DRAFT

Accreditation and Quality Assurance of Devices for measurement of texture of newly laid surfaces

# Version: 0.1

# April 2023

# [www.ukroadsliaisongroup.org/](http://www.ukroadsliaisongroup.org/)

**Contents Amendment Record**

This document has been issued and amended as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| Issue | Description | Date | Signed |
| 0.1 | First draft for stakeholder engagement | 12/04/2023 | SB/AW |
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Acknowledgements

This Accreditation and QA specification has been prepared by TRL, for National Highways, with further assistance and support of the industry. **Introduction to this Draft**

Currently, the performance requirements for texture of newly laid surfaces (series 900 of the MCHW) are specified in relation to the measurements provided using the Volumetric Patch Test (VPT). Due to the limitations of this method, in terms of its safety, practicality and coverage (e.g., the number/density of measurements provided to characterise the texture of newly laid surfaces), research has been carried out to identify an alternative approach to testing texture.

This research has recommended that:

* VPT is replaced by a non-contact measurement system that is able to measure the texture (Texture Profile) of the newly laid surface.
* Multiple lines are measured across the transverse width of newly laid surface is measured in each carriageway lane. This will further improve the robustness of the performance assessment of new surfaces.
* The measured texture is used to obtain a parameter that provides broad continuity with the current VPT method, whilst providing a link between the assessment of new surfaces and assessments carried out during the in-service lifetime of the pavement. This is achieved using the parameter Mean Profile Depth (MPD).
* The delivery of texture measurements from newly laid sites becomes a digital process, with data being delivered to National Highways in a format such that it can be loaded directly into their management databases. This will provide the ability to track the performance of the texture throughout the lifetime of the pavement using a common approach.
* The tools and contractors that undertake the measurements are subject to tests and checks to ensure that there is a high level of quality in the measured data. This will reflect similar quality standards applied to the measurements undertaken during the in-service lifetime of the pavement.
* And that this requirement be built into a revised version of the MCHW.

The draft specification presented in this document presents the requirements for measurement of texture of newly laid surfaces using non-contact methods, which has been developed in the light of the above recommendations.

This draft specification is being published to provide information on the anticipated requirements for the:

* Collection of measurements using non-contact methods
* Processing of these measurements into the required parameters
* Fitting and delivering the data to customers (e.g. National Highways)

This draft specification is being provided alongside a stakeholder engagement programmed being led by National Highways in the summer of 2023 to enable feedback on the approach and how it might best be implemented. Asphalt and measurement industry stakeholder participants in this programme will have opportunity to obtain a better understanding of the implications of the new approach, both for the delivery of new surfaces that meet the performance requirements, and for the measurement of the performance of these new surfaces.

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Definitions of terms used in this document

Note that in this Draft version some criteria are highlighted yellow, where work is ongoing to determine firm values for these criteria.

This document uses the following terms:

**Accreditation Certificate;** documentary evidence of the performance achieved during Accreditation/Re-accreditation. It also sets out the limitations and validity period of the accreditation and the version number of the specification against which the assessment was made. It shall be retained by the Owner and produced upon request.

**Accreditation Period;** normally 24 months from the date of attending an Accreditation/Re-accreditation Assessment.

**Accredited Surveys;** surveys undertaken using Equipment which is adhering to the required QA and has a valid Accreditation Certificate.

**Accreditation Assessment;** an event where accreditation tests are performed to demonstrate that the Equipment can meet the requirements under controlled test conditions.

**Auditor;** any organisation overseeing the Accreditation and QA programmes outlined in this specification. Specific requirements imposed on the Auditor are given in Appendix A. The Auditor is determined by the Network Authority.

**Bias;** bias is a measure of the average offset between the Survey Data and the Reference Data. It is calculated by calculating the differences between the Survey Data and the Reference Data and taking the average of these values.

**Base Condition Data (BCD);** the data file provided by MSP, which contains parameters such as eLPV and information to enable them to be fitted to the network.

**Calibration;** laboratory (or baseline) calibration of a System (or one of its Components) of the Equipment.

**Closed Test Site;** refers to a test site which can be closed to traffic to ensure testing can be completed in a controlled environment and/or for the collection of detailed Reference Data.

**Component;** refers to a part of one of the Systems fitted to the Equipment.

**Contractor;** the organisation carrying out the Accredited Survey. The Contractor may be a third party organisation commissioned to carry out the surveys, but could also be the body undertaking the surfacing works.

**Derived Values;** Parameters derived from the Raw Condition Data (e.g. by the Machine Survey Pre-processor). Includes enhanced Longitudinal Profile Variance.

**Developer;** the manufacturer of an existing Equipment or System, or the organisation or individual who is introducing a new model or variant of Equipment or System. The Developer could also be the Contractor.

**Employer;** the organisation that commissions the Contractor to provide Survey Data.

**Equipment;** the overall machine carrying out the survey to collect the Survey Data, incorporating the Systems and, where applicable, the survey vehicle.

**Equivalent Measurement System;** Equipment that is comparable with existing Accredited Equipment from the same Developer, to an extent that enables it to seek initial Accreditation via the Re-Accreditation process rather than full Accreditation.

**GNSS;** Global Navigation Satellite System e.g. GPS

**HARRIS**; Highways Assessment Road Research Information System – Equipment used for the purposes of reference measurements, Accreditation and Quality Assurance

**Improvement Notice;** a notice issued if the Auditor finds the Equipment is not meeting the requirements of the Accreditation or Quality Assurance processes. The notice shall detail the timescale within which the improvement is required and any restrictions to the use of the equipment prior to satisfactory completion of the improvement.

**Live Test Site;** a test site which is open to live traffic.

**Location Referencing;** the techniques and conventions that are used to locate items on the road Network.

**Location Referencing/Reference Point (LRP);** A known physical or abstract point somewhere on a section having an accurate locational reference.

**Mean Profile Depth (MPD);** A measure of Macro Texture, defined in BS EN ISO 13473‑1:2019 Characterization of pavement texture by use of surface profiles – Part 1: Determination of Mean Profile Depth”.

**MSP;** Machine Survey Pre-processor. Software provided by the Network Authority for the processing of Surface Profile RCD into Base Condition Data for loading into P-AMS. The MSP will fit the Survey to the Route and calculate average MPD values.

**Network;** roads in a given area or of a given classification for which the Network Authority has responsibility.

**Network Authority;** the organisation ultimately responsible for maintenance of any given road network. Unless stated otherwise in this document the Network Authority is National Highways.

**Newly Laid Surface(s);** for the purposes of accreditation a Newly Laid Surface is defined as one that is on a site that has been open to traffic for <=5 days (inclusive). Although the MCHW allows measurements to be undertaken between 3 and 28 of completion of the surfacing, the limited time range specified for accreditation tests ensures that the Equipment demonstrates its ability to carry out measurements over the full range of conditions allowed by the MCHW (as surveys closer to the date of laying are considered to present the most demanding measurement conditions).

**Owner;** the organisation or individual to whom the Equipment belongs and to whom Accreditation Certificates are awarded. The Owner could also be the Contractor.

**P-AMS;** Pavement Asset Management System operated by the National Highways for the management and assessment of the network.

**Parameter;** specific data fields that form part of the Survey Data supplied by the Contractor to the Employer (and may be calculated by the Contractor or by MSP, for example average MPD).

**Primary Check Site;** a site established by the Contractor to check the medium term consistency of the Survey Data.

**Quality Assurance (QA);** a process to give the Employer confidence that the data and results being provided are reliably consistent and suitable for purpose.

**Reference Data;** data against which the Equipment shall be compared for the purposes of Accreditation or Quality Assurance.

**Reference Device;** device that is used to collect Reference Data. The Reference Device (e.g. HARRIS) is typically operated by the Auditor.

**Reference Profile**: Reference Values for use in the Accreditation and Quality Assurance procedures.

**Re-accreditation Assessment;** an event where performance tests are carried out on Equipment which has previously met the mandatory requirements of an Accreditation Assessment.

**Repeatability;** assessment of the consistency of the Equipment/System with previous measurements obtained with the same Equipment/System.

**Reproducibility;** assessment of the consistency of the Equipment or System with the Reference Data.

**Route File;** An ASCII formatted file that contains the definition of a Survey Route (including the sections contained within the survey).

**Routine maintenance;** any maintenance or work done on the Equipment which may affect, or there is a risk that it may affect, the measurement performance (for example accuracy, reliability, consistency) of the Equipment.

**Section**: A length of the network defined in accordance with section referencing rules, each having fixed start and end positions and road alignment.

**Section Label;** An alphanumeric label that, together with a date, uniquely identifies a Section.

**Sub-section;** A fragment of a Section having a pre-determined length. Typical sub-section lengths are 10m.

**Surface Profile Raw Condition Data (RCD);** The data file format for the delivery of the Survey Data;

**Survey Data;** data collected by the Contractor using the Equipment and supplied to the Employer as Surface Profile RCD,

**Survey Lane;** A Lane, within the limits of a Section along which part of a Survey is to take place. A Survey Lane is identified by a Section Label, Lane Direction Indicator, Lane Name, start Chainage and end Chainage.

**Survey Route**; An ordered list of Survey Lanes, each with a Start Reference Label. A Survey Route also shall have an End Reference Label.

**System;** individual measurement system installed on the Equipment e.g. distance measurement system, profile measurement system.

**Texture Profile;** The variation of level along the length of a carriageway excluding wavelengths less than 5mm or greater than 500mm. Used to calculate MPD.

**Trafficked Surfaces;** surfaces on sites that have been open to traffic for a minimum of one month.

**Valid**; a measured data value or Derived Value that would not meet the requirements for accuracy (Repeatability or Reproducibility)

1. Introduction
	1. Introduction
		1. The Accreditation and Quality Assurance requirements for devices for the measurement of texture of Newly Laid Surfaces are defined within this document.
		2. The central principles of the Accreditation and Quality Assurance process are:
* To undertake tests of the Equipment leading to the award of an Accreditation Certificate showing suitable performance levels prior to undertaking Accredited Surveys.
* To undertake Re-accreditation at appropriate intervals.
* To apply an on-going Quality Assurance programme for all Accredited Surveys.
* To confirm that the Accreditation and Quality Assurance programme is implemented.
* To define the role of the Auditor.
	1. Summary
		+ 1. The overall Accreditation and QA process is shown in Figure 1.
		1. **Pre-approval of Equipment**
			1. Prior to undertaking an Accreditation/Re-accreditation Assessment, it may be necessary to undertake an assessment of the Equipment to check its suitability for undertaking Accredited surveys. The need for this shall be determined by the Auditor.
		2. **Accreditation/Re-accreditation testing**
			1. Any Equipment seeking to undertake Accredited Surveys shall take part in, and provide satisfactory performance in, an Accreditation/Re-accreditation Assessment. Following completion of the Assessment the Auditor shall issue an Accreditation Certificate. The Certificate shall detail the level of performance achieved by the Equipment during the assessment and specify the Accreditation Period.
			2. If the Equipment has met the mandatory requirements, but has poor performance in non-mandatory aspects, then the Auditor may issue an Improvement Notice in addition to the Accreditation Certificate. If the required improvement is not demonstrated to the Auditor in the time specified in the Improvement Notice, then the Auditor may revoke the Accredited status of the Equipment.
			3. Owners/Contractors wishing to continue to undertake Accredited Surveys shall attend a Re-accreditation Assessment prior to the end of the Accreditation period.
		3. **Accredited Surveys and QA**
		4. Owners/Contractors undertake Surveys according to the requirements of the Employer and deliver Survey Data as specified in the document.
			1. Owners/Contractors and the Auditor apply a QA process to Surveys and Survey Data. If the QA or other process identifies an issue that may affect the Equipment or the Survey Data the Auditor may issue an Improvement Notice to the Contractor. If a suitable improvement is not demonstrated to the Auditor in the given time frame then the Accreditation status may be revoked.
	2. Structure of this document
		1. This document is split into the following sections:
* The roles and responsibilities of the involved parties are given in Section B
* The specification for the Equipment and Survey Data is provided in Section C.
* Accreditation Assessments are described in Section D.
* Re-accreditation Assessments are described in Section E.
* The Contractor’s Quality Assurance is described in Section F.
* The Auditor’s Quality Assurance checks are described in F.1.
* Details on Improvement Notices are given in Section H.

Accreditation / Re-accreditation testing

Accreditation certificate

Not meeting specification

Pre-approval of new Equipment

Met mandatory criteria?

Y

N

Improvement shown?

Y

N

Acceptable performance?

Y

N

Accredited surveys

QA programme

Surveys of newly laid surfaces

Improvement action

Issue identified

Figure Outline of the Accreditation and Quality Assurance process

1. Roles of the relevant parties
	1. The Network Authority
		1. The Network Authority shall nominate Auditor(s).
* The Network Authority shall ensure that the Auditor(s) hold the required skills to undertake these checks and understand the results (see Appendix A).
* The Network Authority may conduct some or all of the Auditor’s role internally.
	1. Employer
		1. The Employer shall Require:
* That the Contractor has achieved Accreditation for their Equipment. Employers should request the Contractor to provide a copy of an Accreditation Certificate (or Certificates) that is valid throughout the period over which surveys are to be carried out on the Employer’s Network.
* The Contractor to undertake QA checks. These QA checks shall be as specified in this document unless replaced by alternative or additional checks defined by the Employer.
	1. Owner
		1. Owners shall ensure that their Equipment is compliant with the requirements for Equipment and Survey Data given in Section C.
		2. Owners shall obtain Accreditation via an Accreditation/Re-accreditation Assessment prior to undertaking Accredited Surveys, according to Section D and Section E.
		3. Owners shall renew the Accreditation status of their Equipment by the end of the Accreditation Period if they wish to continue to undertake Accredited Surveys.
		4. The Owner should have their own ISO 9001 process and continue to undertake checks to support this. However, the Owner shall also ensure that they adhere to all QA requirements specified in this document or otherwise specified by the Employer.
		5. Where Equipment is hired by the Owner to a Contractor, the Owner should ensure that the Contractor takes responsibility for conducting the required QA during the period of hire.
		6. The Owner shall report promptly to the Auditor any Routine Maintenance or alterations carried out on the Equipment that could affect the measurement of Survey Data.
	2. Contractor
		1. A Contractor hiring/owing Equipment shall establish the Accreditation status of the Equipment and the QA requirements of the Employer.
		2. The Contractor shall ensure that the required QA is undertaken.
		3. The Contractor shall ensure that the Equipment shall only be operated by competent drivers and operatives (as appropriate). The Contractor is responsible for the training and instruction of all drivers and operatives and for ensuring that they comply with the requirements for surveys.
	3. Auditor
		1. The Auditor will carry out Accreditation and Re-accreditation Assessments and carry out QA checks. These roles may be carried out by the same or by separate bodies. In the main body of this document the role is simply referred to as “the Auditor”. Specific requirements for the bodies undertaking one or both of these roles are given in Appendix A.
		2. If the Auditor identifies an issue with the Equipment, QA or survey process which could affect the quality of the Survey Data the Auditor may issue an Improvement Notice. Copies of these improvement notices may also be supplied to the Employer.
1. Equipment and Survey Data
	1. The Equipment
		1. The Equipment comprises
* A distance measurement System and a spatial referencing System (usually based on a GNSS method or equivalent) for the measurement of location and speed.
* A contactless measurement System for the measurement of Texture Profile.
* Processing tools/software for the delivery of the Survey Data in the required formats.
	1. Survey Data
		1. **Location and Speed**
			1. Location and speed data shall be reported at points separated by 10m of longitudinal distance travelled as:
* The OSGB36 National Grid Co-ordinates of the position of the measurements (at the end of each 10m length).
* The average operating speed of the measurement system over the 10m length.
	+ 1. The measurement of location (distance and National Grid Co-ordinates) should be unaffected by the operating speed (within the accredited operating range of the Measurement System, see below) or by the road geometry and shall be consistent and stable throughout any period of data collection, being unaffected by changes in the measurement system (for example resulting from “warming up” of tyres)
		2. All National Grid Co-ordinates shall be reported at the location at which the Texture Profile measurements were collected. Hence any offset or difference in position between the location of the Texture Profile sensors and the location measurement sensors (e.g. location of the GNSS receiver) will be removed before delivery of the location data. Where the Measurement System includes multiple Texture Profile sensors mounted transversally the location data shall be reported at the central position of the Texture Profile sensors.
			1. Equipment that travels at greater than walking speed shall be fitted with a System to automatically identify location reference points physically marking the changes of sections (e.g. using automatic detection of retro reflective markers); these allow for more accurate calibration of the distance measurement System of the Equipment and will be a requirement for accreditation testing.
		3. **Texture profile**
			1. The Equipment shall measure Texture Profile in at least four longitudinal measurement lines (parallel with the edge of the road). Two of these measurements should fall within the locations of the wheelpaths for the lane being surveyed.
* The preferred wheelpath measurement area lies between 0.9m and 1.05m from the centreline of the vehicle.
	+ 1. The Texture Profile sensor(s) used shall be in accordance with BS EN ISO 13473-1:2019.
		2. **MPD**
			1. The Texture Profile will be processed to provide MPD values in the Surface Profile RCD (see Appendix A). The performance in the Accreditation tests is assessed in terms of the measurement of both Texture Profile and MPD.
			2. Note that when measuring Texture Profile a run-in/run-out is required so that the MPD values can be provided for the entire Survey length of interest, which must include any transition to/from the existing surface to the newly laid surface (where present). It is recommended that 100m of Texture Profile measurements are provided for this run-in/run-out.
	1. Data Format
		1. The Survey Data will be provided as a single data file for each survey, in the current version of the Surface Profile Raw Condition Data (RCD) format.
		2. Surface Profile RCD files should span a length that encompasses the whole of the site under test. This should include, unless impractical, a length of “run in” and “run out” of at least 100m.
		3. Surface Profile RCD Files should be named such that they can be referred to the site, contractor and survey date e.g. “M4\_Acme\_20190604.rcd”
		4. A specification for the current format of the Surface Profile RCD file can be obtained from the Network Authority.
			1. Texture profile shall be provided in the Surface Profile RCD at the spacing of the acquisition (e.g., 1mm). This is required for the purposes of accreditation only.
* For Systems that record texture longitudinally this would constitute a set of texture profile heights in each measurement line, spaced longitudinally at, e.g., 1mm intervals.
* For Systems that record texture transversely this would constitute a set of 100mm (minimum) wide transverse texture profiles (each transverse texture profile having a 1mm transverse spacing) provided at regular longitudinal intervals, no greater than 100mm, in each measurement line.
	+ - 1. MPD values will be provided in the Surface Profile RCD file at the MPD calculation interval (i.e., 100mm), along with the MPD validity flags.
			2. Any value (e.g. Texture Profile point or MPD value) that is not considered Valid by the Contractor (e.g. because of adverse surface condition) should be reported as invalid using the mechanism provided by the Surface Profile RCD file format.
	1. Survey routes, fitting and data delivery
		1. A Survey Route file should be provided alongside each Surface Profile Raw Condition Data (RCD), file to facilitate fitting of the survey to the network.
		2. A specification for the current Survey Route File format can be obtained from by the Network Authority.
		3. As required by the Employer, the Contractor will either:
* Create the Surface Profile Raw Condition Data (RCD) file and Survey Route file. Use the MSP software to process the Surface Profile Raw Condition Data (RCD) and Survey Route file to obtain the fitted Base Condition Data (BCD) file, which will be delivered to the Employer,

or

* *In addition to the above*, load the BCD file into the Employer’s database.
	+ 1. The MSP software can be obtained from the Network Authority.
		2. Note that the above (delivery of Surface Profile Raw Condition Data (RCD) files, delivery of Survey Route files, use of MSP and loading into the database) will each be tested during Accreditation, such that Contractors will need to demonstrate their capability in each component to achieve Accreditation for that component (and this will be stated on the Accreditation certificate).
1. Accreditation
	1. Introduction
		1. Any Equipment shall require Accreditation if Equipment of this specific design has not previously been Accredited to this specification and it is not identified as an Equivalent Measurement System.
		2. The Accreditation process checks
* That the Equipment delivers Survey Data which meets the performance, requirements.
* That the Equipment is capable of measuring and reporting this Survey Data consistently under both controlled and network conditions on trafficked and newly surfaced pavements.
* That the Contractor’s approach to operating the Equipment produces consistent and reliable Survey Data.
* That the Contractor is able to fit the Survey Data to the network and provide the Survey Data in the correct formats.
	+ 1. **Pre-approval and preparation**
			1. Pre-approval is required prior to Accreditation. The Contractor shall provide details of their Equipment to the Auditor so that the Auditor can confirm it is eligible for assessment based on the specification given in B.1. This information shall include:
* The make and model of all sensors used (profile laser, location, distance, data acquisition), how many profile sensors are present (i.e. how many measurement positions, and their location). If required, the Auditor will adapt the tests to be appropriate for the measurement system presented.
* The operational procedures that the Contractor will implement when using the Equipment. For example, operational speeds, system installation, warm-up procedures, calibration, training of staff, procedures to process data etc.
* Any limitations on the road surface types for which the Equipment is to be Accredited (the Equipment should meet the criteria on all surface types for which it is to be Accredited).
* Note: If seeking accreditation as an Equivalent Measurement System this description will support any decision by the Auditor on whether the Equipment is suitable for consideration as an Equivalent Measurement System.
	+ 1. The Contractor should provide any other information that may be required for the auditor to prepare the tests. This may include any requirements for the test conditions. For example, contactless profile measurements made on damp/wet surfaces can be subject to undesirable deviations from the required accuracy. Therefore, it is assumed that Accreditation shall be tested, and awarded, for dry pavements only. Contractors requiring Accreditation on damp pavements should request the Auditor to include such tests. If assessment of surveying of wet/damp conditions is undertaken for Accreditation, then Re-accreditation assessments may also incorporate reassessment of this capability.
		2. **Equivalent Measurement systems**
			1. Equipment shall be considered as an Equivalent Measurement System if there is another Accredited Equipment which (meets all of):
* Is made by the same Manufacturer
* Is made to the same design
	+ - 1. Equipment shall only be considered as an Equivalent Measurement System if both the Network Authority and the Auditor agree that it should be.
			2. Equipment considered to be an Equivalent Measurement System will be tested according to Re-accreditation Assessment requirements described in Section E .
			3. Following any updates to this specification, at least one Equipment from the set of Equivalent Measurement Systems may need to undertake an Accreditation Assessment.
		1. **Stages of Accreditation**
			1. Accreditation will be carried out in two stages. The first stage will assess the capability in the measurement of Texture Profile on Trafficked Surfaces. If this is deemed acceptable the Equipment will be tested on Newly Laid Surfaces. Both stages shall be passed to achieve Accreditation for the assessment of Newly Laid Surfaces.
		2. For all stages of the Accreditation tests there is a requirement for the Contractor to undertake repeat surveys with the Equipment over different test sites. For every survey run delivered to the Auditor the Contractor should provide:
* The Surface Profile RCD
* The Route File
* The BCD file provided by MSP
	+ 1. For the closed test sites the Auditor will provide network information to enable the Contractor to produce route files. For sites located on the network of the Network Authority there may be a requirement for the Contractor to access the network definition of the Network Authority. This will be established during the pre-approval and preparation phase.
		2. **Completion of Accreditation**
			1. Following completion of an Accreditation Assessment the Auditor shall issue an Accreditation Certificate, which shall show:
* The performance achieved by the Equipment.
* The Accreditation Period.
* The range of conditions for which the Equipment is Accredited (e.g. if it can test in wet/damp conditions).
* The version of this specification the Equipment was assessed against. Accreditation or Re-Accreditation may be required in the event of this specification being updated. In these situations, an Improvement Notice shall be issued (see Section H).
	+ - 1. In addition to testing the Equipment, the Auditor may assess and provide feedback on the competence of drivers and operatives as part of the Accreditation.
			2. If the Equipment has met the mandatory criteria of the Accreditation Assessment, but the Auditor notes that the performance of the Equipment or the Contractor is not suitable in other aspects, then the Auditor may issue an Improvement Notice as detailed in Section H.
	1. Accreditation Stage 1 – Trafficked Surfaces
		1. Stage 1 testing will confirm the performance of the Equipment on trafficked surfaces. One or more Closed and/or Live test sites shall be selected by the Auditor. Details of the sites and Reference Data are given in Appendix B.
		2. **Mandatory Requirements – Location Referencing**
			1. Note that that there are three methods for recording the location of selected physical positions (Location Reference Points) in the survey data, which may be required for the assessment of location referencing:
* “Push button” entry relies on the survey operator pushing a button to enter the location of each Location Reference Point manually.
* “Automatic marker” uses a system which automatically detects markers placed at each Location Reference Point. These will take the form of retroreflective posts placed at the roadside.
* “OSGR fitted markers” utilises the coordinate data to identify the elapsed chainage of each Location Reference Point within the survey data.
	+ - 1. Automatic markers shall be used for the assessment of location referencing on some test sites. OSGR fitted markers shall be used for the assessment of location referencing on sites where no retroreflective markers are in place.
			2. **Distance**
			3. The Accreditation of distance measurement shall be carried out using at least 6 test sections, surveyed over a range of speeds (as appropriate to the Equipment design and agreed with the Auditor prior to the tests).
			4. The accreditation criteria are given in Table 1.

Table – Criteria for measurement of distance travelled

|  |  |
| --- | --- |
| **Parameter** | **Acceptability Limit** |
| Distance measured between LRPa - automatic markers | ≥95% within 1m or 0.1% of the length (whichever greater) |
| Distance measured between LRPa – OSGR or push button fitted | ≥95% within 3m or 0.2% of the length (whichever greater) |

Notes:

1. These will be obtained using the Surface Profile RCD or BCD (as appropriate) and compared with the Reference
	* + 1. **OSGR Coordinates**

The Accreditation of OSGR Coordinates shall be carried out using at least 6 test sections, surveyed over a range of speeds (as appropriate to the Equipment design and agreed with the Auditor prior to the tests). The criteria are given in Table 2.

Table – Criteria for measurement of OSGR coordinates

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | **Average within** | **90% within** | **95% within** | **All within** |
| OSGR - site with automatic markers | 1.5m | 2m | 4m | 10m |
| OSGR – other sites | n/a | n/a | 4m | 10m |

* + 1. **Mandatory requirements – Texture Profile**
			1. **Texture Profile of artificial profiles on Closed Sites**
			2. A set of artificial profiles will be laid on a Closed Site. A range of measurement speeds shall be identified (as appropriate to the Equipment design and agreed with the Auditor prior to the tests) and at least 3 surveys shall be carried out at each speed. Depending on the size of the plates and the positions of the measurement lines, this may require repeat runs at different offsets relative to the plates.
			3. The accuracy of the Texture Profiles shall be assessed for each measurement position independently, according to Table 3.

Table – Criteria for artificial profiles assessment

|  |  |
| --- | --- |
| **Parameter** | **Acceptability Limit** |
| Measured heights of steps in the artificial profile | ≥95% within ±0.5mm  |
| Measured lengths of features in the artificial profiles (e.g. square wave wavelength) | ≥95% within ±5.0mm |

* + 1. **Mandatory requirements – MPD**
			1. The Auditor will select a number of test lengths located on Closed and Live sites. At least three survey runs will be carried out on each site using the Equipment at a range of speeds (as appropriate to the Equipment design and agreed with the Auditor prior to the tests).
			2. **Calculation of MPD**
			3. To check the Contractor’s calculation of MPD (as delivered in the Surface Profile RCD) the Auditor shall select a test run and calculate the MPD values from the Texture Profile provided in the Surface Profile RCD and compare these to the MPD values provided by the Contractor in the Surface Profile RCD. The values reported from both approaches shall be the same for each MPD value in the selected run.
			4. **MPD of pavement surface - Live and Closed Sites**
			5. The performance in the measurement of MPD shall be assessed in terms of the Reproducibility and Repeatability of the measurement of MPD over 10m reporting intervals in each measurement line, according to the requirements of Table 4.
* Each measurement line will be assessed independently.
* The spike and dropout values (provided in the Surface Profile RCD with each individual MPD value) will be used when determining the average value of MPD over each 10m length in each measurement line. Any individual MPD value having greater than 10% dropouts or spikes will be considered an invalid MPD value and not used in the calculation of the 10m average in that measurement line.
* If greater than 50% of the individual values of MPD in a 10m length are invalid the 10m average value in that measurement line will also be considered invalid.
* Valid 10m MPD values shall obtained over at least 80% of each 100m subsection length in each measurement line (subsection lengths at the end of each section/site that are less than 100m long will be assessed with the previous 100m subsection length). In the event this is not achieved for a subsection, the data from a separate survey run shall be assessed. Where there is strong/ongoing evidence of the Equipment being unable to provide valid datasets on sites (where valid datasets can be obtained by the Reference device), the Equipment may be deemed unable to undertake the assessment and to have failed the criteria.

Table – Criteria for MPD on trafficked sites

|  |  |  |
| --- | --- | --- |
|  | **Reproducibility** | **Repeatability** |
| 65% of differences within | 95% of differences within | Bias | 65% of differences within | 95% of differences within | Bias |
| MPD *in each measurement line* (valid 10m data) | ±0.1mm | ±0.2mm | ≤ ±0.05mm | ±0.1mm | ±0.2mm | ≤ ±0.05mm |

* + - 1. In addition to the above, the MPD data shall be unaffected by speed such that for MPD values calculated from repeat survey runs, carried out at different, nominally constant speeds over the site:
* The correlation coefficient between average MPD over the entire site and average vehicle speed shall be less than 0.9.
* The slope of the best fit line through the average MPD and vehicle speed data points shall not exceed 0.003mm/kmh-1.
* If it cannot be shown that the MPD measurements are unaffected by survey speed over a range then a single speed shall be used for the Assessment (and become an operational requirement for that Equipment).
	+ - 1. The Accreditation Certificate shall record the speed range (or single speed) for which the criteria above are met (including the check on correlation of MPD with speed). If the criteria are not met for any speed then the Equipment shall be identified as not suitable.
	1. Accreditation Stage 2 – Newly Laid Surfaces
		1. If the requirements of trafficked surfaces tests are met the Equipment will be deemed capable of providing measurements of texture on trafficked surfaces. The Equipment can then proceed to Stage 2, which will assess the performance in the measurement of texture on Newly Laid Surfaces
		2. The Auditor shall identify suitable site(s) for the assessment, communicate the location and range of valid survey dates to the contractor and arrange for surveys with a Reference Device. Details of the Newly Laid Surface test sites and Reference Data are given in Appendix B.
		3. A minimum of three runs of each of the Newly Laid Surface sites shall be carried out using the Equipment within the time frame given.
		4. **Mandatory Requirements – Location referencing**
		5. The location referencing requirements on the Newly Laid Surface test sites are the same as those defined in D2.2 above. The method of recording location reference points shall be OSGR fitting.
		6. **Mandatory Requirements – MPD**
			1. Whilst the tests carried out in Stage 1 will test each measurement line individually, the performance of the measurement of MPD on Newly Laid surfaces shall be assessed in terms of the Reproducibility and Repeatability of the measurement of MPD over 100m, after combination of all measurement lines:
* 10m average MPD values will be obtained in each measurement line. The spike and dropout values (provided in the Surface Profile RCD with each individual MPD value) will be used when determining the 10m average value of MPD in each measurement line. Any individual MPD value having greater than 10% dropouts or spikes will be considered an invalid MPD value and not used in the calculation of the 10m average in that measurement line.
* If greater than 50% of the individual values of MPD in a 10m length are invalid the 10m average value in that measurement line will also be considered invalid.
* The standard deviation of all the valid 10m MPD values reported from all measurement lines will be calculated over each 10m length. 10m lengths with standard deviation values greater than 0.2mm will be regarded as invalid. No MPD values from that 10m length (in any measurement line) will be used in the calculation of the 100m average.
* A 100m average value will be calculated from all valid 10m average MPD values.
* The 100m average value will be considered invalid if greater that 50% of the 10m averages within it were regarded as invalid.
	+ - 1. The performance criteria for measurements of Newly Laid Surface test sites are provided in Table 5.

Table – Criteria for Newly Laid Surfaces assessment

|  |  |  |
| --- | --- | --- |
|  | **Reproducibilitya** | **Repeatabilityb** |
| 65% of differences within | 95% of differences within | Bias | 65% of differences within | 95% of differences within | Bias |
| 100m average MPD (obtained over all measurement lines)  | ±0.05mm | ±0.1mm | ≤ ±0.05mm | ±0.05mm | ±0.1mm | ≤ ±0.05mm |

Notes:

1. For the reproducibility assessment the average of the valid 100m data collected by the Reference Device (processed in the same way as above) shall form the Reference Data
2. For the repeatability assessment the valid 100m data from first run by the Equipment shall form the Reference Data.
	* + 1. To provide a valid dataset for the assessment at least 80% of the total length of the identified sites shall have valid 100m averages. In the event this is not achieved, the data will be disregarded and another full dataset shall be obtained. If the Equipment does not meet the requirements in the subsequent tests then it is deemed to be unable to provide a valid dataset.
			2. If both the Equipment and the Reference Device fail to provide a valid dataset, some or all of the identified sites shall be excluded from the analysis and further site(s) identified and tested if required to achieve the minimum length requirements given above.
			3. If the Reference Device provides a valid dataset and the Equipment fails to provide a valid dataset then the Equipment is deemed to be unable to undertake the assessment and have failed the criteria.
3. Re-accreditation
	1. Re-accreditation Tests
		1. Once the Equipment has been accredited it shall require Re-accreditation on expiry of the Accreditation Period. This can be obtained by successfully completing a Re-accreditation Assessment.
		2. Re-accreditation will be undertaken using a sub-set of the tests applied for Accreditation, with the same performance criteria.
* Equipment will be assessed on at least one Closed Test Site, and Equipment that will operate at traffic speed will also be assessed on at least one Live Site.
* Re-accreditation of Equipment (including Equipment that has met the requirements for Newly Laid Surfaces) will normally only include tests on trafficked sites. The Auditor may require tests to be carried out on Newly Laid Surfaces where there is evidence to support this (e.g., if there have been Improvement Action Notices, or if there have been significant changes to the Equipment or the specification).
* If the Accreditation assessment identified that the Equipment can measure in wet/damp conditions then the Re-accreditation may include tests to confirm this continues to be the case.
	+ 1. Following completion of a Re-accreditation Assessment the Auditor shall issue Accreditation Certificates showing the performance achieved by the Equipment and the Accreditation Period.
		2. If the Equipment has met the mandatory criteria of the Re-accreditation Trial, but the performance of the Equipment is not suitable in other aspects then the Auditor shall also issue an Improvement Notice as detailed in Section H.
1. Contractor’s Quality Assurance
	1. Introduction
		1. An on-going Quality Assurance regime shall be applied to ensure that the data provided by the Equipment remains valid throughout the Accreditation Period. In addition to the specific processes described below, the Contractor’s documented Quality Assurance regime shall cover all aspects of the surveys including, but not limited to:
* Equipment operation and maintenance, including inspection of the Equipment to check for defects and that the Equipment and all of its Systems are operating correctly
* Calibration and servicing of the Equipment.
* Driver and operator training and instruction – the Equipment shall only be driven and operated by competent personnel
* Survey operation and record keeping
* Data recording, processing, and analysis
* Fitting and delivery of Survey Data

Undertaking Primary Checks, as described in F.2.

* 1. Contractor’s Primary Check
		1. **General**
			1. The Contractor’s Primary Check provides long term monitoring of the Equipment and checks the performance of the Equipment since the last Accreditation/Re-accreditation Assessment. The Check can also incorporate calibration of the location referencing (distance) System, when required.
			2. Contractor’s Primary Checks shall be carried out at least every 28 days for any period in which the Equipment is in use.
		2. **Check Site**
		3. The Contractor shall establish at least one test site as a Contractor’s Primary Check site. The site provides a reference site for monitoring the performance of the Equipment since the last successful Accreditation or Re-accreditation of the Equipment.
		4. Typically, the site would be close to the Contractor’s base where measurements can be taken safely and without unreasonable disruption to other users of the site. The site shall contain:
* A length of at least 400m of straight and level pavement for the assessment and calibration of distance measurements.
* Ideally, a range of texture (i.e., to provide a range of MPDs)
	+ 1. To accommodate testing carried out across the network (which may make it impractical to return to the Contractor’s base to carry out a Contractor’s Primary Check), it may be necessary to have more than one Contractor’s Primary Check site. Furthermore, if the condition of a Check site is affected by maintenance or other external factors the Contractor may need to re-establish the Reference Data, or establish another site. Having a second Contractor’s Primary Check site would reduce the risks presented as a result of changes to a single site.
		2. The site(s) chosen by the Contractor should be reported to the Auditor. The sites may be subject to monitoring by the Auditor.
		3. **Check Site Reference Data**
		4. Reference data should be obtained by carrying out a survey on the site within 14 days of successfully carrying out an Accreditation/Re-accreditation Assessment, or successfully carrying out a Contractor’s Primary Check on an existing site. More than one survey should be undertaken when collecting the Reference Data as a measure of consistency and repeatability.
		5. The Survey Data should be processed (using MSP or equivalent) to provide Location Reference (OSGR co-ordinates) and MPD values for each 10m length of the site.
		6. On at least one Primary Check Site locational reference (Distance) data should be obtained by measuring and marking a selected length of the site to an accuracy of ±0.5m, using steel tape or other reliable device (to support calibration of the distance measurement system). The marking deployed should be such that the locations of the start and end points of the length can be identified when carrying out a survey of the site. The Contractor should consult the highway authority responsible for the test site location and obtain its agreement before making any marking on or modification of the site.
		7. **Test process – Distance measurement**
			1. A check of the distance measurement System shall be carried out by measuring the site length with the Equipment and comparing the results to the Reference Data. The distance measurement System shall meet the requirements given in Table 6. If the measurements are not within these requirements then the Equipment shall be re-calibrated and the Check repeated.
		8. **Test process – Texture and OSGR**
			1. The Contractor shall compare the Survey Data with the Reference Data. The performance shall meet the requirements stated in Table 6.

Table – Performance requirements for the Primary Check

| Parameter | Measure | Reporting Interval | Tolerance | Bias |
| --- | --- | --- | --- | --- |
| Distance | Distance measured between location reference points | Distance measured between location reference points | ±3 m or ±0.1%a±1 m or ±0.1%b | n/a |
| Coordinates  | Horizontal offset at location reference point | At each location reference point | 95% within 3m | n/a |
| Coordinates  | Horizontal offset for each reported coordinate | 10m | 95% within 3m | n/a |
| MPD  | Difference in each measurement line | 10m | 95% within ± 0.2mm | 0.05mm |

Notes: a) If using OSGR fitting; b) if using reflective markers

* + 1. **Failure of a Test**
			1. If the required performance is not achieved then the survey of the site shall be repeated. If after three repeat runs, the differences still exist then the Contractor shall undertake an investigation to identify the source of error.
			2. No further Surveys should be carried out until a resolution of the issue has been demonstrated through a successful Primary Check.
			3. If the investigation identifies a problem with the Equipment indicative of a long term issue (that may have affected the performance of surveys carried out for Employers) the results of surveys undertaken with the Equipment since the previous successful Primary Check should be considered suspect, and the Auditor shall be informed.
		2. **Reporting**
			1. The Survey Data and performance achieved in all Contractor’s Calibration Checks shall be retained by the Contractor for examination by the Auditor as required. Any Contractor’s Calibration Check Survey Data requested by the Auditor shall be provided within 14 days of receipt of the request.
	1. Equipment Checks Following Routine Maintenance or alterations
		+ 1. It is expected that between re-accreditations of the Equipment, some Routine Maintenance or alterations may be required. The success of the maintenance shall be verified with suitable QA checks ***before******recommencing*****surveys.** In most cases a successful Primary Check would provide a suitable level of QA. If the Contractor is uncertain on the suitable level of QA then they should contact the Auditor for advice.
			2. The records of the maintenance carried out and the checks undertaken following maintenance shall be maintained by the Contractor for examination by the Auditor if required. Any QA records requested shall be provided to the Auditor within 14 days of receipt of the request.
1. Quality Assurance checks by the Auditor
	1. Checks on Contractor’s QA
		1. The Auditor may require the Contractor to demonstrate any aspect of their Quality Assurance regime at any time, through review of their documentation, or their data and records. The scope includes but is not limited to:
* Equipment operation and maintenance
* Calibration of the measurement Systems
* Driver and operative training and instruction
* Survey operation and record keeping
* Data recording, processing, and analysis
* Delivery of Survey Data
	+ 1. If there are any doubts as to the performance of the Equipment or the test procedure following the checks on the Contractor’s QA or from other reports, then the Auditor may undertake additional investigations. Additional investigations may also be conducted if requested by the Employer.
		2. If during checks on the Contractor’s QA the Auditor identifies a lack of competence which may affect the ability of the Contractor to record and deliver good quality Survey Data then the Auditor may issue an Improvement Notice to the Owner and/or Contractor as discussed in Section H.
1. Improvement Notices
	1. Procedure
		1. The Improvement Notice shall detail the nature of the improvement required and a timescale over which it shall be completed. It allows the Contractor to correct problems with their Equipment or Quality Assurance procedures.
		2. Being served with an Improvement Notice will not necessarily lead to withdrawal of Accreditation. However, failure to comply with the Improvement Notice within the given time frame will likely lead to withdrawal of Accreditation.
		3. If the Improvement Notice results in the withdrawal of Accreditation the Auditor shall review the data and the circumstances to determine if the Equipment would be required to carry out a full Accreditation Assessment or a Re-accreditation Assessment to demonstrate the improvement. However, the Auditor may identify a different route to demonstrate the improvement if a suitable one exists.
		4. The Improvement Notice shall detail any restrictions to the use of the Equipment prior to satisfactory completion of the improvement.
		5. The Auditor shall inform the Employer of any Improvement Notices issued and changes of Accreditation status.
			* 1. Requirements on the Auditor

Roles of the Auditor

The role of the Auditor is split into two main roles:

* Conducting and reporting the Accreditation/Re-accreditation process
* Monitoring the QA performed by the Contractor.

These roles can be carried out by the same or by separate bodies. The requirements that these bodies shall meet for these two roles are given in the sections below.

The Auditor for Accreditation and Re-accreditation Assessments shall:

* Organise Accreditation and Re-accreditation Assessments, including designing and developing the methodology for the testing, arranging surveys with the Reference Device, arranging and maintaining suitable sites for Accreditation/Re-accreditation, together with the processing, interpretation and reporting of results.
* Periodically assess the performance of the Trafficked Surfaces site(s) chosen for Accreditation/Re-accreditation so that the longer-term behaviour of the site(s) can be monitored.
* Issue Accreditation Certificates showing the performance achieved by Equipment at the Accreditation/Re-accreditation Assessment in a timely fashion. This should be within 2-3 weeks of the corresponding Assessment.
* Maintain a publicly available list of Accredited Equipment.

The QA Auditor shall:

* Conduct checks on the QA conducted by the Contractor (offering advice where necessary).
* Where required, act as a technical advisor and intermediary to aid discussions between Contractor and Employer with regards to the quality of Survey Data.

The Auditor shall issue improvement notices to the Contractor/Owner if the Auditor identifies an issue with the Equipment, QA or survey process which could affect the quality of the Survey Data.

Capabilities of the Auditor

The Accreditation Auditor shall:

* Have experience with the Survey Data produced by the Equipment and be knowledgeable on how to process and interpret it.
* Understand the implications of any differences in the Survey Data and how this is likely to affect the Employer.
* Demonstrate independence for their Auditor role.
* Have access to suitable test sites to undertake the Accreditation/Re-accreditation testing and capability to identify Newly Laid Sites. In addition, they shall also have access to suitable supporting tools to provide the Reference Data and support the accreditation testing. The requirements for the test site and the Reference Data are given in Appendix B.

The QA Auditor shall:

* Have experience with the Survey Data produced by the Equipment and be knowledgeable on how to process and interpret it.
* Understand the implications of any differences in the Survey Data and how this is likely to affect the Employer.
	+ - * 1. Site and Reference Data requirements for Accreditation/Re-accreditation

Accreditation/Re-accreditation – Trafficked Surfaces

The sites selected for tests on Trafficked Surfaces will have a total length of at least 10km and may be located on the local or strategic road networks (Live Sites), or on a test track (Closed sites).

Selected lengths of the Closed Sites will be equipped with reflective posts that can be identified by sensors installed on the Equipment to record location referencing points. The Auditor will provide technical details on the posts.

**Location referencing**

The Closed Site shall contain one or more sections of straight and level pavement (minimum 500m) for the assessment of Distance. The start and end points of this section(s) shall be clearly marked (e.g. with reflective posts).

The sites may contain test sections which include curves, and tree coverage in which the availability of signal for GNSS may be low.

At least one of the test sites will have Reference data for location that has been obtained using a calibrated measurement wheel (for distance) and survey grade RTK GPS (for National Grid Co-ordinates. All sites will have further Reference data for location referencing obtained using the National Highways HARRIS survey vehicle, or a comparable device.

**Texture Profile and MPD**

These tests shall be carried out on Closed Site and Live Sites.

The Artificial profiles will be surfaces of dimensions approximately 1m by 1m, and at least three profiles shall be machined each containing a different waveform. The waveforms selected shall include square and triangular waveforms with amplitudes between 1mm and 7mm and wavelengths between 50mm and 150mm. The profiles shall be orientated so that the waveforms are measured longitudinally for Equipment that measures in the longitudinal direction and transversally for Equipment that measures in the transverse direction.

The reference data for the Artificial Profiles is the set of defined amplitude and heights to which the Artificial profiles have been machined.

The pavement surfaces will include material types that are representative of those that the Equipment would test. These will include MCHW Clause 942 (Thin Surface Course Systems), 943 (HRA – performance related design) and 923 (Cold Applied Ultra-Thin Surfacing) surfaces.

All test sites (Closed and Live Sites) will have Reference Data collected using the HARRIS Equipment.

Accreditation/Re-accreditation – Newly Laid Surfaces

Identification of Newly Laid Surfaces for accreditation testing will require liaison with asphalt installers. It is anticipated that:

* The Contractor would commence the accreditation programme and complete stage 1 of the tests (trafficked sites)
* The Contractor would liaise with the Auditor to establish the Newly Laid Surface test sites. The Contractor may work with a surfacing provider to propose suitable sites, or the Auditor could undertake this activity, or there may be a combination of these approaches applied (as agreed between the Contractor and the Auditor).
* Newly Laid Surfaces assessment shall be held on at least two Sites, including materials listed above.

Having identified and agreed a set of sites the Auditor and the Contractor shall carry out surveys on the sites with the reference and test Equipment.

* Reference data on the Newly Laid Surface sites will be obtained using the National Highways HARRIS survey vehicle or an alternative, comparable, device. This data will be collected between 3 and 5 days after completion of the surfacing.
* The Contractor shall use the Equipment to survey the sites within 5 days of the site being laid.
	+ - * 1. Calculation of MPD

Calculation of MPD

The evaluation of Mean Profile Depth (MPD) shall be as defined in BS EN ISO 13473‑1:2019 Characterization of pavement texture by use of surface profiles – Part 1: Determination of Mean Profile Depth”.

MPD shall be calculated according to BS EN ISO 13473-1:2019 with the following exceptions:

* The value of MPD shall be reported in the Survey Data regardless of the number of dropouts or spikes recorded in that length

All mandatory steps described in Table of D.1 BS EN ISO 13473‑1:2019 shall be applied to the data (applying the filter parameters described in Table D.2 of BS EN ISO 13473‑1:2019)

The MPD will be reported over the reporting length appropriate to the test. Individual average MPD values will be obtained over length *L* as:

$$MPD\_{L}=\frac{1}{J}\sum\_{i=1}^{J}MPD\_{B}$$

where *MPDB* values are calculated for successive baseline lengths within the length *L*.

e.g. With Texture Profile points at 0.001m interval, an MPD baseline length of 0.1m and an averaging length of 10m; if the Texture Profile point at the start of the length *L* was numbered 1, the first *MPDB* would be calculated using points 1 through 100, the second using points 101 through 200, and the last (100th) using points 901 through 1000.