals separated by no more than 0.1m of distance travelled.
- 3.6.2 The Contractor reports the Average Speed in cms^{-1} with an accuracy of $\pm 5\text{cms}^{-1}$ or $\pm 5\%$, whichever is larger.

3.7 Longitudinal profile

3.7.1 The Contractor measures the Longitudinal Profile during the Survey in the nearside and offside wheelpath at points separated by no more than 0.01m of longitudinal distance travelled.

3.7.2 For the purposes of measuring Longitudinal profile:

- (a) The nearside wheelpath is defined as a measurement line located between 0.75m and 0.9m to the left of the centreline of the survey vehicle.
- (b) The offside wheelpath is defined as a measurement line located between 0.75m and 0.9m to the right of the centreline of the vehicle.
- (c) The nearside and offside wheelpaths will be separated by a distance of 1.5m-1.8m

Note: Where equipment has achieved accredited status for SCANNER surveys prior to the 2011 survey year, but does not satisfy the above wheelpath definitions, the accreditation body may grant re-accreditation but may specify limitations on the extent of the road network that can be surveyed. For example a survey vehicle with wider wheelpaths may not be re-accredited for surveys on narrower roads.

3.7.3 The accuracy of the measured Longitudinal Profile must be unaffected by the profile of the pavement over the full range of profiles that can reasonably be expected to be encountered on the Employer's road network.

3.7.4 The Contractor averages the measured profile points over 0.10 m and expresses the value in units of 1/10mm for each wheelpath.

3.7.5 The Contractor filters the measured Longitudinal Profile from each wheelpath to attenuate wavelengths in excess of 100m using a filter that attenuates the amplitude of wavelengths greater than 150m by at least 50% without distorting the phase of any profile features with wavelengths shorter than 100m.

3.7.6 The Contractor obtains measurements of Longitudinal Profile such that the frequency response is essentially flat in the bandwidth 0.5m to 100m. (i.e. the ratio of measured Longitudinal Profile amplitude to true Longitudinal Profile amplitude should be 1.0 ± 0.1 for profile components with wavelengths between 0.5 m and 100 m).

3.7.7 The Contractor measures the Longitudinal Profile in each wheelpath with accuracy such that at least 95% of the differences in corresponding amplitude between the measured Longitudinal Profile and the true Longitudinal Profile fall within the ranges given in Table 3.1 calculated for profile amplitudes with moving average lengths of 3m and 10m.

- 3.7.8 The Contractor measures the Longitudinal Profile in each wheelpath with accuracy such that the phase difference between the measured and true Longitudinal Profile equals or exceeds the cross correlation coefficients given in Table 3.1, calculated for profile amplitudes with moving average lengths of 3m and 10m.
- 3.7.9 The Contractor measures the Longitudinal Profile in each wheelpath such that the errors between the Enhanced and Moving Average Longitudinal Profile Variances calculated from the measured Longitudinal Profile (over 10m lengths) and the Enhanced and Moving Average Longitudinal Profile Variances calculated from the true Longitudinal Profile (respectively) fall within the ranges given in Table 3.1.
- 3.7.10 The errors are calculated as either the differences or the fractional errors between the Longitudinal Profile Variances calculated from the measured Longitudinal Profile and the Longitudinal Profile Variances calculated from the true Longitudinal Profile. This depends on the value of the Longitudinal Profile Variance calculated from the true Longitudinal Profile, as defined in Table 3.2.

Moving Average Length (m)	Measured Profile		Variance	
	Differences mm	Phase Difference	Errors	
	95% within this range	Required Cross Correlation Coefficient	65% within this range	95% within this range
3	±2.00	0.75	±0.30	±0.60
10	±4.00	0.85	±0.35	±0.70

Table 3.1: Accuracy Requirements for Longitudinal Profile

Waveband (m)	Longitudinal Profile Variance (mm ²)	Error
3	0 to 0.5	Difference
3	> 0.5	Fractional Error
10	0 to 1.0	Difference
10	> 1.0	Fractional Error

Table 3.2: Application of error type according to the true value of the Longitudinal Profile Variance – Applies to both Moving Average and Enhanced Longitudinal Profile Variance.

- 3.7.11 The accuracy of the Survey Equipment in measuring longitudinal profile in each wheelpath is assessed in the Accreditation Tests, described in Volume 5, which will determine the minimum speed, and the limits of acceleration and deceleration within which the Survey Equipment is able to provide accurate measurements of longitudinal profile.
- 3.7.12 If the Survey Equipment is susceptible to errors under slow speed, stop/start and/or conditions of acceleration and deceleration, the Contractor specifies operating procedures to minimise the adverse effects of these conditions on the measurement of longitudinal profile. The Contractor agrees these procedures with the Auditor before commencing surveys on any Employer's road network.
- 3.7.13 The Contractor monitors the effects of speed, acceleration and deceleration on the accuracy of the derived parameter variance in each wheelpath. The Contractor uses this information to label any variance measurements derived from measurements of longitudinal profile measurements that are invalid as a result of any of survey speed, acceleration or deceleration. (See Volume 5)
- 3.7.14 The Contractor monitors the coverage achieved in the surveys of longitudinal profile in each wheelpath. Invalid measurements of longitudinal profile will result in reduced survey coverage.
- 3.7.15 For longitudinal profile, coverage is defined as the total length within any predetermined length over which valid measurements of longitudinal profile variance are provided in either wheelpath.
- 3.7.16 The Contractor reports any survey lengths greater than 1.0 km over which less than 80% by length of valid longitudinal profile variance measurements can be delivered from that length to the Employer and to the Auditor. If required by the Employer, the Contractor carries out repeat surveys of these lengths until a sufficient length of valid longitudinal profile variance measurements can be delivered, or the Employer agrees to accept the survey results without the longitudinal profile coverage.
- 3.7.17 Particularly in built up areas there are likely to be lengths of roads containing features placed in or on the road surface for the purposes of traffic control (e.g. speed humps and traffic "chicanes"). Such locations may cause significant lengths of invalid data. Where these features are present the Contractor records their presence in the Survey Data and labels any of the parameters of the Survey Data that would be affected by these features (for example longitudinal profile) as invalid. The invalid data caused by such features does not contribute to the coverage requirements (i.e. these lengths are disregarded before calculating the coverage achieved by the Contractor).
- 3.7.18 The Contractor provides the Employer (and the Auditor, if the Auditor requests it) with a summary report of the coverage achieved (see also Section 4.7) in the measurement of longitudinal profile (and hence

longitudinal profile variance). This report is provided as a comma delimited text file including:

- (a) The total length surveyed within each Section of the Employer's road Network,
- (b) The total length within each Section for which the Contractor is unable to provide valid longitudinal profile and/or variance data (as applicable).
- (c) The locations within each Section of the Network over which the Contractor is unable to provide valid longitudinal profile and/or variance data (as applicable).

3.8 Transverse profile

- 3.8.1 The Contractor measures the Transverse Profile over the full lane width for lanes up to 3.2m wide. For lanes greater than 3.2m wide, the Contractor measures a minimum width of 3.2m, centred on the middle of the lane, up to a maximum width of 4.0m.
- 3.8.2 The Contractor measures the transverse profile at points separated by no more than 0.1m of distance travelled and expresses the values measured in units of 1/10mm.
- 3.8.3 The Transverse Profile is reported as a minimum of 20 Transverse Profile points spaced across the width of the measured Transverse Profile. Where the Survey Equipment is able to record more than 99 Transverse Profile points the Contractor may be required (as agreed with the Accreditation Tester) to re-sample the Transverse Profile before delivery to limit the number of Transverse Profile points reported.
- 3.8.4 If re-sampling is required, the Contractor agrees the method with the Accreditation Tester. The Accreditation Tester may require the Contractor to smooth the transverse profile to attenuate short wavelength features before reporting the transverse profile data. The procedures for re-sampling and smoothing are agreed between the Accreditation Tester and the Contractor during the Accreditation Tests.
- 3.8.5 The Transverse Profile is reported such that NO correction or normalisation is applied to measurements obtained from consecutive transverse profiles (e.g. applying an offset correction for each transverse profile), so that the values of consecutive transverse profile measurements can be used for the calculation of edge deterioration (see also Volume 5, section 3.).

Note: for some measurement systems employing discontinuous measurements across the survey width it may be necessary to add a common offset (e.g. to ensure the overall transverse profile avoids discontinuities where measurements “join”). This is permissible, provided the measured profile shape is not changed with respect to the requirement to measure edge deterioration.

It is also permitted to remove the effects of vehicle roll and pitch, provided the measured profile shape is not changed with respect to the requirement to measure edge deterioration.

- 3.8.6 The Contractor monitors the measurement of transverse profile and reports in the Survey Data, where possible, individual measurements of transverse profile subject to error as values outside the permitted range. In particular the measurement should be unaffected by the presence of pavement features having high levels of luminosity (such as road markings), or measurements over such features should be marked using an appropriate technique to be agreed with the Accreditation Tester.
- 3.8.7 The accuracy of the measured Transverse Profile must be unaffected by the profile of the pavement over the full range of profiles that can reasonably be expected to be encountered on the Employer's road network.
- 3.8.8 The measured transverse profile should be used to calculate cleaned rut depth, Transverse unevenness, and edge roughness over 10m lengths. The method of the method of calculating these parameters is given in volume 5.
- 3.8.9 The Contractor reports the measured Transverse Profile with accuracy such that
- (a) At least 95% of the differences between the measured Transverse Profile points and the true Transverse Profile points fall within $\pm 1.5\text{mm}$.
 - (b) 65% of the differences between the measured Cleaned Rut Depths in each wheel path and the true rut Cleaned Rut Depths fall within $\pm 1.5\text{mm}$.
 - (c) 95% of the differences between the measured Cleaned Rut Depths in each wheel path and the true rut Cleaned Rut Depths fall within $\pm 3.0\text{mm}$.
 - (d) The differences between the measured Cleaned Rut Depths and the true Cleaned Rut Depths in each wheel path never exceed 10mm, or 50% of the magnitude of the true Cleaned Rut Depth, whichever is the greater.
 - (e) 65% of the differences between the measured Transverse Unevenness in each wheel path and the true Transverse Unevenness fall within ± 0.003
 - (f) 95% of the differences between the measured Transverse Unevenness in each wheel path and the true Transverse Unevenness fall within 0.006.
 - (g) 65% of the differences between the edge roughness calculated from the measured Transverse Profile and the edge roughness calculated from the true Transverse Profile fall within ± 0.025 .

- (h) 95% of the differences between the edge roughness calculated from the measured Transverse Profile and the edge roughness calculated from the true Transverse Profile fall within ± 0.05 .
- 3.8.10 The Contractor monitors the coverage achieved in the surveys of transverse profile. Invalid measurements of transverse profile will result in reduced survey coverage, where coverage is defined as the total length within any predetermined length over which valid measurements of transverse profile are provided.
- 3.8.11 The Contractor reports any survey lengths greater than 1.0 km over which less than 90% by length of valid transverse profile measurements can be delivered to the Employer and to the Auditor. If required by the Employer, the Contractor carries out repeat surveys of these lengths until a sufficient length of valid transverse profile measurements can be delivered, or the Employer agrees to accept the survey results without the transverse profile coverage.
- 3.8.12 Particularly in built up areas there are likely to be lengths of roads containing features placed in or on the road surface for the purposes of traffic control (e.g. speed humps and traffic “chicanes”). Such locations may result in a number of the transverse profile points being invalid. Where these features are present the Contractor records their presence in the Survey Data and uses this to mark as invalid, or remove, any of the parameters of the Survey Data that would be affected by these features (for example transverse profile), as appropriate (i.e. these lengths are disregarded before calculating the coverage achieved by the Contractor).
- 3.8.13 The Contractor provides the Employer (and the Auditor, if the Auditor requests it) with a summary report of the coverage achieved (see also Section 4.7) in the measurement of transverse profile. This report is provided as a comma delimited text file including:
- (a) The total length surveyed within each Section of the Employer's road Network,
 - (b) The total length within each Section for which the Contractor is unable to provide valid transverse profile data.
 - (c) The locations within each Section of the Network over which the Contractor is unable to provide valid transverse profile data.

3.9 Rutting

- 3.9.1 The Contractor provides measurements of maximum rut depths in the Nearside and Offside wheel tracks. The longitudinal separation of successive measurements of rut depth shall not exceed 100mm.
- 3.9.2 The Contractor averages the measurements of maximum rut depth over lengths of 1m and expresses them in units of 1/10mm.

- 3.9.3 These rut depths will be used to calculate average rut depths expressed over 10m lengths, as described in volume 5.
- 3.9.4 The Contractor reports the measured values of maximum rut depth with accuracy such that
- (a) 65% of the differences between the measured average rut depth in each wheel track and the true average rut depth fall within $\pm 1.5\text{mm}$.
 - (b) 95% of the differences between the measured average rut depth in each wheel track and the true average rut depth fall within $\pm 3.0\text{mm}$.
 - (c) The differences between the measured average rut depth and the true rut depth in each wheel track never exceed 10mm, or 50% of the magnitude of the true average rut depth, whichever is the greater.
- 3.9.5 The Contractor identifies any rut depth data that fail to meet the specified requirements by use of the "invalid value" within the SCANNER RCD file.
- 3.9.6 The Contractor monitors the coverage achieved in the surveys of rut depth. Invalid measurements of rut depth will result in reduced survey coverage, where coverage is defined as the total length within any predetermined length over which valid measurements of rut depth are provided.
- 3.9.7 The Contractor reports any survey lengths greater than 1.0 km over which less than 90% by length of valid rut depth measurements can be delivered to the Employer and to the Auditor. If required by the Employer, the Contractor carries out repeat surveys of these lengths until a sufficient length of valid rut depth measurements can be delivered, or the Employer agrees to accept the survey results without the rut depth coverage (i.e. these lengths are disregarded before calculating the coverage achieved by the Contractor).
- 3.9.8 Particularly in built up areas there are likely to be lengths of roads containing features placed in or on the road surface for the purposes of traffic control (e.g. speed humps and traffic "chicanes"). Such locations may cause significant lengths of invalid data. Where these features are present the Contractor records their presence in the Survey Data and uses this to mark as invalid, or remove, any of the parameters of the Survey Data that would be affected by these features (for example rut depths), as appropriate.
- 3.9.9 The Contractor provides the Employer (and the Auditor, if the Auditor requests it) with a summary report of the coverage achieved (see also Section 4.7) in the measurement of transverse profile and rut depth (and hence cleaned rut depth and edge deterioration). This report is provided as a comma delimited text file including:
- (a) The total length surveyed within each Section of the Employer's road Network,

- (b) The total length within each Section for which the Contractor is unable to provide valid rut depth and/or transverse profile data (as applicable).
- (c) The locations within each Section of the Network over which the Contractor is unable to provide valid rut depth and/or transverse profile data (as applicable).

3.10 Texture

- 3.10.1 The Contractor measures the Nearside Texture Profile in the nearside Wheelpath at points separated by no more than 0.75m.
- 3.10.2 For the purposes of measuring Texture Profile the Nearside Wheelpath is defined as a measurement line located between 0.75m and 0.9m to the left of the centreline of the survey vehicle.

Note: Where equipment has achieved accredited status for SCANNER surveys prior to the 2011 survey year, but does not satisfy the above wheelpath definitions, the accreditation body may grant re-accreditation but may specify limitations on the extent of the road network that can be surveyed. For example a survey vehicle with wider wheelpaths may not be re-accredited for surveys on narrower roads.

- 3.10.3 The accuracy of the measured Nearside Texture Profile must be unaffected by the texture or profile of the pavement over the full range of profiles and textures that can reasonably be expected to be encountered on the Employer's road network.
- 3.10.4 The Contractor averages the measured Nearside Texture Profile points over 1.0 mm and expresses the value in units of 1/10mm at 1.0 mm intervals.
- 3.10.5 The Contractor obtains measurements of Nearside Texture Profile such that the frequency response is essentially flat in the bandwidth 2.5 mm to 500 mm (i.e. the ratio of measured Texture Profile amplitude to true Texture Profile amplitude should be 1.0 ± 0.1 for profile components with wavelengths between 2.5 mm and 500 mm).
- 3.10.6 The texture profile shall be used to calculate SMTD and MPD over 10m lengths. The method of calculating these parameters is given in Volume 5.
- 3.10.7 The Contractor measures the Nearside Texture Profile measurements with accuracy such that:
 - (a) At least 95% of the differences between the measured Nearside Texture Profile and the true Nearside Texture Profile fall within ± 0.5 mm of the true Nearside Texture Profile.
 - (b) At least 65% of the differences between the Nearside Sensor Measured Texture Depth (SMTD) calculated from the measured

- Nearside Texture Profile and the SMTD calculated from the true Nearside Texture Profile fall within the range ± 0.13 mm.
- (c) At least 95% of the differences between the Nearside Sensor Measured Texture Depth (SMTD) calculated from the measured Nearside Texture Profile and the SMTD calculated from the true Nearside Texture Profile fall within the range ± 0.25 mm.
 - (d) All of the differences between the Sensor Measured Texture Depth (SMTD) calculated from the measured Nearside Texture Profile and the SMTD calculated from the true Nearside Texture Profile fall within the range ± 0.75 mm.
 - (e) 65% of the differences between the MPD calculated from the measured Texture Profile and the MPD calculated from the True Profile fall within the range ± 0.13 mm.
 - (f) 95% of the differences between the MPD calculated from the measured Texture Profile and the MPD calculated from the True Profile fall within the range ± 0.25 mm.
- 3.10.8 All of the differences between the MPD calculated from the measured Texture Profile and the MPD calculated from the True Profile fall within the range ± 0.75 mm. The Contractor checks the Survey Data for any conditions that may result in invalid measurements of texture profile. These conditions may include, but would not be limited to missing data points and failures in any of the measurement devices. The Contractor identifies any texture data that fail to meet the specified requirements by use of the "invalid value" within the SCANNER RCD.
- 3.10.9 The Contractor monitors the coverage achieved in the surveys of texture. Invalid measurements of texture will result in reduced survey coverage, where coverage is defined as the total length within any predetermined length over which valid measurements of texture (Nearside SMTD) are provided.
- 3.10.10 The Contractor reports any survey lengths greater than 1.0 km over which less than 95% by length of valid nearside SMTD (and/or MPD) measurements can be delivered to the Employer and to the Auditor. If required by the Employer, the Contractor carries out repeat surveys of these lengths until a sufficient length of valid nearside SMTD (and/or MPD) measurements can be delivered, or the Employer agrees to accept the survey results without the texture coverage.
- 3.10.11 The Contractor provides the Employer and the Auditor, (if the Auditor requests it) with a summary report of the coverage achieved (see also Section 4.7) in the measurement of texture (Nearside SMTD and MPD). This report is provided as a comma delimited text file including:
- (a) The total length surveyed within each Section of the Employer's Road Network,

- (b) The total length within each Section for which the Contractor is unable to provide valid texture (Nearside SMTD and/or MPD) data.
- (c) The locations within each Section of the Network over which the Contractor is unable to provide valid texture (Nearside SMTD and/or MPD) data.

3.11 Multiple line texture

- 3.11.1 The contractor measures the Multiple Line Texture Profile over the full lane width for lanes up to 3.2m wide. For lanes greater than 3.2m wide the Contractor measures a minimum width of 3.2m, centred on the middle of the lane, up to a maximum width of 4.0m.
- 3.11.2 The Contractor measures the Multiple Line Texture Profile at points separated by no more than 5mm of distance travelled.
- 3.11.3 The accuracy of the measured Multiple Line Texture Profile must be unaffected by the texture or profile of the pavement over the full range of profiles and textures that can reasonably be expected to be encountered on the Employer's road network.
- 3.11.4 The Contractor measures the Multiple Line Texture Profile as a minimum of 3 (maximum 40) Multiple Line Texture Profile points spaced across the width of the measured Transverse Profile. At least one Multiple Line Texture Profile is measured in the nearside wheelpath, one in the offside wheelpath and one midway between the wheelpaths.
- 3.11.5 For the purposes of measuring Multiple Line Texture Profile:
 - (a) The nearside wheelpath is defined as a measurement line located between 0.75m and 0.9m to the left of the centreline of the survey vehicle.
 - (b) The offside wheelpath is defined as a measurement line located between 0.75m and 0.9m to the right of the centreline of the survey vehicle
 - (c) The nearside and offside wheelpaths will therefore will be separated by a distance of between 1.5m and 1.8m
 - (d) Midway between the wheelpaths is defined as a measurement line that is located equidistant between the nearside and offside wheelpaths

Note: Where equipment has achieved accredited status for SCANNER surveys prior to the 2011 survey year, but does not satisfy the above wheelpath definitions, the accreditation body may grant re-accreditation but may specify limitations on the extent of the road network that can be surveyed. For example a survey vehicle with wider wheelpaths may not be re-accredited for surveys on narrower roads.

- 3.11.6 The frequency responses of the Multiple Line Texture Profile measurements should satisfy an equivalent specification for each measurement line.
- 3.11.7 The contractor calculates the Root Mean Square Texture Depths for each Multiple Line Texture Profile measurement line as described in Volume 5, and reports the values over longitudinal intervals of 100mm. For the purposes of assessing the accuracy of the system they will be expressed as nearside, middle and offside mean RMST over 10m lengths, as described in Volume 5.
- 3.11.8 The Contractor measures the Multiple Line Texture Profile with accuracy such that:
- (a) 95% of the differences between the measured and the True Nearside, Middle and Offside Mean RMST (respectively) fall within $\pm 0.25\text{mm}$.
 - (b) All of the differences between the measured and the True Nearside, Middle and Offside Mean RMST (respectively) fall within the range $\pm 0.75\text{mm}$.
- 3.11.9 The Contractor checks the Survey Data for any conditions that may result in invalid measurements of the Multiple Line Texture profile. These conditions may include, but would not be limited to missing data points and failures in any of the measurement devices. The Contractor identifies any Multiple Line Texture data that fail to meet the specified requirements by use of the "invalid value" within the SCANNER RCD.
- 3.11.10 The Contractor monitors the coverage achieved in the surveys of Multiple Line Texture. Invalid measurements of Multiple Line Texture will result in reduced survey coverage, where coverage is defined as the total length within any predetermined length over which valid measurements of Multiple Line Texture (RMST) are provided.
- 3.11.11 The Contractor reports any survey lengths greater than 1.0 km over which less than 95% by length of valid RMST measurements can be delivered to the Employer and to the Auditor. If required by the Employer, the Contractor carries out repeat surveys of these lengths until a sufficient length of valid RMST measurements can be delivered, or the Employer agrees to accept the survey results without the Multiple Line Texture coverage.

- 3.11.12 The Contractor provides the Employer and the Auditor, (if the Auditor requests it) with a summary report of the coverage achieved (see also Section 4.7) in the measurement of Multiple Line Texture (RMST). This report is provided as a comma delimited text file including:
- (a) The total length within each Section for which the Contractor is unable to provide valid Multiple Line Texture (RMST) data.
 - (b) The locations within each Section of the Network over which the Contractor is unable to provide valid Multiple Line Texture (RMST) data.

3.12 Cracking

- 3.12.1 The Contractor uses the Survey Equipment to identify Cracks over a total width of at least 80% of the width of the traffic lane for traffic lanes up to 3.65m wide on the range of surfaces to be encountered on the Employer's road Network. For lanes greater than 3.65m wide the Survey Equipment identifies cracking within a minimum overall width of 2.9m, centred on the centre of the traffic lane.
- 3.12.2 The cracking data are reported as a record of the location of each individual crack.
- 3.12.3 The identification of cracking must be unaffected by:
- (a) The surface type or surface texture over the full range of surface types that can reasonably be expected to be encountered on the Employer's road network.
 - (b) The presence of longitudinal and transverse joints on either concrete or bituminous pavements.
 - (c) The presence of longitudinal and transverse grooves on concrete pavements.
- 3.12.4 The Contractor records all cracking data as specified in Volume 5. The Contractor removes any cracking data that would fail to meet those requirements from the survey data before delivery.
- 3.12.5 If the Survey Equipment is acceptable, but has restrictions on the areas of the local road network for which it is acceptable (e.g. unacceptable over concrete or block paving) then:
- (a) The Accreditation Tester endorses any Accreditation Certificate to identify the limitations of the Survey Equipment and the restrictions on its use to provide SCANNER accredited surveys.
 - (b) The Contractor removes all cracks identified on such areas from the Survey Data before delivering either the SCANNER RCD or the SCANNER HMDIF to any Employer.
 - (c) The lengths for which the Contractor is unable to provide acceptable measurements of Cracking Intensity do not contribute to

the coverage requirements for the measurement of Cracking Intensity.

- (d) If required, the Contractor agrees a procedure with any Employer for providing alternative measurements on these areas,

Note: Options for this might include, for example, the commissioning of alternative surveys by the Employer to provide this data, or the provision of this data by the Contractor using alternative survey methods. These options may have cost implications which the Employer and Contractor should clarify before entering any contract.

3.12.6 The Contractor monitors the coverage achieved in the surveys of cracking. Invalid measurements of cracking will result in reduced survey coverage, where coverage is defined as the total length within any predetermined length over which valid measurements of cracking are provided.

3.12.7 The Contractor provides the Employer (and the Auditor, if the Auditor requests it) with a summary report of the coverage achieved (see also Section 4.7) in the measurement of cracking. This report is provided as a comma delimited text file including:

- (a) The total length surveyed within each Section of the Employer's Network,
- (b) The total length within each Section for which the Contractor was unable to provide valid cracking data.
- (c) The locations within each Section of the Network over which the Contractor is unable to provide valid cracking data.

3.13 Other Visible Defects

3.13.1 Methods of measuring the percentage area of “other visible defects” were investigated as part of the SCANNER research programme, and one possible approach was proposed. However it has not so far been possible to develop a reliable specification and there is therefore no requirement to measure or report “other visible defects”.

3.13.2 Further information is provided in a research report by Scott Wilson Pavement Engineering Ltd. “Department for Transport SCANNER research – Other Visible Defects” available on the UK Roads Board website.

4 Data Processing

4.1 Processing survey data

4.1.1 Where the Employer or the Auditor requires SCANNER Raw Condition Data (SCANNER RCD), the Contractor processes the Survey Data to provide the SCANNER RCD. The delivery of SCANNER RCD is a requirement for the accreditation tests.

4.1.2 The Contractor uses a suitable facility to process the Survey Data or the SCANNER RCD (as appropriate) to provide the SCANNER HMDIF file.

4.1.3 The Data Processing facility:

- (a) Enables the Survey Data to be reported as SCANNER RCD (if SCANNER RCD is not the standard output format of the Survey Data)
- (b) Reads and validates the format and consistency of the Survey Data.
- (c) Validates the measured values.
- (d) Carries out corrections to and/or analysis of the measured values.
- (e) Calculates the elapsed chainage of section start and end points for which the location has been provided in the route file as National Grid Co-ordinates.
- (f) Enables the Contractor to fit the Survey to the route defined in the Route File.
- (g) Calculates the parameters that are derived from the measured values.
- (h) Reports the measured values, and the parameters that are derived from the measured values (as appropriate), fitted to the route, in SCANNER HMDIF files.

4.2 Validation of SCANNER Survey Data

4.2.1 The Survey Data are validated by reviewing each measurement within the Survey Data and comparing it against acceptability limits for each data value.

4.2.2 As a minimum, the validation checks include checking the data against:

- (a) The known configuration of the Equipment (e.g. position of transverse profile sensors).
- (b) The maximum acceptable length of Survey.
- (c) The required format, to check for file errors.
- (d) The permissible types to be used.

- (e) The minimum and maximum values for the National Grid co-ordinates and altitudes.
- (f) The allowed range of reporting intervals between the geometry, longitudinal profile, transverse profile, rutting, texture profile points and multiple line texture points.
- (g) The maximum and minimum acceptable values of gradient, cross fall, radius of curvature, speed, longitudinal profile, transverse profile, rutting, texture profile and multiple line texture (RMST).
- (h) The maximum permissible difference between adjacent longitudinal profile height measurements.
- (i) The number of values of gradient, cross fall, radius of curvature, speed, longitudinal profile, transverse profile, rutting, texture profile and multiple line texture (RMST) that are allowed to exceed these maximum and minimum acceptable values limits before the survey is rejected as invalid.
- (j) The number of cracks reported.
- (k) The limits for offset, length and angle for each reported crack.

Note: Suggested default values for these limits are given in Table 4.1

4.2.3 The Contractor reviews these and, if appropriate, agrees suitable alternative values for the limits with the Auditor. The Contractor delivers a copy of these values to the Auditor and Accreditation Tester. The values are confirmed as part of the Accreditation Tests and it should not be necessary, following award of the Accreditation Certificate, to change the limits. If changes are required the Contractor agrees them with the Auditor before the changes are implemented.

Measure	Minimum	Maximum
Length of Survey (m)	0	1000000
Chainage interval between geometric measurements (m)	4.9	5.1
X co-ordinate (m)	140000	1000000
Y co-ordinate (m)	0	680000
Z co-ordinate (m)	-10	1000
X, Y or Z co-ordinates outside limits (%)	0	1
Gradient (%)	-20	20
Gradient values outside limits (%)	0	1
Crossfall (%)	-20	20
Crossfall values outside limits (%)	0	1
Absolute radius of curvature (m)	6	2000
Radius of curvature values outside limits (%)	0	5
Offset of longitudinal profile points from centre of vehicle	Equip	Equip
Chainage interval between longitudinal profile points (m)	0.09	0.11
Longitudinal profile point value (m)	-9.9998	9.9998
Absolute difference between adjacent longitudinal profile point value (m)	0	0.02
Longitudinal profile points outside value or difference limits (%)	0	10
Speed	Equip	Equip
Speed values outside limits (%)	0	0
Number of points within each transverse profile	Equip	Equip
Offsets of transverse profile points from vehicle centre	Equip	Equip
Spacing between offsets of two adjacent transverse profile points	Equip	Equip
Chainage interval between transverse profiles (m)	0.09	0.11
Transverse profile point value (m)	-0.265	0.265
Transverse profile point values outside limits (%)	0	25
Chainage interval between rut depth values (m)	0.09	0.11
Rut depth value (m) (not mm)	0	0.2
Rut depth values outside limits (%)	0	5
Offset of texture profile points from vehicle centre	Equip	Equip
Chainage interval between texture profile points (m)	0.0005	0.0015
Texture profile point value (m)	-0.2	0.2
Texture profile point values outside limits (%)	0	5
Number of RMST lines	Equip	Equip
Offsets of RMST lines from vehicle centre	Equip	Equip
Spacing between offsets of two adjacent RMST lines	Equip	Equip
Chainage interval between multiple line RMST values (m)	0.09	0.11
Multiple line RMST value (m)	0	0.005
Multiple line RMST values outside limits (%)	0	5
Number of cracks	0	99999
Crack offset	Equip	Equip
Length of crack (m)	0.02	9.999
Angle of crack (degrees)	-89	90
Cracks outside offset, length or angle limits (%)	0	5
Note: Equip = Equipment Dependent		

Table 4.1 Suggested limits for data checking, and default values

4.3 Aligning the Survey to the Survey Route

4.3.1 The Contractor aligns the Survey to the Survey Route using either:

- (a) extracting, from the Route File, Sections for which the locations of the Start and/or End Points have been provided as National Grid Co-ordinates and hence using the National Grid Co-ordinates recorded in the Survey Data to determine the elapsed chainages of those Section Start and End Points;
- (b) extracting the reference labels and elapsed chainages from the Survey Data (recorded during the survey) and aligning those with the reference labels defined in the Route File;
- (c) a combination of the above.

4.3.2 These processes are described further in the following paragraphs.

Use of National Grid Co-ordinates

4.3.3 The use of National Grid co-ordinates recorded during the survey to identify the locations of the network Section Start and End Points is deemed to be the most accurate method of fitting SCANNER data to the client's network and it is recommended that this approach be used, if possible.

4.3.4 For the use of National Grid coordinates for the alignment of the Survey Data with the Survey Route, the elapsed chainages at which the survey passed closest to the Section Start and End Points is determined. The exact method to be used for determination of the elapsed chainages shall be agreed between the Contractor and the Auditor, but may be similar to the following:

- (a) The string of co-ordinates recorded in the survey is searched to determine the point closest to the co-ordinates of the first provided Section Start Point.
- (b) The process assumes that there are straight lines between two adjacent survey points (e.g. A-B or B-C as shown below). The chainage at which the survey was closest to the Section Start Point is determined as shown below, where the four possible scenarios for calculating this chainage are illustrated in the Figure 4.2, Figure 4.3, Figure 4.4 and Figure 4.5.




Symbol	Key
	Survey point
	Section Start Point
	Survey chainage closest to the Section Start Point

Figure 4.1 Key to symbols used in figures 4.2 to 4.5

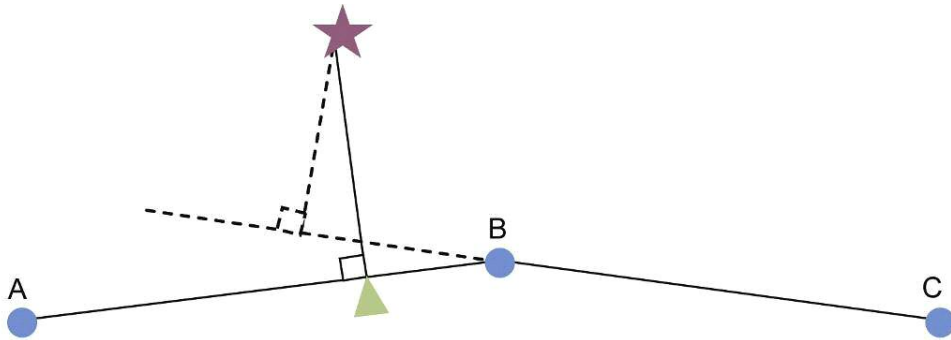


Figure 4.2 Scenario 1 – Perpendicular falls between A and B, but not between B and C.

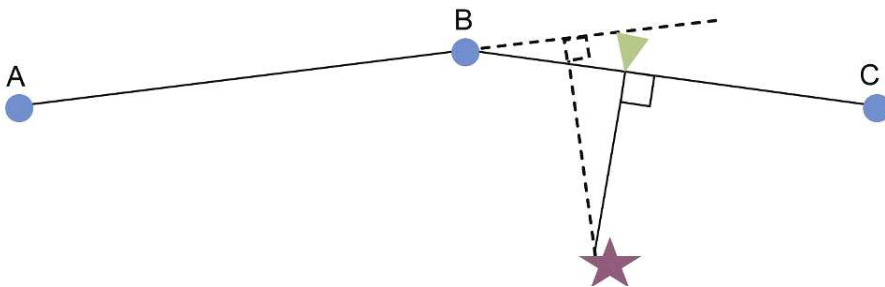


Figure 4.3 Scenario 2 – Perpendicular falls between B and C, but not between A and B

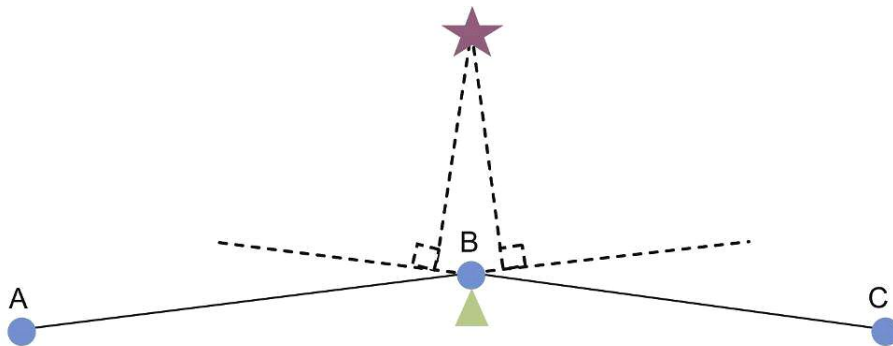


Figure 4.4 Scenario 3 – Perpendicular falls neither between A and B, nor between B and C

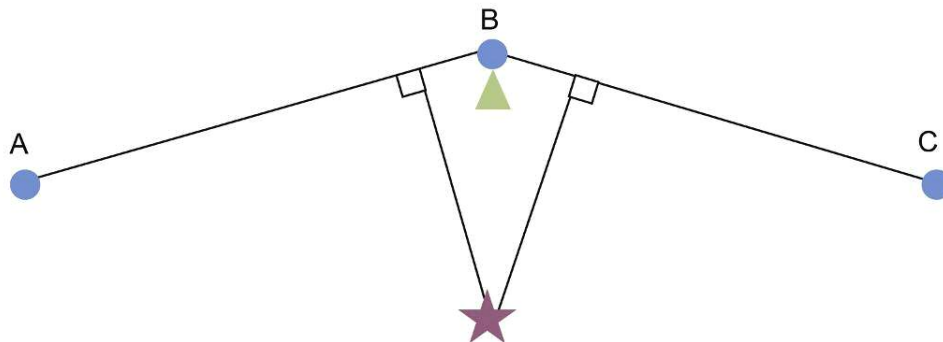


Figure 4.5 Scenario 4 – Perpendicular falls both between A and B and between B and C

- (c) This process is repeated for each Section Start and End Point, starting the search at the chainage determined for the previous point.

Note: Where a survey route crosses over itself, or loops back on itself (for example, running up to a roundabout, around the roundabout and then back down the same road), the above method can result in incorrect elapsed chainages. These situations must be identified and dealt with appropriately within the processing.

- 4.3.5 If the horizontal distance between the co-ordinates at the chainage identified as closest to the Section Start or End Point (determined assuming straight lines between the survey points) and the co-ordinates for that section start or end point provided by the Employer is more than a predefined limit (typically 10m, to be agreed between the Contractor and the Employer), the Contractor reports the disparity to the Employer.
- 4.3.6 If a Section Start or End Point for which a chainage has been determined by use of National Grid co-ordinates also has a chainage recorded within the survey data (via the reference labels), and the difference between those chainages is more than a predefined limit (typically 10m, to be agreed between the Contractor and the Employer), the Contractor shall assess the accuracy of the reference label chainage. If the contractor is unable to resolve the difference, the Contractor reports the disparity to the Employer.
- 4.3.7 If a Section Start or End Point for which a chainage has been determined by use of National Grid co-ordinates also has a chainage recorded within the survey data (via the reference labels), and the difference between those chainages is less than the predefined limit, the chainage determined by use of National Grid co-ordinates is used unless otherwise agreed with the Employer.

Section Start and End Points for which no chainage can be determined

- 4.3.8 Within a survey, it is permissible for there to be a number of Section Start and End Points for which no elapsed chainage is recorded (via the reference labels) and for which no National Grid co-ordinates are defined. These are referred to as “missing markers”. The maximum acceptable percentage of missing markers within any one survey is agreed between the Contractor and the Employer, with a typical value of between 10% and 25%, depending upon the nature of the survey route.
- 4.3.9 Where the percentage of missing markers falls below the agreed maximum, the elapsed chainages of those markers are calculated from the chainages of adjacent Section Start and End Points assuming equal proportions between the survey length and the route length, where appropriate, as shown in Table 4.2 and Table 4.3.

Section B follows Section A within the route	
Length of Section A	= 576m
Length of Section B	= 845m
Elapsed chainage at start of Section A	= 1563m
Elapsed chainage at end of Section A / Start of Section B	= Unknown
Elapsed chainage at end of Section B	= 2964m
Calculated chainage for end of Section A / start of Section B:	
= $1563 + (576 * (2964 - 1563)/(576+845))$	= 2131m

Table 4.2 Example 1 – Determining unknown Section Start and End Points

Section C is the last section within the route	
Length of Section C	= 354m
Elapsed chainage at start of Section C	= 6345m
Elapsed chainage at end of Section C	= Unknown
Calculated chainage for end of Section C:	
= $6345 + 354$	= 6699m

Table 4.3 Example 2 – Determining unknown Section Start and End Points

- 4.3.10 If it is not possible to calculate an elapsed chainage for a missing marker, e.g. where there are no recorded chainages (and no Section Start/End National Grid co-ordinates), the Contractor reports the situation to the Employer.

Use of references (events) recorded during the survey

- 4.3.11 Where it is not possible to use National Grid co-ordinates to identify the locations of the network Section Start and End Points, it may be necessary to use events recorded during the survey to fit the SCANNER data to the client's network.
- 4.3.12 This process relies on the identification and recording of section change points by the Survey operator, who must rely on rules (such as those given in section 2.3) or a description provided by the Employer to decide when to record these events. This process will result in an elapsed chainage being recorded in the Survey Data for each Section Start and End Point manually identified by the Survey Operator. The process is likely to result in greater errors than that achievable using National Grid co-ordinates.

Comparison of Survey and Route Section Lengths

- 4.3.13 Following the processes described above, there will be elapsed chainage recorded, determined or calculated for every Section Start and End Point.
- 4.3.14 The survey length of each Section is then compared with the length of that Section as defined in the Route File.
- (a) Where a survey length differs from the Section Length recorded in the Route File by more than 50m or 10% of the Section Length (whichever is less) the Contractor verifies that the correct route was driven and assesses whether the Survey Data used to record, determine or calculate the Section Start and End Points has the required level of accuracy and therefore the Survey is not at fault.
 - (b) If the Contractor determines that the incorrect route was driven, he creates a new Route File to match that driven and realigns the Survey to that route.
 - (c) If the Contractor determines that the Survey is not at fault, and therefore the length or Co-ordinates provided by the Employer are incorrect, then the Contractor reports the disparity to the Employer.

4.4 The characteristic values (derived parameters)

- 4.4.1 The Contractor obtains the following characteristic values, which are defined in Volume 5:
- (a) Velocity
 - (b) 3m Moving Average Longitudinal Profile Variance.

- (c) 10m Moving Average Longitudinal Profile Variance.
- (d) 3m Enhanced Longitudinal Profile Variance.
- (e) 10m Enhanced Longitudinal Profile Variance.
- (f) Bump Measure
- (g) Average Rut Depths
- (h) Transverse Profile Unevenness
- (i) Cleaned Rut Depths
- (j) Edge Roughness
- (k) Road Edge Stepping
- (l) Transverse Variance
- (m) Nearside SMTD
- (n) Nearside MPD
- (o) Mean Nearside, Middle and Offside RMST
- (p) 5th Percentile RMST
- (q) 95th Percentile RMST
- (r) Mean RMST
- (s) Variance in RMST
- (t) Cracking Intensity.
- (u) Left wheel track Cracking intensity
- (v) Right wheel track Cracking intensity
- (w) Transverse Cracking Intensity
- (x) Surface Deterioration Intensity

4.4.2 When calculating the characteristic values from the data the Contractor applies the checks and limits on the data and parameters described in Volume 5.

4.5 Fitting the data within the HMDIF file

General principals

4.5.1 Gradient, crossfall, and radius of curvature, are averaged over the defined output interval (normally 10m) within the survey. Similarly the characteristic values listed in paragraph 4.4 are calculated over a defined length (normally 10m) within the survey. Where the length determined for a Section within the Survey does not exactly match the length defined in the Survey Route, these data are stretched or shrunk on a Section-by-Section basis. The data

are then output in the HMDIF file with Start and End Section chainages rounded to the nearest metre. See 4.5.4 to 4.5.6.

- 4.5.2 Co-ordinate data (X, Y and Z) are interpolated to produce co-ordinate values corresponding to the ends of the same defined lengths used for the characteristic values (e.g.10m). Calculation of these interpolated co-ordinate values also requires stretches of shrinking where the Survey Section length does not match that defined in the survey route. See 4.5.7 to 4.5.8.
- 4.5.3 Individual crack values are also reported in the HMDIF and the start chainage of cracks will require sections of shrinking where the survey length does not agree with the route. Crack lengths and angles are not stretched or shrunk. See paragraph 4.5.9.

Example – Fitting continuous data

- 4.5.4 Continuous data (i.e. data referred to in paragraph 4.5.1), assumed to be averaged / calculated over each 10m within the survey. Figure 4.6 shows the survey chainages recorded on an example section A which had a route length of 58m.

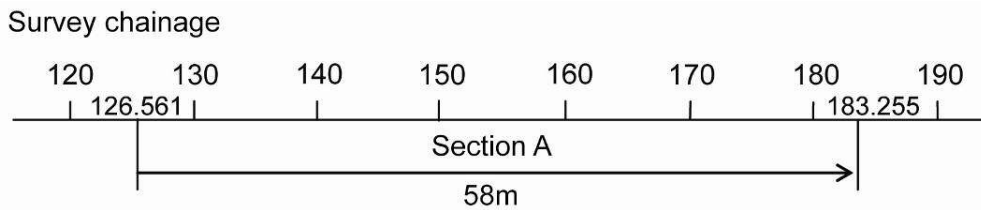


Figure 4.6 Fitting continuous data

For Section A,
the stretch/shrink factor is $58 / (183.255 - 126.561) = 1.0230359$.
Each survey chainage X equates to Section A chainage $(X - 126.561) * 1.0230359$
The application of this factor is illustrated in Table 4.5

Table 4.4 Calculating the stretch / shrink factor

Survey Chainage	Section Chainage	Section Chainage rounded to 1m
130	3.518	4
140	13.748	14
150	23.978	24
160	34.208	34
170	44.438	44
180	54.668	55

Table 4.5 Applying the stretch / shrink factor to the survey data

4.5.5 Data averaged / analysed over each 10m within the survey will be output for Section A in the chainage ranges shown in Table 4.6:

Survey Chainage	Section A Chainage
120-130	0-4
130-140	4-14
140-150	14-24
150-160	24-34
160-170	34-44
170-180	44-55
180-190	55-58

Table 4.6 Matching survey chainage to section chainage

4.5.6 If the start of a Section lies just before a 10m point within the survey, it is possible that the rounded end chainage for the first block of data is zero (the same as its start chainage). Similarly, if the end of a Section lies just after a 10m point within the survey, it is possible that the rounded start chainage for the last block of data is equal to the Section length (the same as its end chainage). In either of these cases the (zero-length) block of data will not be reported in the HMDIF.

Example – Fitting co-ordinate data

4.5.7 Co-ordinate data is normally recorded at 5m intervals within the survey, as shown in Figure 4.7, again for the example section A.

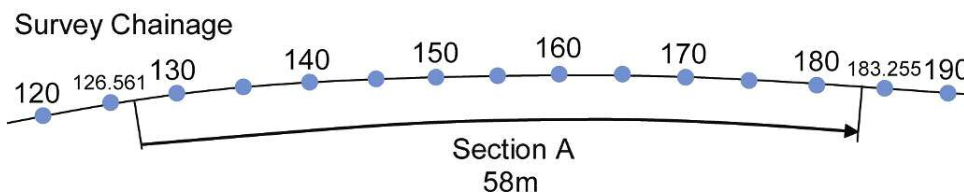


Figure 4.7 Fitting co-ordinate data

4.5.8 A set of co-ordinates is interpolated for each Section chainage resulting from the rounding procedure above assuming a straight line between the co-ordinates of the survey points on either side.

For Section A,
the stretch/shrink factor is $58 / (183.255 - 126.561) = 1.0230359$.
Each Section chainage Y equates to survey chainage $(Y / 1.0230359) + 126.561$
Interpolation is carried out using the points shown in Table 4.8

Table 4.7 Calculating the stretch / shrink factor

Section Chainage	Survey Chainage	Survey points used for interpolation
0	126.561	125 & 130
4	130.471	130 & 135
14	140.246	140 & 145
24	150.021	150 & 155
34	159.796	155 & 160
44	169.570	165 & 170
55	180.323	180 & 185
58	183.255	180 & 185

Table 4.8 Converting survey chainage to section chainage

If the X co-ordinate at survey chainage 140 is	= 528466.280
and the X co-ordinate at survey chainage 145 is	= 528471.177
the X co-ordinate for section chainage 14 will be reported as	
$528466.280 + ((528471.177 - 528466.280) * (140.246 - 140) / (145 - 140))$	
	= 528466.521

Table 4.9 Calculating section co-ordinates from survey chainage

Example – Fitting crack data

4.5.9 The (start) chainage of individual cracks are also stretched or shrunk on a section-by-section basis and are reported rounded to the nearest millimetre (together with the measured offset, length, angle and type). If a crack spans the boundary between two sections, it is reported only in the section in which the start of the crack was recorded. (It should be noted that the start chainage, angle and length of the crack may mean that the end of the crack is beyond the length of that section.) If the chainage at the start of a crack lies exactly on the boundary between two sections, it is reported in the second section only (at section chainage 0).

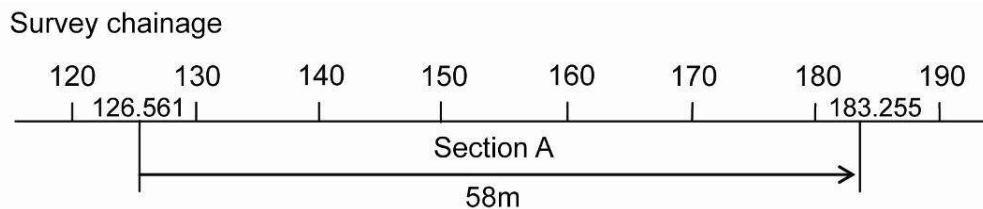


Figure 4.8 Fitting crack data

For Section A,	
The stretch/shrink factor is $58 / (183.255 - 126.561) = 1.0230359$.	
Each crack with a survey chainage (X) :	
greater or equal to 126.561	and less than 183.255
Will be output for Section A at a chainage of $(X - 126.561) * 1.0230359$ as shown in Table 4.11	

Table 4.10 Calculating the stretch / shrink factor

Survey Chainage of Crack	Section A Chainage
126.561	0.000
126.802	0.247
145.222	19.091
168.216	42.615
183.250	57.995
183.255	Crack not output in section A

Table 4.11 Converting survey chainage to section chainage

4.6 Delivering the data

- 4.6.1 The Contractor retains survey data (HMDIF file) in a retrievable format for at least six years after initial acceptance by the Employer.
- 4.6.2 On delivery the Employer may compare the section information contained within the SCANNER HMDIF file with the “known” section data (e.g. when the SCANNER HMDIF file is loaded into the Employer’s UKPMS database). If any discrepancies are found, the entire data set may be rejected. In which case the Contractor corrects and re-delivers the SCANNER HMDIF file.

4.7 Invalid Data and Network Coverage

- 4.7.1 The Contractor defines the set of Survey Routes before commencing the surveys of the Employer's network. Before commencing the Surveys the Contractor provides the Employer with an estimate of the total length of the Employer’s network that is to be surveyed, which is the basis for the coverage requirements.
- 4.7.2 The Contractor provides a return from 100% of the length of each of the Survey Routes consisting of
- (a) a SCANNER HMDIF file containing valid data, and
 - (b) a SCANNER coverage report of Sections (or parts of Sections) for which valid data has not been provided, and the reasons for the failure to provide those data. Further details of the expected content of a SCANNER coverage report are given in Volume 2, Section 2.4.
- 4.7.3 For lengths over which invalid data was obtained for any parameter no data is output in the HMDIF file for that length for that particular parameter. Volume 5 provides further guidance on the requirements for checking on data validity for the derived parameters.

- 4.7.4 If required by the Employer, the Contractor also provides the survey data as a SCANNER RCD.
- 4.7.5 The Contractor also provides the Employer (and the Auditor (if the Auditor requests it) with a summary report of the coverage achieved in the measurement of all characteristic values and the quantity of invalid data for each Survey Route. This report is provided as a comma delimited text file and describes the percentage of the Survey Route for which invalid measurements were made for each item of survey data defined in Section 3.
- 4.7.6 The Contractor monitors the coverage achieved in the surveys on the network. Invalid measurements will result in reduced survey coverage, where coverage is defined as the percentage of the total survey length required (i.e. the total length surveyed plus the total length not surveyed) for which valid data has been provided in the SCANNER HMDIF file.
- 4.7.7 The minimum requirements for the coverage of the Employer's network are summarised in Table 4.12.

Measured Parameter	Percent of surveyed Network for which		Total coverage ² (%)
	Valid Survey Data shall be provided	Invalid or missing Survey Data are permitted ¹	
Average Speed	98	2	100
National Grid Co-ordinates	98	2	100
Longitudinal Profile ³ Rural Areas			
3m Variance	96	4	100
10m Variance	96	4	100
Longitudinal Profile ³ Urban Areas			
3m Variance	95	5	100
10m Variance	92	8	100
Transverse Profile	98	2	100
Multiple Line Texture	98	2	100
Texture Profile	98	2	100
Road Geometry	98	2	100
Cracking	98	2	100
¹ Invalid Survey Data are survey data which do not meet the accuracy requirements. For the purposes of the coverage requirements invalid Survey Data includes lengths not surveyed.			
² Total coverage excludes those lengths which have been disregarded because of traffic calming features (see section 2).			
³ A length is considered to be covered if valid longitudinal profile data are available in either the nearside or offside wheelpath			

Table 4.12 Coverage Requirements by Parameter

5 Quality Assurance

5.1 General Requirements

- 5.1.1 The purpose of **QUALITY ASSURANCE** (QA) is to give the Employer, national and local governments confidence that the data and results provided are consistent and suitable for purpose. The purpose of **AUDIT** is to ensure that Quality Assurance procedures are operating effectively.
- 5.1.2 In order to provide comprehensive Quality Assurance for SCANNER accredited surveys, QA is provided by a combination of 'first party' QA, operated by the Contractor and 'third party' Audit, provided by an Independent Auditor.
- 5.1.3 It is the responsibility of the body commissioning the survey (e.g. the Local Authority Employer) to ensure that the Audit is carried out. As discussed in Volume 2 of this Specification, it is envisaged that the Independent Auditor will be commissioned either:
- (a) Directly by the Employer, who will instruct the Auditor to apply the Quality Assurance procedures described herein, or
 - (b) By the Contractor, who will appoint an Independent Auditor to carry out the Auditing described herein.
- 5.1.4 Before commencing surveys the Contractor must confirm with the Employer how the Independent Audit is to be commissioned and carried out.

Requirements for the Contractor

- 5.1.5 The Contractor provides and operates an effective and documented Quality Assurance regime covering all aspects of the SCANNER accredited surveys, including, but not limited to:
- (a) vehicle operation and maintenance
 - (b) driver and operative training and instruction
 - (c) survey operation and record keeping
 - (d) data recording, processing, and analysis
 - (e) delivery of survey results
- 5.1.6 As part of the Quality Assurance process the Contractor also:
- (a) Delivers any Quality Assurance tests and data required by the specification for SCANNER accredited surveys within the overall price agreed with the Employer for the surveys of the Employer's road network.

- (b) Delivers any reports required by the specification for SCANNER accredited surveys to the Employer and to the Auditor promptly in accordance with the timescales defined by the specification.
 - (c) Reports **any** repairs or alterations carried out on the Survey Equipment **promptly** to the Auditor..
- 5.1.7 The Auditor may require the Contractor to demonstrate any aspect of their Quality Assurance regime at any time, including documentation and performance.

Contractor's drivers and operators

- 5.1.8 When carrying out SCANNER accredited surveys the accredited Survey Equipment is only driven and operated by competent drivers and operatives. The Contractor is responsible for the training and instruction of all drivers and operatives and for ensuring that they comply with the Employer's and the Contractor's requirements and the requirements for SCANNER accredited surveys.
- 5.1.9 The Auditor may assess the competence of drivers and operatives carrying out SCANNER accredited surveys at any time. If, in the Auditor's opinion, there are concerns about the competence of drivers or operators to carry out the surveys effectively, the Auditor reports these concerns to the Contractor. The Auditor may review the driver or operator's performance against the criteria set out in the Contractor's training documentation and method statements. If the Contractor is unable to resolve the Auditor's concerns about the competence of drivers or operatives, the Auditor may report these concerns to any Employer affected and to the Department for Transport.
- 5.1.10 If the Auditor considers a lack of driver or operator competence may affect the ability of the Contractor to perform effective SCANNER accredited surveys, the Auditor may suspend or revoke any current Accreditation Certificate when the Survey Equipment is driven or operated by those whose competence is in doubt until competence to operate the Survey Equipment has been demonstrated by a re-test, carried out by those drivers and/or operatives whose competence is in doubt.

Independently Audited QA

- 5.1.11 The objective of QA is to install confidence that the data and results from SCANNER accredited surveys are suitable to support local maintenance management and for local and national performance monitoring.
- 5.1.12 As stated above, local authorities (Employers) are responsible for ensuring their surveys are independently Audited and may secure the services of their own Independent Auditor, or request the Contractor to do so.

- 5.1.13 The following sections set out the requirements for Quality Assurance operated by each Contractor, and for Audit provided by an Independent Auditor.
- 5.1.14 As a matter of principle, the Auditor has the right to ask for any and all information but will normally only ask for a sample of data sufficient to be satisfied that the Survey Equipment is being operated satisfactorily in accordance with the Specification and that data of acceptable quality, including extent and consistency, are being delivered to all Employers.

5.2 Contractor's Regular Checks

- 5.2.1 To ensure that survey equipment remains able to produce consistent and reliable results throughout the year, between annual accreditation re-testing, the survey contractor must carry out checks based on four levels of reference standard:

- (a) Contractor's Calibration Site
- (b) Primary reference sites
- (c) Secondary Reference Sites
- (d) Daily test sites

- 5.2.2 There are four main elements

- (a) The survey contractor sets up a Contractor's Calibration Site which is used as required (by the Contractor) to regularly calibrate the survey equipment and to monitor long term data trends.
- (b) The establishment of one or more "Primary Reference Sites" and the testing of satisfactory operation of the Survey Equipment at one of the Primary Reference Sites at least once every month (monthly tests).
- (c) The establishment of one or more "Secondary Reference Sites" and the testing of satisfactory operation of the Survey Equipment at one or other of the Secondary Reference Sites or a Primary Reference Site at least once every 7 days (weekly tests).
- (d) The establishment of one or more "Daily Test Sites" and the testing of satisfactory operation of the Survey Equipment on a daily basis.

- 5.2.3 There are special requirements for checks on the identification of cracking. These requirements are described in Table 5.2 and Section 5.7.

Contractor's Calibration Site

- 5.2.4 The Contractor selects and establishes the performance of the Survey Equipment at the Contractor's Calibration Site within 7 days immediately following the successful completion of Accreditation Testing or any subsequent re-testing.

- 5.2.5 For operational convenience, it is likely that the Contractor's Calibration Site will be located close to the Contractor's main operational base.
- 5.2.6 The "Contractor's Calibration site" site should be reasonably flat and have a length of at least 400m (ideally 1km or more) and contain areas without any sharp bends or extremes of profile unevenness and geometry. The sites should also be free of any isolated surface defects. The start and end points of the site should be durably marked on the kerb or road surface. The Contractor consults the local highway authority responsible for the reference test site and obtains its agreement before making any marking on or modification of the site. The Contractor measures the length of each site, to an accuracy of $\pm 0.5\text{m}$, using a calibrated distance measuring wheel or other reliable device, for use in checking the accuracy of the measurement of distance travelled.
- 5.2.7 The Contractor informs the Auditor of the Contractor's Calibration Site it has chosen. The Auditor may carry out an independent survey of the Contractor's Calibration Site at any time.
- 5.2.8 The Contractor surveys its Contractor's Calibration Site with the accredited Survey Equipment within 7 days immediately following the successful completion of Accreditation Testing or subsequent Accreditation re-testing of that Survey Equipment, to provide a reference data set. The Contractor may carry out more than one survey at each site as a measure of consistency and repeatability of the Survey Equipment.
- 5.2.9 During the survey(s) the start and end points of the test site will be identified using an automatic marker recognition system (e.g. reflective marker posts).
- 5.2.10 The Contractor processes the survey data collected from the Contractor's Calibration Site to obtain the parameters given in Table 5.1, and reports them to the Auditor within 14 days immediately following the successful completion of Accreditation Testing or subsequent Accreditation re-testing.
- 5.2.11 The Contractor and the Auditor store these parameters as a reference data set for future comparison with subsequent re-surveys of the Contractor's Calibration Site. These data sets are the "Reference Data Set" for the Contractor's Calibration Site.
- 5.2.12 If the condition of the Contractor's Calibration Site is affected by maintenance or other external factors at any time during the year, the Contractor reports this fact to the Auditor and the Contractor may either establish the changed characteristics of the site by repeated testing or establish another site as a replacement Contractor's Calibration Site, as agreed with the Auditor.

Parameter	Units	Reporting Interval ¹
Location Referencing – length of surveyed check site	m	N/A
Location Referencing – National Grid Co-ordinate	m	10m
Location Referencing – altitude	m	10m
Longitudinal Profile - 3m moving average in the nearside wheelpath and 3m enhanced variance in each wheelpath	mm ²	10m
Longitudinal Profile - 10m moving average in the nearside wheelpath and 10m enhanced variance in each wheelpath	mm ²	10m
Rutting – average rut depths ²	mm	10m
Transverse Profile – cleaned rut depths ²	mm	10m
Transverse Profile – transverse unevenness		10m
Transverse Profile – edge roughness		10m
Texture Profile – nearside SMTD	mm	10m
Texture Profile – nearside MPD	mm	10m
Multiple Line Texture – mean nearside, middle and offside RMST	mm	10m
Cracking ³ – crack map or grid	N/A	N/A
Alignment – gradient	%	10m
Alignment – crossfall	%	10m
Alignment – radius of curvature	m ⁻¹	10m
¹ The parameters are averaged over the length indicated		
² Both nearside and offside rut depth are calculated		
³ See Table 5.2 and Section 5.7		

Table 5.1 Derived parameters to be calculated from the Survey Data for monthly, weekly and daily checks

5.3 Primary Reference Site(s) and Monthly Checks

Primary Reference Sites

- 5.3.1 The Primary Reference Site(s) may be established throughout the year and at different geographical locations within the UK. These will be used for monthly checks, and their location is likely to be selected to avoid travelling long distances, which could be disruptive to the survey progress.
- 5.3.2 The Primary Site(s) will, ideally, be located on the SCANNER principal road network. The majority of the site should be without any sharp bends or extremes of profile. They should have a length of at least 10km and contain features that are representative of the SCANNER principal road network. The site should be separated into Sections, each no longer than 2km.
- 5.3.3 To set up Primary Reference Site(s), the Contractor surveys the Primary Reference Site(s) within 7 days of a successful Calibration Check at the Contractor's Calibration Site, to provide a reference data set for that site. If a survey contractor has a number of accredited Survey vehicles then they may wish to use a single accredited Survey vehicle to collect the reference measurements (for the Monthly Checks of their other accredited Survey vehicles). Alternatively they may wish to collect separate reference data sets for each accredited Survey vehicle to carry out Monthly Checks against reference data collected with the same accredited Survey vehicle.
- 5.3.4 The Contractor may carry out more than one survey over each site as a measure of consistency and repeatability of the survey equipment on that network.
- 5.3.5 The Contractor informs the Auditor within 7 days of carrying out the reference survey of each Primary Reference Site it has established. The reference data set is also provided to the Auditor. The Auditor may carry out an independent survey of any of the Primary Reference Site(s) at any time.
- 5.3.6 The Contractor processes the survey data collected from the Primary Reference Site(s) to obtain the parameters given in Table 5.1. The contractor provides the survey data and the processed results from the site to the Auditor within 14 days of the reference survey (it is anticipated that this timescale may not always be achievable for some devices (depending on their geographical location etc.). Where this is the case the Auditor should be informed and the data delivered as soon as practicable.
- 5.3.7 The Auditor may request a sample (no more than 100m) of the downward facing images of the road surface collected during the collection of the reference data set.
- 5.3.8 The Contractor stores these parameters as a reference data set for future comparison with subsequent re-surveys of the Primary Reference Site(s).

These data sets are the reference data set for that Primary Reference Site(s).

'Monthly' Checks

- 5.3.9 In order to maintain control over possible changes in the measurement accuracy of the Survey Equipment the Contractor carries out, at its own cost, regular 'monthly' checks of the survey data from a Primary Reference Site against the reference data set previously collected on the same site.
- 5.3.10 At intervals not exceeding one month, the Contractor surveys at least one previously established Primary Reference Site with the accredited Survey Equipment. The Contractor may carry out more than one survey on the site as a measure of consistency and repeatability of the Survey Equipment at that site.
- 5.3.11 The Contractor processes the survey data collected from the site within 14 days of the survey to obtain the parameters given in Table 5.1 for comparison with the reference data set.
- 5.3.12 The Contractor calculates the differences between the reference data set for that site and the parameters calculated from the Survey Data obtained during the monthly check. The differences should fall within the tolerances given in Table 5.2.
- 5.3.13 If the measurement of any parameter exceeds the tolerance given in Table 5.2 the test run is repeated. If, after three repeat runs the measurement of any parameter still exceeds the tolerance level, the Contractor informs the Auditor and investigates the source of the difference. The Contractor may not carry out any further accredited SCANNER surveys on any Employer's network until the source of the difference has been identified and any deficiencies in the operation or performance of the Survey Equipment have been rectified. The Auditor will advise on the level of QA required to verify the repairs/alterations.
- 5.3.14 If, on comparison, any of the measurements is found to be outside the permitted tolerance levels, the results of any and all SCANNER accredited surveys since the last previous successful survey of a Primary Reference Site are suspect.
- 5.3.15 If the Auditor finds that the failure of the monthly check is due to a failure in the operation or performance of the Survey Equipment, then the Auditor may define any survey data collected since the last previous successful monthly check of a Primary Reference Site as invalid.
- 5.3.16 The Auditor may also suspend any current Accreditation Certificate until the acceptable operation and performance of the Survey Equipment to the SCANNER specification has been demonstrated in an Accreditation re-test.
- 5.3.17 The Survey Data and results of the check should be supplied to the Auditor within 14 days of the survey (or as soon as practicable for survey devices in remote geographical locations). The Auditor may request that

a sample (no more than 100m) of the downward facing images of the road surface are provided for assessment.

- 5.3.18 The Contractor maintains a record of all monthly checks which must be available for inspection by the Auditor at any time.
- 5.3.19 The Auditor may require the Contractor to demonstrate the operation of the processing system used to calculate the parameters used in the monthly check.
- 5.3.20 The Auditor may also compare the results of any monthly check with the reference data set.

5.4 Secondary Reference Sites and Weekly Checks

Secondary Reference Sites

- 5.4.1 For operational convenience, the Contractor may select one or more Secondary Reference Sites over which to carry out 'weekly' checks.
- 5.4.2 The Secondary Reference Site should be reasonably flat and have a length of at least 400m (ideally >1km) and contain areas without any sharp bends or extremes of profile unevenness and geometry. The sites should also be free of any isolated surface defects. They may be the same sites as used for monthly checks.
- 5.4.3 To set up Secondary Reference Site(s), the Contractor surveys the Secondary Reference Site(s) within 7 days of a successful monthly check on a Primary Reference Site, to provide a reference data set for that survey equipment only. The Contractor may carry out more than one survey over each site as a measure of consistency and repeatability of the survey equipment on that network.
- 5.4.4 The Contractor processes the Survey Data collected from the site, to obtain the parameters given in Table 5.1. The Auditor may request to see the Survey Data, sample downward facing images and the results at any time thereafter.

Note: The contractor retains the Survey Data from a test on a Secondary Reference site as a record for quality assurance and audit purposes, but not as a "reference set" for checking machine calibration or consistency in future.

- 5.4.5 Any Secondary Reference Site may also be subject to an independent survey by the Auditor. The Auditor may require the Contractor to demonstrate the operation of the processing system used to calculate the parameters used in the weekly checks.

'Weekly' checks

- 5.4.6 The Contractor selects one or more of the Secondary Reference Sites to carry out 'weekly' checks. At intervals not exceeding 7 days, the Contractor surveys the selected test site(s) with the accredited Survey

Equipment, at its own cost. The Contractor may carry out more than one survey on the site(s) as a measure of consistency and repeatability of the Survey Equipment.

- 5.4.7 The Contractor processes the Survey Data, ideally on-board the Survey Equipment, to obtain the parameters given in Table 5.1.
- 5.4.8 The Contractor calculates the differences between the reference data for that site and the parameters calculated from the Survey Data obtained during the weekly check. The differences should fall within the tolerances given in Table 5.2.
- 5.4.9 If the measurement of any parameter exceeds the tolerance given in Table 5.2 the test run is repeated. If, after three repeat runs the measurement of any parameter still exceeds the tolerance level, the Contractor informs the Auditor and investigates the source of the difference. The Contractor may not carry out any further accredited SCANNER surveys on any Employer's network until the source of the difference has been identified and any deficiencies in the operation or performance of the Survey Equipment have been rectified. The Auditor will advise on the level of QA required to verify the repairs/alterations.
- 5.4.10 If the failure of the weekly check is due to a failure in the operation or performance of the Survey Equipment, then the Auditor may define any or all survey data collected since the last previous successful weekly check as invalid.
- 5.4.11 The Auditor may also suspend any current Accreditation Certificate until the acceptable operation and performance of the Survey Equipment to the SCANNER specification has been demonstrated in an Accreditation re-test.
- 5.4.12 There are special requirements for weekly checks on the identification of cracking. These requirements are described in Section 5.7.
- 5.4.13 The Contractor maintains a record of all weekly checks which must be available for inspection by the Auditor at any time.
- 5.4.14 The maximum time between weekly checks should be no longer than 7 days during the period that SCANNER accredited surveys are being carried out. If the Contractor designates more than one reference test site for weekly checks the Survey Equipment only needs to be checked at one of the designated sites each week.

5.5 Daily Checks

- 5.5.1 The Contractor selects a suitable test site, which could be close to the depot used for the overnight storage of the accredited Survey Equipment, for carrying out daily checks on the accredited Survey Equipment. The Contractor surveys the same site in the same direction before and after each day's work.
- 5.5.2 Daily test sites should be reasonably flat and have a length of at least 400m (ideally >1km) and contain areas without any sharp bends or

extremes of profile unevenness and geometry. The sites should also be free of any isolated surface defects. The test site may be the same as that used for a weekly check, in which case the Contractor may alternatively follow the procedures for the weekly check.

Note: For operational convenience the contractor may carry out the daily check at the beginning, or at the end of the day's work. However at least one daily check must be carried out every 24 hours elapsed time, and the testing cycle must be "closed" in the sense that the daily tests before and after each shift must be on the same site.

So, for example, the contractor might carry out the first daily test on Monday morning, successive daily tests either starting Monday evening or Tuesday morning, and finishing with a test on Friday evening. In practice, as the survey machines move around the country, it may be necessary to carry out additional tests on other sites to ensure "closure" around every survey shift.

- 5.5.3 The Contractor carries out a survey of the daily check test site at the start of the survey shift, obtaining all of the Survey Data defined in Table 5.1. The Contractor processes the Survey Data using a suitable processing system to obtain the parameters given in Table 5.1. These reference data are termed the daily check reference data. A new set of daily check reference data is generated by each survey shift, each set only being used only for the survey shift for which it is collected.
- 5.5.4 At the end of the survey shift the Contractor carries out an identical measurement to that carried out at the start of the shift over the same daily check test site. The Contractor processes the Survey Data to obtain the parameters given in Table 5.1.
- 5.5.5 The Contractor compares the Survey Data collected from the second test site survey with the daily check reference data. The differences between the daily check reference data and the data from the second survey should fall within the tolerances given in Table 5.2.
- 5.5.6 There are special requirements for daily checks on the identification of cracking. These requirements are described in Section 5.7
- 5.5.7 If the Contractor finds any measured parameter to be outside the permitted tolerance then the Contractor repeats the test run. If, after three repeat runs, any measured parameter still exceeds the tolerance level, any and all survey data collected during the survey shift over which the inconsistency occurred is suspect.
- 5.5.8 The Contractor investigates the source of the discrepancy and may not carry out any further SCANNER accredited survey runs until the source of the discrepancy has been identified and rectified. The Auditor should be informed of the issue who will advise on the level of QA required to verify any repairs/alterations.
- 5.5.9 If a change in weather conditions makes it impractical or impossible to complete a daily check, this should be recorded, and a daily check survey

should be carried out on the same site the following day (or as soon as weather conditions improve). If the survey vehicle has moved to a new geographical location (in order to find better surveying conditions) then it will be necessary to set up a new daily check site.

- 5.5.10 The Contractor maintains records of all daily checks which must be available for inspection by the Auditor at any time.

5.6 Checks after maintenance

- 5.6.1 The Contractor maintains a record of all alterations and routine maintenance activity carried out on each item of accredited Survey Equipment which must be available for inspection by the Auditor at any time.
- 5.6.2 If the Contractor makes any alterations to any part of the Survey Equipment or carries out any routine maintenance on the Survey Equipment that might affect the performance of SCANNER accredited surveys, the Auditor should be informed of the issue. The Auditor will advise on the level of QA required to verify the repairs/alterations, which must be completed successfully before the Survey Equipment recommences SCANNER accredited surveys.

Measured Parameter	Tolerance			
	Calibration Checks ⁽ⁱ⁾	Monthly ⁽ⁱⁱ⁾ and weekly checks ⁽ⁱⁱⁱ⁾	Daily Checks & Auditor's repeat surveys ^(iv)	All Test Surveys (Maximum)
Location referencing ^(v) – length of surveyed site	±1m or ±0.1% ^(xii)	±3m or ±0.1% ^(xii)	±5m or ±0.1% ^(xii)	±50m or ±10% ^(xii)
Location referencing ^(v) – National Grid Co-ordinate of section start point – OSGR fitting	2m	4m	5m	50m
Location referencing ^(v) – National Grid Co-ordinate of section start point- Manual fitting	2m ^(vi)	7m	8m	50m
Location referencing- National Grid Co-ordinate- OSGR fitting	2m	5m	6m	50m
Location referencing- National Grid Co-ordinate – Manual fitting	2m ^(vi)	8m	9m	50m
Alignment – gradient	±1.50 or ±10% ^(ix)	±1.50 or ±10% ^(ix)	±1.50 or ±10% ^(ix)	±6
Alignment – crossfall	±1.50 or ±10% ^(ix)	±1.50 or ±10% ^(ix)	±1.50 or ±10% ^(ix)	±6
Alignment – curvature	0.003m ⁻¹	0.003m ⁻¹	0.0015m ⁻¹	0.005m ⁻¹
Longitudinal profile in each wheelpath ^(vii) -3m Variance	±0.60	±0.60	±0.60	N/A
Longitudinal profile in each wheelpath ^(vii) -10m Variance	±0.70	±0.70	±0.70	N/A
Rutting – average rut depths ^(viii)	±3.0 mm	±3.0 mm	±3.0 mm	10mm ^(x)
Transverse profile - cleaned rut depths ^(viii)	±3.0 mm	±3.0 mm	±3.0 mm	10mm ^(x)
Transverse profile – transverse unevenness	0.007	0.007	0.007	0.05
Transverse profile – edge roughness	0.1	0.1	0.1	0.3
Nearside texture profile – SMTD	±0.25mm	±0.25mm	±0.25mm	±0.75mm
Nearside texture profile – MPD	±0.25mm	±0.25mm	±0.25mm	±0.75mm
Multiple Line Texture, nearside, middle and offside RMST	±0.25mm	±0.25mm	±0.25mm	±0.75mm
Cracking – area of cracking	See note ^(xi) or section 5.7 as appropriate	See note ^(xi) or section 5.7 as appropriate	See note ^(xi) or Section 5.7 as appropriate	N/A

Table 5.2: Acceptable tolerances for Calibration, monthly, Weekly, Daily Checks and Repeat Surveys

Notes for Table 5.2	
(i)	For calibration checks 95% of the differences should fall within the range of tolerances specified. The data should be expressed as averages, or at intervals of (as appropriate), 10m.
(ii)	For Monthly Checks 90% of the differences should fall within the range of tolerances specified. The data should be expressed as averages, or at intervals of (as appropriate), 10m.
(iii)	For Weekly Checks 80% of the differences should fall within the range of tolerances specified. The data should be expressed as averages, or at intervals of (as appropriate), 10m.
(iv)	For Daily Checks and Auditors repeat surveys 65% of the differences should fall within the range of tolerances specified. The data should be expressed as averages, or at intervals of (as appropriate), 10m.
(v)	The comparison of Site Length and the location of the section start point is absolute. All measurements of distance travelled and the location of the section start point must fall within the specified tolerance of the reference distance travelled.
(vi)	Must use automatic marker recognition to identify section start and end points
(vii)	For 3 m and 10 m Longitudinal Profile Variance the tolerances are in terms of the differences or fractional errors between the Average Longitudinal Profile Variances calculated from the measured profile and the Longitudinal Profile variances calculated from the Reference Profile.
(viii)	Both Nearside and Offside Rut Depths should fall within the tolerance specified.
(ix)	Whichever is the larger.
(x)	50% of Reference Rut Depth or 10mm whichever is the larger.
(xi)	For Calibration checks and the monthly checks the difference in the reported levels of cracking (reported as a %) between the two survey runs will be calculated. The distribution of these differences will be assessed and if 65% fall within 0.1, the test shall be classified as successful. For Auditor's Repeat Surveys the tolerance in the detection of cracking is the minimum percentage of 10m lengths shown by the reference survey to contain high or low levels of cracking that are also shown to contain high or low levels of cracking in the repeat survey. The Auditor may also request the delivery of sample downward facing images from the crack detection system.
(xii)	Whichever is the larger

5.7 Checks on the Measurement of Cracking

- 5.7.1 The application of checks on the measurement of cracking intensity based on statistical differences between survey runs is not straightforward on the test sites that are used for the daily and weekly checks. This arises from the nature of typical crack identification systems in missing some cracks and identifying and reporting small numbers of false cracks. Therefore, over a test site that has a relatively short length and a low number of cracks, such as might be selected for a daily check test or as a weekly reference site, missing one or two existing cracks or identifying one or two false cracks, will significantly affect the statistical performance of the system.
- 5.7.2 The Contractor is therefore responsible for putting a procedure in place that ensures that daily and weekly checks are carried out on the crack identification system of the accredited Survey Equipment. This procedure should include:
- (a) Checks on the lighting system to ensure that the lighting levels and evenness fall within the tolerances defined as “acceptable” for the accredited Survey Equipment by the Contractor. The Contractor provides a definition of the “acceptable tolerances” for the lighting levels and evenness of lighting.
 - (b) Checks on the image collection equipment to ensure that the images meet the requirements defined as “acceptable” for the accredited Survey Equipment by the Contractor. The Contractor provides a method for the operator to visually compare images collected during the daily or weekly checks with the reference images collected during daily checks, weekly or monthly reference surveys. The Contractor provides a definition of “acceptable requirements” for the quality of the images collected by the accredited Survey Equipment.
 - (c) Checks on the crack identification software to ensure it is operating effectively. The Contractor provides a method for the operator to visually compare the results of the crack identification carried out on images collected during daily or weekly checks with the results of crack identification carried out on reference images collected during the daily checks, weekly or monthly reference surveys
- 5.7.3 The Auditor investigates and approves the Contractor's procedure as part of the Acceptance Testing and subsequent re-testing before it is used as a method of carrying out monthly, weekly or daily checks on the Survey Equipment.

5.8 Checks on data delivered from SCANNER surveys

- 5.8.1 SCANNER data are currently used by local highway authorities to support the management and maintenance of carriageways in asset management systems, and by national governments to report the overall condition of

the local road network. There is, therefore, a need for the quality assurance and audit regime to check the underlying quality of the data that is actually delivered to local authorities and to national governments.

- 5.8.2 The QA processes described in the above sections allow the Contractor and Auditor to carry out quality checks at the local, detailed level. An additional process is therefore included to allow the Auditor to carry out checks on the data at the network level. This will allow checks to be carried out on the coverage achieved, and will monitor for changes at a network level from year to year that may highlight changes in the consistency of the measurements.
- 5.8.3 In order facilitate these checks on the SCANNER data the Contractors are required to deliver all SCANNER data to the Auditor as and when the data is released to their clients. Regular (e.g. monthly) deliveries of SCANNER (HMDIF) data to the Auditor should be made throughout the survey year to enable regular monitoring of data quality, and allow potential issues to be identified at an early stage.
- 5.8.4 The Auditor will load the delivered data into a database to allow basic statistical checks to be carried out. These will aim to identify fundamental changes in the Survey Data provided by individual Equipment. For example, these checks would enable the Auditor to identify, at an early stage, the introduction of a bias or larger variability than expected in certain measured parameters.
- 5.8.5 If the Auditor identifies any concerns in the SCANNER data, the Auditor will carry out further, more in-depth, investigations in to the survey data collected by the contractor concerned. The Auditor will discuss the concerns with the Contractor and work with the Contractor to identify potential causes and solutions.
- 5.8.6 In extreme cases, if the Auditor considers the performance of any accredited device has deteriorated to such an extent that it cannot perform effective SCANNER accredited surveys, the Auditor may suspend or revoke any current accreditation certificate until a satisfactory performance of the equipment has been demonstrated.
- 5.8.7 All SCANNER data are delivered to local authorities to be loaded into UKPMS compliant asset management systems. In some cases these systems are provided by SCANNER accredited contractors and data loading is an integral process. In other cases the data are transferred in UKPMS HMDIF files. The auditor will investigate the quality of a small sample of data delivered to individual local authorities and investigate the coverage of the data provided, the data fitting to the network, and the relationship between the data as extracted from the UKPMS system and the original data obtained by the SCANNER survey.

5.9 Auditor's Repeat Surveys (ARS)

- 5.9.1 The purpose of Auditor's Repeat Surveys is to demonstrate independently the continuing reliability of the operation and performance

- of SCANNER accredited surveys by each Contractor, with each item of survey equipment, and the consistency and reliability of the survey data obtained.
- 5.9.2 The Auditor selects suitable sites for Auditor's Repeat Surveys. The Auditor performs these surveys with a survey vehicle selected by the Auditor, which has been assessed against the requirements of the SCANNER specification for accuracy.
- 5.9.3 The Auditor may carry out Auditor's Repeat Surveys over any length of an Employer's Network.
- 5.9.4 The Auditor uses the Contractor's progress reports to select the sites over which Auditor's Repeat Surveys will be performed and will notify the contractor of the sites selected for Auditor's Repeat Surveys.
- 5.9.5 The Contractor provides the data from the sites selected for the Auditor's Repeat Surveys within 14 days of the Auditor notifying the Contractor of the sites selected for Auditor's Repeat Surveys.
- 5.9.6 The Contractor provides the Auditor with the survey data recorded by the Contractor over each site selected for Auditor's Repeat Surveys as SCANNER HMDIF.
- 5.9.7 The Auditor compares this SCANNER HMDIF with the SCANNER HMDIF produced from the survey data obtained by the Auditor over the same site. The differences between the parameters in the Contractor's SCANNER HMDIF and the Auditor's SCANNER HMDIF must fall within the tolerances for Repeat Surveys given in Table 5.2..The Auditor may invite the Contractor to explain if any differences between the data obtained from the Auditor's repeat survey and the data collected from the Contractor's original survey fail to meet the tolerance requirements for Repeat Surveys given in Table 5.2.
- 5.9.8 The Auditor decides whether to accept the Contractor's explanation or not, and whether to accept that the survey equipment still meets the requirements for SCANNER accredited surveys.
- 5.9.9 If the Auditor does not accept the explanation the Auditor may require the Contractor to re-survey that test site to confirm the results of the original survey. The Auditor may also require the Contractor to carry out additional repeat surveys, at the Contractor's cost, to demonstrate consistency and reliability. These may include surveys on a small but representative sample of any Employer's network that was being surveyed within one month of the original problematic survey, or an additional monthly test on a primary reference site.
- 5.9.10 If these additional repeat surveys demonstrate a wider problem with either the operation or performance of the accredited survey equipment, the Auditor may suspend or revoke any current accreditation certificate until the acceptable operation and performance of the survey equipment to the SCANNER specification has been demonstrated in an Accreditation re-test.

5.10 Random Spot Checks

- 5.10.1 The Auditor may carry out random spot checks of the operation and performance of SCANNER accredited surveys. These may include checks on survey planning, carrying out of the surveys, Survey processing and/or quality procedures.
- 5.10.2 The Auditor may attend the premises of the Contractor to ensure that these processes are being carried out to an appropriate standard. The Auditor will provide at least 5 working days notice of the intention to carry out such a Spot Check.
- 5.10.3 The Auditor may accompany the Contractor on randomly selected surveys to ensure that the surveys are being carried out in an acceptable manner and to an appropriate standard, and in particular that the Contractor is complying with its quality assurance procedures and the requirements of the SCANNER specification.
- 5.10.4 The Auditor may assess the competence of drivers and operatives carrying out SCANNER accredited surveys at any time. The Auditor reports any concerns about competence to the Contractor and may also report them to any Employer affected and to local and national governments.
- 5.10.5 If the Auditor considers a lack of driver or operator competence may affect the ability of the Contractor to perform effective SCANNER accredited surveys, the Auditor may suspend or revoke any current accreditation certificate until competence to operate the survey equipment has been demonstrated by an Accreditation re-test, carried out by the drivers and/or operatives whose competence is in doubt.

5.11 Checks on SCANNER RCD

- 5.11.1 Contractors are not expected to deliver SCANNER RCD as part of routine SCANNER accredited surveys within the United Kingdom. However, the Auditor may, at its discretion, request the Contractor to deliver SCANNER RCD from one of the routes surveyed by the Contractor for any Employer. The purpose of this requirement is to enable detailed checks on the performance of the Contractor's processing system to produce HMDIF files. Normally the Auditor will only request the Contractor to deliver SCANNER RCD (and resulting HMDIF) from one Employers' network each year, unless there are concerns that need to be investigated.

Note: This request is to demonstrate the Contractor's continuing ability to produce SCANNER RCD format files, if and when required.

- 5.11.2 The Contractor provides the data required by the Auditor for the checks on SCANNER RCD (and HMDIF) at their own expense.
- 5.11.3 The Auditor selects the routes for delivery of SCANNER RCD from the routes provided to the Employer by the Contractor before commencing the surveys, and notifies the Contractor of these selected survey routes

before the Contractor carries out SCANNER accredited surveys on the routes using the accredited Survey Equipment.

- 5.11.4 The Auditor obtains the SCANNER HMDIF from the SCANNER RCD provided by the Contractor for the selected survey routes and compares this SCANNER HMDIF with the SCANNER HMDIF provided by the Contractor from the same survey routes to check that the Contractor has calculated the SCANNER HMDIF correctly.
- 5.11.5 The Auditor may invite the Contractor to explain the reasons for any differences between the Auditor's SCANNER HMDIF and the SCANNER HMDIF provided by the Contractor. The Auditor decides whether to accept the Contractor's explanation or not, and whether to accept that the equipment still meets the requirements for SCANNER accredited surveys
- 5.11.6 If the Auditor does not accept the explanation the Auditor may require the Contractor to reprocess the SCANNER RCD to confirm the results of the original processing
- 5.11.7 If this additional processing demonstrates a wider problem with either the operation or performance of the accredited survey equipment, the Auditor may suspend or revoke any current accreditation certificate until the acceptable operation and performance of the survey equipment to the SCANNER specification has been demonstrated in an accreditation re-test.

6 Contractor's Progress Reports

6.1 Requirements

- 6.1.1 The purpose of a Contractor's progress report is to enable the Auditor to monitor the operation and performance of each Contractor carrying out SCANNER accredited surveys on the local road network in the United Kingdom and (if required) to inform an Employer about the plans and progress of the SCANNER accredited surveys on its network and to inform local and national governments about the overall plans and progress of SCANNER accredited surveys.
- 6.1.2 Each Contractor informs the Auditor of each SCANNER accredited survey that it has contracted to undertake for any highway authority as soon as possible after the award of contract, with an indication of the extent of the surveys and the anticipated programme and timing for carrying them out.
- 6.1.3 The Contractor informs the Employer when surveying has started on the Employer's road network and when it has been completed
- 6.1.4 If specifically required by the Employer, the Contractor provides information on the presence of the survey equipment whenever it is surveying on the Employer's road network, and of its absence when it leaves.
- 6.1.5 The Contractor reports to the Auditor on the locations that have been surveyed on each Employer's network within 14 days of carrying out the SCANNER accredited surveys.
- 6.1.6 The Contractor reports to the Auditor on the locations for which the SCANNER accredited survey results have been delivered to the Employer within 14 days of the Employer receiving the results. This will take the form of a copy of the delivered SCANNER data (in HMDIF format) being delivered to the Auditor.
- 6.1.7 The Contractor informs the Auditor of the location of reference sites it has chosen both Calibration and Primary Reference Sites and, if specifically requested by the Auditor, Secondary Reference Sites, and reports when it uses Primary sites for 'Monthly' checks.
- 6.1.8 The Contractor informs the Auditor of the outcome of all 'monthly', checks and, provides the data and results of them to the Auditor for independent checking.
- 6.1.9 The Contractor informs the Auditor as soon as practicable of any accident or incident involving the SCANNER accredited survey equipment that might affect the performance of SCANNER accredited surveys.
- 6.1.10 The Contractor informs the Auditor as soon as practicable of any alterations to any part of the survey equipment or any routine maintenance on the survey equipment that might affect the performance of SCANNER accredited surveys.

7 Health and Safety

7.1 Requirements

- 7.1.1 In addition to statutory duties the Contractor complies with the following requirements:
- 7.1.2 The Contractor carries out the Surveys in accordance with any additional requirements specified by the Employer relating to safety and minimum disruption to other road users.
- 7.1.3 The Contractor complies with the requirements of its own safety policy statements and safety codes of practices, and of any safety policy statements and safety codes of practice the Employer notifies to the Contractor.
- 7.1.4 The Contractor:
- (a) If required, provides the Employer with a copy of the Contractor's current safety policy statement, safety codes of practice, and method statements.
 - (b) Informs the Employer as soon as the Contractor becomes aware of any prosecution or pending or likely prosecution of the Contractor for any offence pertaining to the health and safety of its employees or of other persons, or of any conviction on such prosecution, and provides the Employer with such further information and documents as the Employer may require.
 - (c) Notifies the Employer as soon as possible of any accident or dangerous occurrence as defined under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulation 1985. This is in addition to the statutory requirement to notify the Health and Safety Executive.
- 7.1.5 The Contractor takes such steps as are necessary to ensure that its employees, and those of any Sub-Contractors, engaged on the Surveys, are competent to carry out their respective tasks with due regard to the Contractor's obligations and in the interest of the health and safety of other persons engaged in the Surveys or present on the site of the Surveys, and of the general public.
- 7.1.6 The Employer is empowered to suspend the provision of the Surveys in the event of non-compliance by the Contractor with these health and safety requirements. The Contractor does not resume provision of the Surveys until the Employer is satisfied that the non-compliance has been rectified.
- 7.1.7 The Contractor ensures that its employees are provided with an adequate and suitable supply of protective clothing and other protective equipment as conditions may require. The equipment and clothing supplied complies with the appropriate British or European EEC equivalent Standard. All personnel, either working on or visiting the site, are

required to wear high visibility clothing to Class 3 BS EN 471:1994. High visibility sleeveless waistcoats are NOT acceptable. The Contractor instructs its employees in the use of protective equipment and clothing which is maintained in a fit condition and ensures that protective clothing is worn effectively.

- 7.1.8 The Contractor ensures that all of the vehicles used in this contract clearly display the Contractor's name and/or logo and telephone number(s). All survey vehicles must comply with Traffic Signs Manual, Chapter 8 and particularly with respect to the use of conspicuous beacons etc.