ROADS
UK ROADS BOARD

SCANNER surveys for local roads

Specification Volume 3
Acceptance Testing and Accreditation

July 2005

Halcrow Group Limited

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		DRAFT	20/05/05	P C King
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Acknowledgement

This specification is substantially based on the original "TRACS Type Surveys for the Principal Road Network- Specification and Advice Note" produced for the UK Roads Board by Chris Britton Consultancy and TRL. It incorporates many detailed changes based on experience of using the TTS specification in 2003/04 and 2004/05 and a wide range of comments from interested parties and includes the results of the initial research. In addition the style has been changed to be consistent with new styles of contract (i.e. "the contractor carries out surveys", rather than, "the contractor shall survey").

Considerable assistance and support has been given by: TRL, UKPMS Development Support Consultant (Chris Britton Consultancy), Survey Contractors, UKPMS developers, and members of the SCANNER Implementation Advisory Group.

Contents

Foreword

This document is one of a series of five describing the complete process of carrying out SCANNER Surveys (Surface Condition Assessment of the National Network of Roads):

The five Volumes are:

1. Advice to Local Authorities

2. Specification for Services

3. Acceptance Testing and Accreditation

4. Quality Assurance and Audit

5. Further Technical Guidance

This Volume, Acceptance Testing and Accreditation, describes the requirements for testing survey vehicles to become accredited by site and network tests and is to be read in conjunction with the other documents. It describes the requirements for the reporting and delivery of survey data from SCANNER accredited Surveys.

Volume 1 contains advice to Local Authorities about the Services to be provided under the SCANNER Specification. It contains background information about the development of SCANNER surveys from TTS and TRACS. It includes advice on contact procurement and mobilisation. It includes a glossary of technical terms and a model contact document as annexes.

Volume 2, Specification for Services contains details of survey procedures, data processing, route fitting and calculations of derived parameters.

Volume 4, Quality Assurance and Audit contains details of the Quality Assurance procedures to ensure Services are consistent and reliable. The document includes audit processes, monitoring, calibration, and requirements for repeat surveys.

Volume 5, Further technical guidance explains the background to SCANNER Surveys and gives further guidance on the interpretation of processed SCANNER data.

1 Introduction

1.1.1 The purpose of acceptance testing and accreditation to the SCANNER survey specification (Surface Condition Assessment of the National Network of Roads) is to ensure that the system of data collection and data processing complies with the SCANNER specification. This should give a client (the Employer) confidence that a machine and its driver and operator, offered to carry out SCANNER accredited surveys, are capable of producing accurate, consistent and reliable results under standardised test conditions.

1.1.2 The Employer specifies in any contract for the provision of SCANNER surveys that the surveys may only be carried out by a machine (the Equipment) which has passed an Acceptance test and has a currently valid Accreditation Certificate.

1.1.3 The Employer specifies in any contract for the provision of SCANNER surveys that the Contractor has and operates a Quality Assurance regime for carrying out surveys that includes driver/operator training and instruction.

1.1.4 Before commencing SCANNER accredited surveys the Contractor provides the Employer and any appointed Auditor with a copy of a currently valid Accreditation Certificate.

1.1.5 The Acceptance Tests may be carried out on any machine and at any time. Following the successful completion of the tests, the tester issues an Accreditation Certificate for the survey machine to carry out SCANNER accredited surveys for a period of up to 15 months.

1.1.6 At intervals of one year following the successful completion of the Acceptance Tests the Contractor submits the survey equipment for retesting as described in Section 6. Following the successful completion of an annual retest, the tester issues a SCANNER Accreditation Certificate for a further period of up to one year. This is calculated from the date of expiry of the previous Accreditation Certificate.

1.1.7 The Acceptance Tester may assess the competence of drivers and operatives as part of the Acceptance Testing and the annual retesting.

1.1.8 The Auditor may revoke an Accreditation Certificate at any time and require the Contractor to undertake retesting if the Equipment fails to meet the accuracy requirements during SCANNER surveys, including Contractor's repeat surveys and Auditor's repeat surveys.

1.1.9 If a Contractor makes any significant change to the Equipment after the issue of an Accreditation Certificate the Auditor may require the Equipment to be submitted for an additional Accreditation re-test.

2 Acceptance Testing

2.1.1 The Acceptance Tests assess the capability of the survey equipment in the measurement and reporting of the parameters specified in the following sections. The accuracy of the equipment in the measurement of each parameter is assessed separately so that the equipment may be judged as acceptable or not (as applicable) in the measurement of each parameter individually.

2.1.2 The machine developer or Contractor attends the Acceptance Tests, and carries out any surveys or data processing required by the Acceptance Tester, at its own cost.

2.1.3 The survey equipment is driven and operated by drivers and operators named in the Contractor's quality system. The Acceptance Tester supervises and controls the tests.

2.1.4 The Acceptance Testing is carried out as site tests, network tests and survey data acceptance tests:

- In the site tests the parameters measured by the survey equipment are compared with those measured by the Reference Methods on test sections located on sites selected by the Acceptance Tester.
- The network tests assess the operational capabilities of the survey equipment when carrying out surveys under normal operating conditions on one or more routes selected by the Acceptance Tester and located on the public road network.
- In the survey data acceptance tests the data output from the Survey Equipment is checked to ensure that it complies with all the requirements for loading into a UKPMS accredited system.

2.1.5 If the survey equipment fails to achieve the required levels of accuracy in the measurement of individual parameters, the machine developer or Contractor may seek to resolve this issue by enhancing the performance of the survey equipment. The Acceptance Test for that measurement may then be repeated, at the Contractor's expense, at a time convenient to both the Acceptance Tester and the machine developer or Contractor.

2.1.6 Failure to achieve the requirements in the measurement of any single parameter does not necessarily exclude the survey equipment from carrying out surveys on the local road network in England, provided the measurement that the survey equipment is not able to provide is not required by the Employer for the assessment of the Employer's network. (For example, if a survey machine cannot meet all the requirements for surveying concrete road surfaces and the Employer does not require surveys of concrete road surfaces, the machine may be acceptable and accredited for use on other road surfaces).

2.1.7 On successful completion of the Acceptance Tests, including the survey data acceptance testing, the Acceptance Tester issues an Accreditation Certificate as shown in Figure 3-1 which summarises the results of the Acceptance Tests in the measurement of each defined survey parameter.

2.1.8 The initial accreditation certificate is valid up to15 months from the date of issue. Before the accreditation certificate expires, the machine developer or Contractor submits the survey equipment for retesting , as described in Section 5.

SCANNER Accreditation Certificate

The Equipment: .....

Operated by: .....

Has undergone testing at:.....

Test Format:: .....

Supervised by (company) .....

Parameter CommentsPass/Fail/Partial

Location Referencing:.....

Grid Co-ordinates: .....

Road Geometry:

Gradient:

Crossfall:

Curvature:

Longitudinal Profile: .....

Deceleration limits(m/s^2): 3m: .....10m:.....30m: .....

Rutting:

Texture Profile:.....

Cracking:

Sensitivity Factor (if available):.....

The Equipment is Accredited to carry out surveys to the SCANNER specification between:

Date of Issue: **Date of Expiry:**

Assessor's Name: **Assessor's Signature:**

Figure 3-1: Example SCANNER Accreditation Certificate

3 Site Tests

3.1 ***General Matters***

3.1.1 For several of the Site Tests it is necessary for the survey equipment to record the location of the start of each test section to an accuracy better than ±1m so that the data provided by the machine developer or Contractor can be accurately aligned with the Reference Data.

- To enable this level of accuracy to be achieved the Acceptance Tester places markers at the test section start and end points adjacent to the nearside of the traffic lane being surveyed.
- These markers take the form of posts approximately 0.75m tall. The face of the posts (aligned longitudinally with the traffic lane) are covered with a retro-reflective material of dimensions approximately 0.65m by 0.1m.
- The survey equipment must record the location of these posts placed at the test Section start and end points to an accuracy of better than ±1m over the range of speeds under which the survey equipment would normally be operated.

3.1.2 The Acceptance Tester provides the Contractor with a plan describing the test sites and the survey procedures to be applied (e.g. survey speeds) on those sites at least 5 working days before the commencement of the tests.

3.1.3 For the Site Tests the Contractor:

- Surveys the test sites as instructed by the Acceptance Tester in the plan provided before the tests.
- Where reflective posts are placed at the Section start and end points, records the location of the posts marking the Section start and end points to an accuracy of better than ±1m using suitable equipment installed on the survey equipment
- Processes the Survey Data from the test site to generate SCANNER RCD and SCANNER HMDIF files. [Where reflective posts are placed at the Section start and end points and are recorded by the survey equipment, it should not normally be necessary to align the Survey Data with the planned survey route before generating the SCANNER RCD and SCANNER HMDIF files. However, where it is found necessary to carry out alignment of the Survey Data with the planned survey route the

Contractor ensures that the elapsed distances of the section change points recorded in the location records of BOTH the SCANNER RCD and SCANNER HMDIF files are the aligned (post-fitted) distances.

- Delivers the SCANNER RCD and SCANNER HMDIF files to the Acceptance Tester within 8 working days of the test sites being surveyed.

3.1.4 The Acceptance Tester uses a number of Reference Methods to assess the accuracy of the Equipment in the Site Tests, these are summarised in Table 3.1.1.

Parameter	Parameter	Values to be Compared with Reference	Reference Method - Site Tests
Location Referencing	Distance Travelled	Measured lengths of Sections	Calibrated Measuring wheel and Steel Tape
	National Grid Co-ordinates of Section start points	National Grid Co-ordinates of Section start points	Static GPS combined with an Optical Survey
	National Grid Co-ordinates of positions of moving vehicle	National Grid Co-ordinates of positions of moving vehicle	Static GPS combined with an Optical Survey
Geometry	Gradient	Gradient	Rod and level
	Crossfall	Crossfall	Rod and level
	Radius of Curvature	Radius of Curvature	Calibrated Measuring wheel / Steel Tape
Longitudinal Profile	Longitudinal Profile	Measured Longitudinal Profile	ARRB Walking Profiler and/or Artificial Profile (characterised using micrometer and/or rod and level)
	Variance	3m, 10m, 30m Moving Average Longitudinal Profile Variance	ARRB Walking Profiler
Rutting	Rut Depth	Rut depth	Straight-edge and wedge **And/or** HARRIS[1], with manual assessment of the measured transverse profiles
Texture Profile	Texture Profile	Measured Texture Profile	Characterised Artificial Profile
	Sensor Measured Texture Depth (SMTD)	Sensor Measured Texture Depth (SMTD)	HARRIS[1]
Cracking	Crack Intensity	Crack Intensity	Primary Reference Data: Manual Assessment of Digital Images
	Crack Intensity	Crack Intensity	Secondary Reference Data: Mean Crack Intensity Recorded by each item of Equipment[2]
	Crack map	Individual Grid tiles containing Cracks	Manual Assessment of Digital Images

1. Highways Agency Road Research Information System
2. Where more than one piece of Equipment from *different* Contractors participate in the Tests

Table 3.1.1: Reference Methods to be used in the Acceptance Tests of the survey equipment on the test sites selected by the acceptance tester

3.2 ***Site Tests of location Referencing***

3.2.1 The Acceptance Tester selects a test site and divides it into a number of Sections, marking the start and end of each section with a reflective post.

- The site may contain both straight and curved Sections.
- The site may contain Sections having levels of GPS signal availability (in terms of the length of the Section over which the GPS signal is available) ranging from less than 10% availability of GPS signal to greater than 90% availability.

3.2.2 The Contractor defines a survey route appropriate for the survey of the test site, surveys the test site at a range of speeds (as required by the Acceptance Tester) and delivers the SCANNER RCD and the SCANNER HMDIF from the test site to the Acceptance Tester.

3.2.3 The Acceptance Tester compares the lengths of the Sections recorded in the SCANNER RCD and SCANNER HMDIF provided by the Contractor with the lengths of the Sections measured by the Reference Method.

3.2.4 The Acceptance Tester compares the National Grid Co-ordinates and the Altitudes recorded in the SCANNER RCD and SCANNER HMDIF provided by the Contractor with National Grid Co-ordinates and the Altitude recorded for these Sections using the Reference Method.

3.2.5 The test is passed if all the following criteria are met:

- 95% of the measured Section lengths fall within ±1m (or ±0.1%, whichever is larger) of the Section lengths measured using the Reference Method.
- 95% of the measured National Grid Co-ordinates are within ±2m of the National Grid Co-ordinates measured using the Reference Method for those Sections having better than 70% availability of GPS signal
- 95% of the measured National Grid Co-ordinates are within ±10m of the National Grid Co-ordinates measured using the Reference Method for those Sections having less than 70% availability of GPS signal
- All of the measured National Grid Co-ordinates are within 50m of the National Grid Co-ordinates measured using the Reference Method.
- 95% of the measured Altitudes are within ±3m of the Altitudes measured using the Reference Method for those Sections having better than 70% availability of GPS signal
- 95% of the measured Altitudes are within ±5m of the Altitudes measured using the Reference Method for those Sections having less than 70% availability of GPS signal
- All of the measured Altitudes are within 50m of the Altitudes measured using the Reference Method.

3.3 ***Site Tests of Road Geometry***

3.3.1 The Acceptance Tester selects a test site and divides it into a number of Sections, marking the start and end of each section with a reflective post..

3.3.2 The Acceptance Tester surveys the test site for Gradient, Cross-fall and Radius of Curvature using the Reference Method(s) given in Table 3.1.1.

- The geometry of the site may be varied, with cross-fall, gradient and curvature lying in the full range specified in [Volume 2 Section 3.5].

3.3.3 The Contractor defines a survey route appropriate for the survey of the test site, surveys the test site at a range of speeds (as required by the Acceptance Tester) and delivers the SCANNER RCD and the SCANNER HMDIF from the test site to the Acceptance Tester.

3.3.4 The Contractor provides measurements of gradient, cross fall and radius of curvature. The longitudinal separation of measurements may not exceed 0.5m. The measurements are averaged over 5m and expressed as values at 5m intervals.

Measured Parameter	Range
Gradient	At least ±20%
Cross-fall	At least ±20%
Radius of curvature	At least ±2000m

Table 3.2 Road Geometry Parameters: Range requirements.

3.3.5 The Acceptance Tester subtracts the gradient, cross-fall and radius of curvature recorded in the SCANNER RCD and SCANNER HMDIF provided by the Contractor from the gradient, cross-fall and radius of curvature measured with the Reference Method.

3.3.6 The test is passed if all the following criteria are met:

- 95% of the differences between the measured Gradient and the Reference Gradient fall within ±1.5, or ±10% of the Reference Gradient, whichever is greater.
- The difference between the measured gradient and the Reference Gradient shall never exceed ±6.
- 95% of the differences between the measured Cross-fall and the Reference Cross-fall fall within ±1.5, or ±10% of the Reference Cross-fall, whichever is greater.
- The difference between the measured cross-fall and the Reference Cross-fall shall never exceed ±6.
- 65% of the differences between the measured Radius of Curvature and the Reference Radius of Curvature fall within ±20m, or ±10% of the Reference Radius of Curvature, whichever is greater.
- 95% of the differences between the measured Radius of Curvature and the Reference Radius of Curvature fall within ±50m, or ±25% of the Reference Radius of Curvature, whichever is greater.

3.4 ***Site Tests of Longitudinal Profile***

3.4.1 The Acceptance Tester selects a test site and divides it into a number of Sections, marking the start and end of each section with a reflective post.

- The site may contain both straight and curved Sections, but shall not contain any extremes of geometry.

3.4.2 The Acceptance Tester measures the longitudinal profile of the site using the Reference Method given in Table 3.1.1

3.4.3 The Contractor defines a survey route appropriate for the survey of the test site.

3.4.4 The Acceptance Tester provides the Contractor with a breakdown of the range of speeds for which longitudinal profile measurements of the site will be required.

- A number of test surveys are carried out at constant survey speed and a number of test surveys are carried out under conditions of deceleration.
- To achieve even decelerations the Acceptance Tester marks out the test site to indicate the locations at which survey vehicle braking should start and end.

3.4.5 The Contractor uses the survey equipment to collect measurements of Longitudinal Profile on the test site under the range of conditions defined by the Acceptance Tester and delivers the SCANNER RCD and the SCANNER HMDIF from the test site to the Acceptance Tester.

3.4.6 If the Contractor intends to use its own facilities to calculate SCANNER HMDIF from the Survey Data when carrying out SCANNER accredited surveys, the Acceptance Tester checks to ensure that the calculation of 3m, 10m and 30m variance in the Contractor's facility is satisfactory.

3.4.7 The test of the calculation of variance is carried out as follows:

- The Contractor delivers the SCANNER RCD from the test site and the SCANNER HMDIF from the test site calculated from the Survey Data using the facility provided by the Contractor.
- The longitudinal profile recorded in the SCANNER RCD provided by the Contractor is processed by the acceptance tester, using the MSP, to obtain the SCANNER HMDIF. This is compared with the SCANNER HMDIF provided by the Contractor.

3.4.8 The measurement of Longitudinal Profile measured by the survey equipment over the test site and provided in the SCANNER RCD is assessed as follows:

- A moving average filter is applied to both the Reference Profile and the measured profile to obtain three filtered profiles for which wavelengths in excess of 3m, 10m and 30m have been attenuated.
- If required, the Acceptance Tester normalises the measured profile, for example to remove any constant, or linear, offset between the Reference and measured profiles. The Acceptance Tester calculates the differences between the filtered Reference Profile and the filtered measured profile by subtracting the filtered Reference Profile from the filtered measured profile.
- If required, the Acceptance Tester normalises the measured profiles and calculates the cross-correlation coefficient between the filtered Reference Profile and the filtered measured profile.
- The Acceptance Tester calculates the 3m Moving Average Longitudinal Profile Variances from the Longitudinal Profiles measured by the survey equipment using the method described in Volume 5. The Acceptance Tester subtracts these values from the 3m Moving Average Longitudinal Profile Variances calculated from measurements of Longitudinal Profile previously made on the selected lengths using the Reference Method(s), to obtain the differences between the measured profile and the Reference Profile.
- The Acceptance Tester calculates the fractional errors by dividing the differences by the 3m, 10m and 30m Moving Average Longitudinal Profile Variances calculated from the Reference Profile.
- The Acceptance Tester assesses accuracy separately for surveys carried out at constant speed and surveys carried out under conditions of deceleration

3.4.9 The tests for longitudinal profile are passed, for the surveys carried out at constant speed, if:

- The SCANNER HMDIF obtained by the Acceptance Tester from the SCANNER RCD is the same as the SCANNER HMDIF calculated by the Contractor from the Survey Data.
- 95% of the differences between the measured Longitudinal Profile and the Reference Profile fall within the ranges given in column A of.Table 3.3
- 95% of the cross-correlation coefficients equal or exceed the values given in column B of Table 3.3.
- 65% of the fractional errors between the moving average profile variances calculated from the measured profile and the moving average profile variances calculated from Reference Profile fall within the ranges given in column C of Table 3.3
- 95% of the fractional errors between the moving average profile variances calculated from the measured profile and the moving average profile variances calculated from Reference Profile fall within the ranges given in column D of Table 3.3

	A	B	C	D
Moving Average Length (m)	Profile Differences (95%)	Profile Cross Correlation Coefficient	Variance Fractional Error (65%)	Variance Fractional Error (95%)
3	±2.00	0.75	±0.30	±0.60
10	±4.00	0.85	±0.35	±0.70
30	±6.00	0.85	±0.45	±0.90

Table 3.3: Accuracy requirements for the Site Tests of longitudinal profile

3.4.10 The Acceptance Tester compares the performance of the Equipment at each level of deceleration with the accuracy requirements given in Table 3.3 for the surveys carried out under conditions of deceleration.

3.4.11 The Acceptance Tester records the level of deceleration at which, in its opinion, the Equipment fails to provide measurements to an acceptable level of accuracy when compared with the accuracy requirements given in Table 3.3. This defines the limit of deceleration under which the Equipment provides acceptable data.

3.5 ***Site Tests of transverse profile and wheel path rutting***

3.5.1 The Acceptance Tester selects a test site and divides it into a number of Sections, marking the start and end of each section with a reflective post.

3.5.2 The Acceptance Tester provides the Contractor with a map showing the location of the sites and the description of each Section start and end point on each site.

- The sites may cover a broad range of rut depths and other transverse features.

3.5.3 The Acceptance Tester measures the rutting present on the test sites using the Reference Method given in Table 3.1.1.

3.5.4 The Contractor defines a survey route appropriate for the survey of each of the test sites, carries out one or more surveys of the test sites as required by the Acceptance Tester and delivers the SCANNER RCD and the SCANNER HMDIF to the Acceptance Tester.

3.5.5 The Acceptance Tester averages the rut depths recorded in the SCANNER RCD over 10m lengths and subtracts them from the rut depths measured with the Reference Method over 10m lengths.

3.5.6 The test is passed if all the following criteria are met:

- 65% of the differences between the measured maximum Rut Depths in each Wheelpath, and the Reference maximum Rut Depth in each Wheelpath fall within ±1.5mm.
- 95% of the differences between the measured maximum Rut Depths in each Wheelpath, and the Reference maximum Rut Depth in each Wheelpath fall within ±3.0mm.
- All of the differences between the measured maximum Rut Depths in each Wheelpath, and the Reference maximum Rut Depth in each Wheelpath are less than ±10.0mm, or 50% of the magnitude of the Reference Rut Depth, whichever is the greater.

3.5.7 The tests of transverse profile also assess the accuracy of the Contractor's calculation of the transverse profile parameters defined in Volume 2, Annex A Section 8.2. The Acceptance Tester compares the values of these parameters calculated by the Contractor for the test site with values calculated by the Acceptance Tester.

3.5.8 The Contractor provides data files containing the transverse profile measurements collected over the test sites. The transverse profile measurements are provided at intervals of 100mm in the form of comma separated value text files, with elapsed distance and with location referencing information to enable the location of the transverse profiles to be correlated with the location of the data delivered in the SCANNER HMDIF files provided for the test sites. The Contractor agrees the format of these files with the Acceptance Tester before commencing the tests.

3.5.9 The Contractor also provides SCANNER HMDIF files containing the parameters defined in Volume 2, Annex A, Section 8.2 for the test sites.

3.5.10 The Acceptance Tester calculates the transverse profile parameters defined in Volume 2, Annex A, Section 8.2 using the transverse profile data provided by the Contractor and compares them with the values provided by the Contractor in the SCANNER HMDIF files for the test sites.

3.5.11 The Contractor's calculation of the transverse profile parameters defined in Volume 2, Annex A, Section 8.2 is acceptable if the values in the Contractor's HMDIF are the same as those calculated by the Acceptance Tester.

3.6 ***Site Tests of Texture Profile***

3.6.1 The Acceptance Tester selects a test site consisting of a single Section for the assessment of the measurement of "raw" texture profile, marking the start and end of the Section with a reflective post.

- The Section contains features of a known Texture Profile, characterised using conventional measurement methods.
- These measured shapes are referred to as the Reference Profile for the assessment of Texture Profile measurement.

3.6.2 The Acceptance Tester selects a further test site and divides it into a number of Sections for the assessment of the measurement of Sensor Measured Texture Depth (SMTD), marking the start and end of each section with a reflective post.

- The site may contain both straight and curved Sections, but shall not contain any extremes of geometry.

3.6.3 The Acceptance Tester measures the texture profile of the site using the Reference Method given in Table 3.1.1 for the measurement of SMTD.

3.6.4 The Contractor defines a survey route appropriate for the survey of the test site, carries out one or more surveys of the test site as required by the Acceptance Tester and delivers the SCANNER RCD and the SCANNER HMDIF to the Acceptance Tester.

3.6.5 If the Contractor intends to use its own facilities to calculate SCANNER HMDIF from the Survey Data when surveying the Employer's Network the Acceptance Tester checks to ensure that the calculation of SMTD in the Contractor's facility is satisfactory. The Acceptance Tester carries out the test of the calculation of SMTD as follows:

- The Contractor delivers the SCANNER RCD from the test site and the SCANNER HMDIF from the test site calculated from the Survey Data using a facility provided by the Contractor.
- The Acceptance Tester processes the texture profile recorded in the SCANNER RCD provided by the Contractor, using the MSP, to obtain the SCANNER HMDIF. The Acceptance Tester compares this with the SCANNER HMDIF provided by the Contractor.

3.6.6 The Acceptance Tester assesses the measurement of texture Profile by the Equipment, over the test site, and provided in the SCANNER RCD as follows:

- The texture profile recorded in the SCANNER RCD provided from the test site for the assessment of the measurement of "raw" texture profile is subtracted from the Reference Profile to obtain the differences between the texture profile and the reference profile.
- The SMTD is calculated from the texture profiles recorded in the SCANNER RCD provided from the test site for the assessment of the measurement of SMTD using the method described in Volume 2 Annex A, Section 8.4. These values will then be subtracted from the SMTDs calculated from measurements of texture Profile previously made on the selected lengths using the Reference Method(s) to obtain the differences between the measured SMTD and the Reference SMTD.

3.6.7 The tests for texture profile measurement will be passed if:

- The SCANNER HMDIF obtained by the acceptance tester from the SCANNER RCD is the same as the SCANNER HMDIF calculated by the Contractor from the Survey Data for the test site for the assessment of the measurement of SMTD.
- 95% of the differences between the measured Texture Profile and the Reference Profile (from the test site for the assessment of the measurement of "raw" texture profile) fall within ±0.5mm.
- 95% of the differences between the SMTD calculated from the measured Texture Profile and the SMTD calculated from the Reference Profile (from the test site for the assessment of the measurement of SMTD) fall within the range ±0.25mm.
- All of the differences between the SMTD calculated from the measured Texture Profile and the SMTD calculated from the Reference Profile (from the test site for the assessment of the measurement of SMTD) fall within the range ±0.75mm.

3.7 ***Site Tests of Cracking***

3.7.1 The Acceptance Tester selects a number of test sites and divides them into a one or more Sections, marking the start and end of each Section with a reflective post.

- The sites may cover a broad range of crack intensities; pavement constructions (including fully flexible, rigid and composite); surface types; surface texture; crack widths and crack orientations; as may be found on the English local road network.

3.7.2 There are two sources of reference data for the Acceptance Tests of the measurement of cracking, shown in Table 3.1.1, termed the Primary and Secondary Reference Data.

3.7.3 The Primary Reference Data forms the basis for initial assessment of the performance of the Equipment as described in paragraphs 3.7.3 to 3.7.15.

3.7.4 The Acceptance Tester derives the Primary Reference Data by visual inspection of digital images. The Highways Agency Road Research Information System (HARRIS) survey vehicle provides the images from which the Primary Reference Data are derived, as follows:

- The HARRIS survey vehicle provides greyscale images (256 levels) of the test sites over a survey width of approximately 2.9m at an image resolution of 2mm longitudinally and 2mm transversely.
- The HARRIS images are displayed in a strip map format on a computer screen for visual inspection. The images are marked with a 200 mm square grid. (Note the outermost grid square will therefore be only partially occupied.).
- The grid-marked images are inspected by eye to identify cracking. Any grid tile containing a crack is counted. The total number of grid tiles with a crack is counted over each 50m length of survey data.

- The Acceptance Tester calculates the Cracking Intensity as the percentage of 200 mm square grid tiles with a crack over each 50 m sub-section length, which is the Primary Reference Data.

3.7.5 The Acceptance Tester interprets the Primary Reference Data to obtain the Relative Cracking Intensity for each sub-section.

- The Acceptance Tester calculates the average Cracking Intensity recorded over all of the sub-sections surveyed in the Primary Reference Dataset.
- The Acceptance Tester divides the Cracking Intensity for each sub-section by the average Cracking Intensity to obtain the Relative Cracking Intensity for each of the 50m sub-sections. (Note, the overall average value is 1.)
- The Acceptance Tester classifies the individual subsections into high, moderate and low levels of cracking.
- Sub-sections with a Relative Cracking Intensity greater than 1.75 are defined as sub-sections containing high levels of cracking.
- Sub-sections with a Relative Cracking Intensity less than 1.25 but greater than 0.5 are defined as sub-sections containing moderate levels of cracking.
- Sub-sections with a Relative Cracking Intensity less than 0.2 will be defined as sub-sections containing low levels of cracking.

[Note the deliberate separation between high levels of cracking >1.75; moderate levels between 0.5 and 1.25 and low levels <0.2,]

3.7.6 The Acceptance Tester provides the Contractor with a map showing the location of the test sites and the description of each Section start and end point on each test site.

3.7.7 The Contractor defines survey routes appropriate for the surveys of these test sites and carries out at least two surveys over each site, or more if requested by the Acceptance Tester.

3.7.8 The methods of identifying and measuring cracking intensity differ for different systems and the Contractor may need to calibrate the Survey Equipment to be able to measure cracking intensity on the English local road network. Therefore the Acceptance Tester provides the Contractor with a sample of the Reference Data for a length not exceeding 5km of the Reference Sites. The Contractor may use this data to calibrate the crack identification system fitted to the Survey Equipment.

3.7.9 After any necessary calibration of the crack identification system, the Contractor carries out the surveys of the test sites, and delivers the SCANNER RCD and the SCANNER HMDIF from the test sites to the Acceptance Tester.

3.7.10 If the Contractor intends to use its own facilities to calculate SCANNER HMDIF from the Survey Data when carrying out SCANNER accredited surveys, the Accreditation Tester checks to ensure that the calculation of crack intensities in the Contractor's facility is acceptable. The test of the calculation of crack intensity is carried out as follows:

- The Contractor calculates the SCANNER RCD and the SCANNER HMDIF from the Survey Data of the test sites.
- The Accreditation Tester processes the cracking recorded in the SCANNER RCD provided by the Contractor, using the MSP, to obtain the SCANNER HMDIF.
- The Acceptance Tester compares this with the SCANNER HMDIF provided by the Contractor.

3.7.11 The Acceptance Tester processes the crack data provided by the Contractor in the SCANNER RCD to obtain the Cracking Intensity over each 50m long sub-section. The Acceptance Tester calculates the average Cracking Intensity recorded over all of the sub-sections surveyed from the SCANNER RCD provided by the Contractor. The Acceptance Tester divides the Cracking Intensity for each sub-section surveyed by the calculated average Cracking Intensity. The Acceptance Tester classifies the sub-sections in the same way as the Primary Reference Data described in Paragraph 3.7.5 to obtain the Relative Cracking Intensities for the survey data provided by the Contractor.

3.7.12 The Acceptance Tester compares the Primary Reference Data with the results of the surveys carried out by the Contractor. Each survey run is treated separately, so that if there are two survey runs two sets of Relative Cracking Intensities will be compared with the Primary Reference Data.

3.7.13 The Acceptance Tester assesses the accuracy of the measurement of cracking using the Primary Reference Data:

- The Acceptance Tester identifies the 50m sub-sections containing a high level of cracking (as defined in paragraph 3.7.5) from the Primary Reference Data. The Acceptance Tester compares the results of the survey carried out by the Contractor using the Survey Equipment over the same sub-sections with the Primary Reference Data.
- The Acceptance Tester identifies the 50m sub-sections containing a moderate level of cracking (as defined in paragraph 3.7.5) from the Primary Reference Data. The Acceptance Tester compares the results of the survey carried out by the Contractor using the Survey Equipment over the same sub-sections with the Primary Reference Data.
- The Acceptance Tester identifies the 50m sub-sections containing a low level of cracking (as defined in paragraph 3.7.5) from the Primary Reference Data. The Acceptance Tester compares the results of the survey carried out by the Contractor using the Survey Equipment over the same sub-sections with the Primary Reference Data.

3.7.14 The tests for measuring Cracking Intensity will be passed only if all of the following requirements are met **for each survey run** (see also paragraph 3.7.15):

- The Acceptance Tester obtains the same SCANNER HMDIF from the SCANNER RCD provided by the Contractor as the SCANNER HMDIF calculated by the Contractor from the Survey Data.
- The Survey Equipment shows a high level of cracking over at least 75% of the 50m sub-sections that the Primary Reference Data shows to have high level of cracking.
- The Survey Equipment shows a low level of cracking over at least 75% of the 50m sub-sections that the Primary Reference Data shows to have a low level of cracking.

[Note, the Acceptance Tester also checks whether the Survey Equipment shows a moderate level of cracking over at least 50% of the 50m sub-sections that the Primary Reference Data shows to have a moderate level of cracking. This is not an absolute requirement for acceptance, but a more stringent test of machine performance]

3.7.15 As a test of repeatability, the Acceptance Tester applies the requirements in paragraph 3.7.14 separately to the Cracking Intensity recorded in each of the survey runs carried by the Contractor.

3.7.16 If the Survey Equipment is able to meet all of the requirements of paragraph 3.7.14, the Acceptance Tester accredits the Survey Equipment to carry out SCANNER accredited surveys with any variable settings fixed at the settings used for the acceptance tests. The Contractor provides details of any variable settings to the Acceptance Tester so that the Acceptance Tester may endorse the Accreditation Certificate with the accredited settings.

3.7.17 If the Survey Equipment is unable to meet all of the requirements of paragraph 3.7.14, the Acceptance Tester assists the Contractor to investigate the performance of the Survey Equipment in the measurement of Cracking Intensity to ascertain the reasons for the failure to meet the required standards. This investigation may include, for example:

- Allowing the Contractor to re-process the Survey Data in view of the performance achieved during the first tests of the survey data
- Reviewing performance in terms of surface type.
- Reviewing performance in terms of surface texture.
- Reviewing performance in terms of surface features (such as road furniture, joints etc).

3.7.18 The Contractor and the Assessment Tester may repeat the assessment of the Survey Equipment, taking into account the results of the further investigations, to determine whether the Survey Equipment is suitable for carrying out surveys on parts of the local road network, with limitations or restrictions.

3.7.19 If the Survey Equipment is acceptable , but with restrictions on the areas of the local road network for which it is acceptable, then:

- The Acceptance Tester endorses any Accreditation Certificate to identify the limitations of the Survey Equipment and the restrictions on its use to provide SCANNER accredited surveys.
- 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.
- 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.
- 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 letting any contract].

3.7.20 The Acceptance Tester uses Secondary Reference Data to assess the sensitivity and accuracy of the Survey Equipment in relation to other Survey Equipment (operated by others) that provides measurements of cracking. These comparison tests can, therefore, only be carried out when data from the test sites is provided by more than one set of Survey Equipment

3.7.21 The Acceptance Tester assembles data provided from surveys of the test sites by each piece of Survey Equipment to form the Secondary Reference Data:

- The Acceptance Tester obtains the Cracking Intensities from the SCANNER RCD or SCANNER HMDIF provided by each set of Survey Equipment participating in the Site Tests of cracking, expressed over 50m sub-section lengths.
- The Acceptance Tester examines all the data from each set of Survey Equipment and removes any measurements of Cracking Intensity that are not representative of the overall levels reported by that set of survey equipment (outlying data values).
- The Acceptance Tester calculates a single average Cracking Intensity for each 50 m sub-section from the Cracking Intensities provided by each set of survey equipment.
- These average Cracking Intensities are the Secondary Reference Data.

3.7.22 The Acceptance Tester compares the Cracking Intensities obtained from the SCANNER RCD provided by each Contractor with the Secondary Reference Data.

- The Acceptance Tester identifies any significant local differences between the Cracking Intensities obtained from the SCANNER RCD provided by each Contractor and the Secondary Reference Data.
- The Acceptance Tester may require the Contractor to investigate and explain the reasons for these differences. If the difference arises from an apparent deficiency in the Contractor's Survey Equipment the Acceptance Tester may require the Contractor to make improvements or may impose restrictions applied as described in paragraph 3.7.19.
- The Acceptance Tester evaluates the differences between the general sensitivity of the survey equipment and the Secondary Reference Data.

3.7.23 The comparison with the Secondary Reference Data may enable the Acceptance Tester to estimate a sensitivity factor for the Survey Equipment so that the Cracking Intensities reported by the Survey Equipment can be correlated with the Cracking Intensities reported by Survey Equipment provided by other Contractors. Where this is possible the Acceptance Tester endorses the Accreditation Certificate with the results of the comparison

3.7.24 The comparison with the Secondary Reference Data may show significant differences between the Cracking Intensities reported by the Survey Equipment, or show deficiencies in the capability of the Survey Equipment. In these cases, the Assessment Tester will require the Contractor to explain the reasons for these differences, and will give the Contractor an opportunity to make improvements to the Survey Equipment. Differences or deficiencies that remain at the conclusion of the Acceptance Tests may result in the Acceptance Tester specifying restrictions on the use of the Survey Equipment as described in paragraph 3.7.19 or the refusal to issue an Accreditation Certificate.

4 Network Tests

4.1 ***General requirements***

4.1.1 Providing that the Acceptance Tester accepts the performance of the Survey Equipment in the Site Tests, the performance of the Contractor and the Survey Equipment is further examined in the Network Tests.

4.1.2 The Network Tests assess the overall operational capability of the Contractor and the Survey Equipment in carrying out surveys under conditions typical of those to be encountered on the local road network. They test:

- Route planning.
- Survey procedures.
- Efficiency of operation of the Survey Equipment.
- Alignment of the surveyed route with the planned route and accuracy of locating Section start points.
- Accuracy of the SCANNER RCD and SCANNER HMDIF.
- Coverage obtained by the Survey Equipment.

4.1.3 The Acceptance Tester selects one or more test sites consisting of several Sections. The sites include road types that are typical of the local road network in terms of construction, condition and traffic levels. The test sites may include:

- Flexible and rigid constructions;
- Urban and rural roads,;
- Single and dual carriageway roads;
- Traffic light controlled junctions;
- Slip roads;
- Roundabouts and
- A wide range of typical road geometries.

4.1.4 Some, all or none of the section change points on the test sites may be physically marked at the location of the Section start using "studs" as defined in Volume 1 (Part 2) of the Trunk Road Maintenance Manual (TRMM). The Acceptance Tester provides a list of Sections having such physical marks before the commencement of the Network Test Surveys.

4.1.5 The Acceptance Tester obtains Reference Data on the test sites using the Highways Agency Road Research Information System (HARRIS). The Acceptance Tester processes Survey Data provided by the HARRIS survey vehicle to provide the following Reference Data for the Network Tests for each Section within the test site (reported relative to elapsed chainage within Section, as appropriate):

- The OSGR co-ordinates of the Section start points.
- The OSGR co-ordinates reported at 5m intervals.
- The road geometry, 3m, 10m and 30m moving average longitudinal profile variance, rut depth and SMTD reported as averages over 50m sub section lengths
- The cracking intensity reported over 50m sub section lengths.

4.1.6 The Acceptance Tester also produces a forward facing video record of the test route surveyed by HARRIS for reference purposes.

4.1.7 The Acceptance Tester provides the Contractor with a map showing the location of the test sites, the description of each Section start and end point and the Section Labels. The Acceptance Tester provides the Contractor with OSGR co-ordinates of some, but not all, of the Section start points.

4.1.8 The Contractor:

- Defines survey routes appropriate for the surveys of these sites and delivers the planned route to the Acceptance Tester as required for Network surveys in accordance with the requirements of the SCANNER survey specification for survey routes.
- Carries out at least one survey of each route, or more if required by the Acceptance Tester. Wherever possible, the Contractor takes measurements in the left most traffic lane except where otherwise instructed by the Acceptance Tester.
- Uses an appropriate method to record the location of the Section start points marked as described in paragraph 4.1.4 and applies the rules defined in the SCANNER survey specification for survey routes (Volume 2, Section 4 for recording the location of the remaining Section start points (unless otherwise instructed by the Acceptance Tester).
- Processes the survey data to obtain the SCANNER RCD and SCANNER HMDIF, noting the requirements of the SCANNER survey specification (Volume 2 Section 6.1) concerning the delivery of the route information in the SCANNER HMDIF and SCANNER RCD.
- Following the completion of the survey, carries out any necessary route alignment using the MSP, or a facility provided by the Contractor, as defined in the SCANNER survey specification for survey routes (Volume 2, Section 6.2. This includes obtaining the elapsed chainage of those Section start points for which OSGR co-ordinates were provided by the Acceptance Tester.
- Delivers the SCANNER RCD and SCANNER HMDIF to the acceptance tester for analysis and comparison with the Reference Data.
- Delivers the coverage records as defined in the SCANNER survey specification (Volume 2 Section 6.3).

4.1.9 The Acceptance Tester evaluates the Network Level performance by comparing frequency distribution of the data from the whole of the test routes and by

comparing detailed data from a sample of individual Sections with the Reference Data.

4.1.10 The tolerances allowed for the comparison of the measurements provided by the Contractor and the Reference Data are given in Table 4.1.1.

4.1.11 The Network Test will be passed if all the following criteria are met: -

- The survey equipment is able to operate safely whilst causing minimum disruption to other road users, in the opinion of the Acceptance Tester
- Satisfactory procedures have been implemented by the Contractor for route planning and carrying out the survey, in the opinion of the acceptance tester
- The data provided by the Contractor meet the tolerances given in Table 4.1.1.
- The data provided by the Contractor comply with the requirements for coverage for each measured parameter given in the specification for SCANNER accredited surveys (Volume 2, Section 6.3).

Parameter Measured	**Tolerance (90% Limits)**	**Tolerance (Maximum Error)**
Section Lengths	±5m or ±0.1%[6]	±50m or ±10%[7]
National Grid Co-ordinates of Section Start Point[1]	±5m	±50m
National Grid Co-ordinates[2] where GPS > 70%	±7m	±50m
National Grid Co-ordinates[3] where GPS < 70%	±15m	±50m
Road Geometry – Gradient	±1.5 or ±10%[6]	±6
Road Geometry – Crossfall	±1.5 or ± 10%[6]	±6
Road Geometry[4] - Radius of Curvature	±50m or 25%[6]	2xReference Radius of Curvature or ±100m[6]
3m Moving Average Longitudinal Profile Variance[4]	±0.6	N/A
10m Moving Average Longitudinal Profile Variance[4]	±0.7	N/A
30m Moving Average Longitudinal Profile Variance[4]	±0.9	N/A
Rut Depth	±3.0mm	50% of True Rut Depth or 10mm[7]
SMTD	±0.25mm	±0.75mm
Cracking Intensity[5]	75%	N/A

Table 4.1.1.: Acceptable tolerances for network level evaluation

Notes for Table 4.1.1.:

(1) The Acceptance Tester calculates National Grid Co-ordinates of Section Start Point from the SCANNER RCD and compares them with the Reference co-ordinates. 90% of the positions obtained from the SCANNER RCD must fall within the required tolerance of the reference position. For those Section start points for which National Grid Co-ordinates were provided by the Acceptance Tester the reference position is the National Grid Co-ordinates provided by the Acceptance Tester. For the remaining Section start points the reference position is the National Grid Co-ordinates of the Section start point recorded in the Reference Survey.

(2) National Grid Co-ordinates where GPS availability > 70% over each 100m length.

(3) National Grid Co-ordinates where GPS availability < 70% over each 100m length.

(4) The tolerance for 3m, 10m and 30m Moving Average Longitudinal Profile are in terms of the fractional errors between the Moving Average Longitudinal Profile Variances calculated from the measured profile and the Moving Average Longitudinal Profile Variances calculated from the Reference Profile.

(5) The tolerance for the detection of Cracking Intensity is the minimum percentage of sub-sections that the survey data show to contain high or low levels of Cracking Intensity that are also shown to contain high or low levels of Cracking Intensity in the Reference Data. Cracking Intensity is assessed over selected test Sections using a similar method to that described for the Site Tests

(6) Whichever is greater.

(7) Whichever is smaller

5 Survey data acceptance testing

5.1 ***General Requirements***

5.1.1 Provided that the Survey Equipment successfully completes both the Site Tests and the Network Tests, the data output from the Survey Equipment is checked to ensure that it complies with all the requirements for loading into a UKPMS accredited system.

5.1.2 The Contractor provides a sample SCANNER HMDIF file (an HMDIF file) to the Auditor.

5.1.3 The Auditor tests the SCANNER HMDIF file to ensure that it complies with the requirements of the UKPMS specification in all respects.

5.1.4 The Auditor checks a sample of SCANNER HMDIF files to ensure that the format is consistent with the current version of the HMDIF specification as defined in the current version of UKPMS Technical Note 3 and the current version of the UKPMS Rules and Parameters.

5.1.5 The Auditor may ask any or all of the Organisations that supply UKPMS accredited Pavement Management Systems to check a sample of SCANNER HMDIF files to ensure that the files can be loaded into their Pavement Management Systems. The Auditor notifies the Contractor if the SCANNER HMDIF files cannot be loaded or if any differences are found between the format of the SCANNER HMDIF file and the current version of the HMDIF.

5.1.6 The Auditor advises the Contractor of the results of the tests and notifies the Contractor of any differences between the format of the SCANNER HMDIF file and the current version of the HMDIF specification.

6 Accreditation Re-testing

6.1 ***General Requirements***

6.1.1 At intervals of one year following the successful completion of the Acceptance Tests the Contractor submits the survey equipment for retesting to demonstrate that it still meets the SCANNER specification requirements under rigorously controlled test conditions.

6.1.2 Following the successful completion of an annual retest, the tester issues a SCANNER Accreditation Certificate for a further period of up to one year. This is calculated from the date of expiry of the previous Accreditation Certificate.

6.1.3 In the event of a failure to achieve the survey requirements set out in the quality assurance and audit regime, Survey Equipment may be required to undergo additional re-testing. The requirements for Quality Assurance and Audit for SCANNER accredited surveys are set out in Volume 4 of SCANNER surveys for Local Roads.

6.1.4 The Acceptance Tester supervises and controls the tests.

6.1.5 The Contractor attends the accreditation retests, and carries out any surveys or data processing required by the Acceptance Tester, at its own cost.

6.1.6 During the re-testing the Survey Equipment is driven and operated by drivers and operators named in the Contractor's quality system.

6.1.7 The re-testing assesses the accuracy of the survey equipment in the measurement of each survey parameter and is carried out on a site or sites selected by the Acceptance Tester.

6.1.8 The accreditation retesting follows the same general procedure as the Acceptance Tests described in Section 2. However, it is unlikely that tests of acceleration and deceleration described in Section 3.4.4 will be carried out during re-testing of the measurement of longitudinal profile unless the Acceptance Tester specifically requires these tests.

6.1.9 The tests will normally take same form as the Acceptance Tests, but reduced in extent and duration, including site tests, as described in Section 3, a short network test, as described in Section 4, on a route located conveniently near the site tests, and survey data acceptance tests as described in Section 5.

6.1.10 During the retesting the Contractor uses the same survey equipment and settings that are employed by for routine SCANNER accredited surveys.

6.1.11 The Contractor delivers the survey data obtained in the re-testing to the accreditation tester as SCANNER RCD and SCANNER HMDIF for all test sites used in the re-testing within 8 working days following the date when the surveys for the re-tests were carried out.

6.1.12 The AcceptanceTester assesses the SCANNER RCD and SCANNER HMDIF from the Contractor's re-testing surveys against the reference methods described in Section 3 for site tests, Section 4 for network tests and Section 5 for the survey data acceptance tests.

6.1.13 If the survey equipment fails to meet the requirements for accuracy in the re-test then any current Accreditation Certificate becomes invalid, any data collected by the Equipment since the last successful weekly check on a Reference Test Site (see requirements for Quality Assurance and Audit) are invalid and any results reported from that data are not acceptable as SCANNER accredited surveys.

6.1.14 If a Contractor makes any significant change to the Equipment after the issue of an Accreditation Certificate the Auditor may require the Equipment to be submitted for an additional Accreditation re-test.

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