

Accreditation and Quality Assurance of Sideway-force Skid Resistance Survey Devices

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Definitions of terms used in this document

This document uses a selection of specific terms which are defined below, are detailed in the corresponding standard for the surveys of these devices on UK trunk roads, CS 228 (Design Manual for Roads and Bridges) or in the introduction to the Design Manual for Roads and Bridges (GG 101).

Accreditation Certificate; documentary evidence of the performance achieved during an Accreditation/Re-accreditation Trial. It also sets out the limitations and validity period of the accreditation. It shall be retained by the Owner and produced upon request.

Accreditation Period; is normally 13 months from the date of attending an Accreditation/Re-accreditation Trial.

Accredited Surveys; surveys undertaken using Equipment which is adhering to the QA discussed in this document and has a valid Accreditation Certificate.

Accreditation Trial; an event where accreditation tests are performed to demonstrate that the Equipment can meet the specification requirements under rigorously controlled test conditions (also see Re-accreditation Trial).

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 Employer or the Network Authority.

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

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

Contractor; the organisation carrying out the Accredited Survey. The Contractor can be the Owner of the Equipment.

Contractor's Calibration Check; QA assessment undertaken by the Contractor to determine if the Equipment is performing to an acceptable level of consistency between Accreditation/Re-accreditation Trials.

Contractor's Calibration site; a site where Regular Checks to monitor the long term performance of the Equipment are undertaken.

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.

Employer; the organisation that commissions the Contractor to provide Survey Data. This may be the Network Authority.

Equipment; The overall machine carrying out the survey, incorporating the measuring systems and where applicable the survey vehicle.

Fleet; collection of Equipment which provide the Reference Data for an Accreditation/Re-accreditation Trial.

Improvement Notice; a notice issued to the Owner and/or Contractor if the Auditor finds the Equipment is not meeting the requirements of the Accreditation or Quality Assurance processes. The notice will 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.

Lay Off Period; a period of time greater than 10 working days where the Equipment is not surveying (for the purposes of this specification it also means a period where surveying for Employers who do not require adherence to this standard).

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

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, such as Highways England or a Local Highway Authority.

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Owner; the organisation or individual to whom the Equipment belongs and to whom Accreditation Certificates are awarded.

Parameter; specific data fields that form part of the Survey Data supplied by the Contractor to the Employer. This includes survey speed and skid resistance.

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 will be compared for the purposes of Accreditation or Quality Assurance.

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

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.

Survey Data; data collected by the Contractor using the Equipment and supplied to the Employer,

System; individual measurement system installed on the Equipment e.g. distance measurement system, OSGR measurement system etc.

Section A Introduction

A.1 Introduction

- A1.1 It is essential that maintenance of a road network is planned, prioritised and undertaken in a way that limits delays when carrying out road works and improvements. It should provide value for money and investment in improved service which helps to make journeys safer and more reliable. A key element in the successful maintenance of a network is the accurate, reliable and consistent assessment of the pavement's surface and structural condition. Inaccurate condition assessment data could, on one hand, lead to unnecessary and costly works causing needless traffic congestion. However, on the other hand if maintenance is overlooked, it could lead to poorly maintained carriageways presenting a risk to road users.
- A1.2 Within the Standard for UK trunk roads, CS 228 (Design Manual for Roads and Bridges), it is required that Contractors commissioned to supply Survey Data use Equipment that has been accredited to undertake these surveys.
- A1.3 An Accreditation and Quality Assurance programme has therefore been devised for sideway-force skid resistance survey devices. This process is the subject of this document.
- A1.4 The central principles of the Accreditation and Quality Assurance programme 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, via independent audit.
- A1.5 This document sets out the requirements for Accreditation, Re-accreditation and Quality Assurance of skid resistance surveys carried out to characterise road condition under CS 228.

A.2 Summary of the Accreditation and QA process

- A2.1 Prior to the Accreditation and QA process it is necessary to identify an Auditor or Auditors to oversee the process. The Employer shall nominate Auditor(s) and this may be external or internal (or a combination of the two). Further details on the responsibilities of these roles are given in Section B.
- A2.2 The overall skid resistance Accreditation and QA process is shown in Figure 1, and is described further in the following sub-sections.

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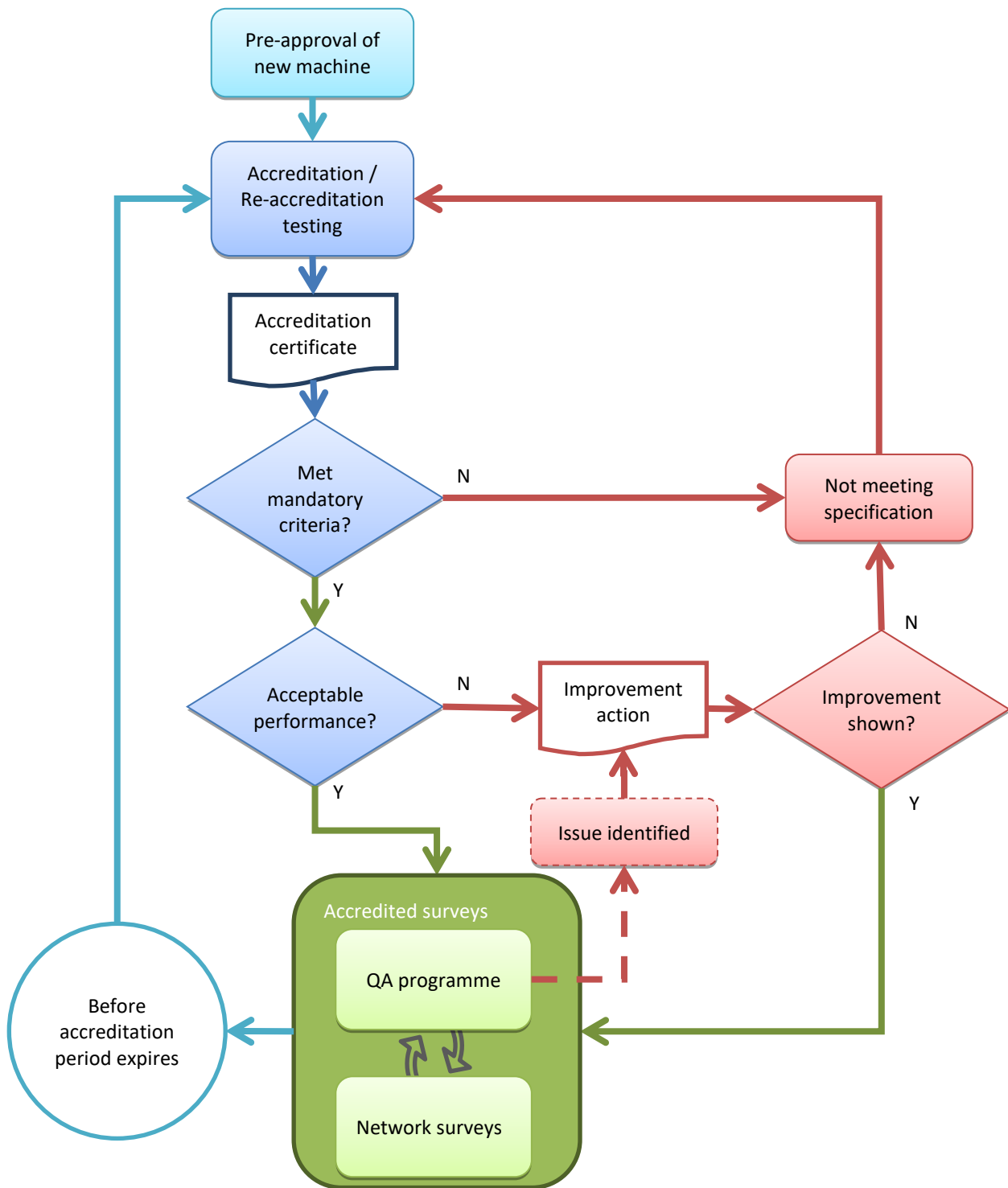


Figure 1: Outline of the Accreditation and Quality Assurance programmes

A2.3 Pre-approval of Equipment

A2.3.1 Prior to undertaking an Accreditation/Re-accreditation Trial, it may be necessary to undertake an assessment of the Equipment to check its suitability for undertaking Accredited Surveys. The need for this will be determined by the Auditor.

A2.4 Accreditation/Re-accreditation Trial

A2.4.1 Any machines seeking to undertake Accredited Surveys shall take part in, and provide satisfactory performance in, an Accreditation/Re-accreditation Trial.

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- A2.4.2 Following completion of a Trial the Auditor shall issue an Accreditation Certificate. The Certificate shall detail the level of performance achieved by the Equipment at the Trial.
- A2.4.3 If the Equipment has not met the mandatory requirements of the trial then this Equipment is not meeting specification, and will need to undertake an additional Trial and meet the requirements before undertaking Accredited Surveys.
- A2.4.4 If the Equipment has met the mandatory requirements of the trial, 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.
- A2.5 **Accredited Surveys**
- A2.5.1 Accredited Surveys are network surveys undertaken by Accredited Equipment, combined with Quality Assurance (QA).
- A2.5.2 If the QA or other process identifies an issue that may affect Survey Data the Auditor may issue an Improvement Notice to the Contractor and supply a copy to the Employer. If a suitable improvement is not demonstrated to the Auditor in the given time frame then the Equipment accreditation status may be revoked.
- A2.6 **Accreditation Period**
- A2.6.1 Each Accreditation Certificate issued by the Auditor shall have a corresponding Accreditation Period. Owners/Contractors wishing to continue to undertake Accredited Surveys shall attend a Re-accreditation Trial prior to the end of the Accreditation period.

A.3 **Structure of this document**

- A3.1 This document is split into several sections:
- The roles and responsibilities of the involved parties are given in Section B
 - The specification for the skid resistance device is provided in Section C.
 - The Accreditation trials (undertaken on any new survey equipment) are detailed in Section D.
 - The Re-accreditation trials (undertaken on equipment that has been previously Accredited) are detailed in Section E.
 - The Contractor's Quality Assurance procedures are detailed in Section F.
 - The Quality Assurance checks conducted by the Auditor are described in Section G.
 - Details on Improvement Notices which may be issued by the Auditor are given in Section H.

Section B Roles of the relevant parties

B.1 Employer

- B1.1* The Employer shall consider the requirements for Accreditation and QA ahead of appointing a survey contractor to undertake skid resistance surveys.
- The Employer shall require (for example within any contract or order) 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 Employer shall require that the Contractor undertakes QA checks. These QA checks shall be as specified in this document unless replaced by alternative or additional checks defined by the Employer.
- B1.2* To ensure that the required Accreditation and QA processes are applied, the Employer shall nominate Auditor(s) to carry out checks. The Employer may conduct some or all of the Auditor's role internally. The Employer shall ensure that the Auditor(s) hold the required skills to undertake these checks and understand the results (see Appendix A).

B.2 Owner

- B2.1* Owners shall ensure that their Equipment is compliant with the equipment configuration and specification given in Section C.
- B2.2* Owners shall obtain Accreditation via an Accreditation/Re-accreditation trial prior to undertaking Accredited Surveys. An Owner may commission an Accreditation Trial at any time. However some Network Authorities may provide centrally organised annual Accreditation Trials. The process and requirements of these trials are given in Section D and Section E.
- B2.3* 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.
- B2.4* 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.
- B2.5* 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.
- B2.6* 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.

B.3 Contractor

- B3.1* A Contractor hiring Equipment shall establish, from the Owner and/or the Employer (as appropriate), the Accreditation status of the Equipment and the QA requirements of the Employer.
- B3.2* The Contractor shall ensure that the Equipment completes the QA required by their Employer(s). In addition the Owner may require the Contractor to undergo QA to maintain Accredited status throughout the period of hire. For example ensuring regular checks are carried out as scheduled when Equipment is transferred from one Contractor to another.
- B3.3* The Contractor shall ensure that the Equipment shall only be driven and operated by competent drivers and operatives. The Contractor is responsible for the training and instruction of all drivers and operatives and for ensuring that they comply with the requirements for surveys.

B.4 Auditor

- B4.1* The key roles of the Auditor are to carry out Accreditation and Re-accreditation Trials and to 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.

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- B4.2* 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 to the Contractor/Owner. Copies of these improvement notices shall also be supplied to the Employer.

Section C Equipment

C.1 Equipment requirements

C1.1 The specification for measurement of skid resistance by the sideway-force method is given in the Design Manual for Roads and Bridges (DMRB); CS 228 Skidding Resistance.

C.2 General Description

C2.1 The Equipment comprises of a sideway-force skid resistance System combined with a distance measurement System and water delivery System. The Equipment is further described and defined in CS 228 and in BS 7941-1.

C.3 Additional Components

C3.1 Some Employers may require the data to be spatially referenced and, therefore, the Equipment may also include a 3D Spatial Coordinate measurement System (e.g. GPS).

C3.2 It is considered best practice to include a calibrated System for air temperature measurement. The System may be incorporated into the Equipment or as a separate device. This System would allow the operator to check to see if the temperature is above the minimum testing level (i.e. to avoid the risk of leaving ice on the road).

C3.3 Equipment should be fitted with a System to automatically identify section change points (e.g. using automatic detection of retro reflective markers); these allow for more accurate calibration of the distance measurement System of the Equipment. In addition automatic detection allows for more robust tests of the distance measurement System (due to removal of operator error). Some Employers may require mandatory installation of a System which achieves this.

C.4 Calibration of the Equipment

C4.1 Sections D, E, and F of this document describe the Accreditation and QA processes to be applied to test and monitor the performance of the Equipment. The tests assume that any day to day or longer term calibration required to ensure the ongoing performance of the equipment has been carried out by the Contractor, Equipment Developer or System Developer as appropriate. Particular Systems or Components of the Equipment which are known to require Calibration include:

- Horizontal and vertical Load cells.
- Horizontal force calibration rig.
- Distance measurement System

Section D Accreditation

D.1 Introduction

D1.1 The purpose of an Accreditation Trial is to ensure that the Equipment is capable of measuring and reporting the Survey Data consistently under controlled conditions. It should also demonstrate that the Contractor is able to operate the Equipment in order to produce consistent and reliable Survey Data. The results from the Accreditation Trial shall also show that all accredited Equipment are consistent within defined tolerances.

D1.2 Equipment shall require Accreditation if one or more of the following conditions are met:

- The Equipment is new, or has not previously been Accredited to this specification or an earlier version of this specification.
- Equipment Accredited to this specification has changed ownership and the new Owner does not currently operate any Equipment Accredited to this specification.
- Equipment previously Accredited has lapsed in its Accreditation status.

D.2 Accreditation

D2.1 Following completion of an Accreditation Trial the Auditor shall issue Accreditation Certificates showing the performance achieved by the Equipment. The Certificate should expire 13 months from the Trial date.

D2.2 If the Equipment has met the mandatory criteria of the Accreditation Trial, but performance of the Equipment is not suitable in other aspects, then the Auditor shall also issue an Improvement Notice as detailed in Section H.

D2.3 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 Trial.

D.3 The Accreditation Trial

D3.1 Prior to an Accreditation Trial, pre-approval of any Equipment meeting the criteria in D1.2 is required. The Owner shall provide details of their Equipment to the Auditor so that the Auditor can confirm it is eligible to attend the trial based on the specification given in Section C and can detail any additional assessments that shall be required. The Auditor may charge a supplementary fee for these additional assessments.

D3.2 Following the successful completion of the pre-approval stage the Equipment shall then be deemed to be authorised to take part in an Accreditation Trial.

D3.3 The structure, criteria and requirements for an Accreditation Trial are exactly the same as those used for a Re-accreditation Trial. Therefore reference shall be made to Section E for full details of the Accreditation Trial, including criteria and requirements.

D3.4 The main difference between an Accreditation Trial and a Re-accreditation Trial is that any Equipment undertaking an Accreditation Trial shall not be included in the Reference Data.

D3.5 Note that, as well as testing the Equipment, the Auditor may assess and provide feedback on the competence of drivers and operatives as part of the Accreditation Trial.

Section E Re-accreditation

E.1 Introduction

E1.1 Re-accreditation Trials should typically include:

- Equipment Inspections, which comprise overall checks of the Equipment and its Systems.
- Trials and assessment of Equipment against mandatory criteria.
- Trials and assessment of Equipment against additional criteria.
- Checking of file formats

E1.2 Requirements for the test site and the required Reference Data for a Re-accreditation Trial are given in Appendix B.

E.2 Re-accreditation

E2.1 Following completion of a Re-accreditation Trial the Auditor shall issue Accreditation Certificates showing the performance achieved by the Equipment. The Certificate should expire 13 months from the Trial date.

E2.2 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.

E2.3 Once the Equipment has been re-accredited it shall require a further Re-accreditation before expiry of the Accreditation Period. This can be obtained by successfully completing another Re-accreditation Trial.

E.3 Equipment inspection

E3.1 Equipment shall be inspected to ensure that they are in a suitable condition to conduct the tests. Contractors should be provided with an inspection check sheet to complete and provide to the Auditor *in advance* of the Trial.

E3.2 Inspections shall include:

- Water flow System (including verification of flow rate, nozzle alignment and general condition).
- Verification of the test wheel weight.
- Verifying that the Equipment is in good general mechanical order.

E3.3 During the trial the Auditor should confirm that the Contractors have undertaken the following calibrations:

- Vertical load System
- Horizontal load System

E.4 Running Trials

E4.1 Overview

E4.1.1 As detailed in Appendix B, trials shall be carried out on a test site separated into test stations, and laid out such that laps of the set of test sections can be undertaken by the Fleet for the purposes of repeating the measurements.

E4.2 Skid resistance testing – Mandatory Requirement

E4.2.1 The assessment for skid resistance measurements is described below, and a worked example is provided in Appendix C.

E4.2.2 Some Equipment may have skid resistance measurement Systems fitted to both the nearside and offside of the Equipment. If fitted then these systems should be assessed independently and given independent Accreditation results. This requires that suitable reference data is collected for both wheel paths or that the Equipment test on offset driving lines so that the test wheel traffics the same part of the test surface. The Auditor may specify that only one side of the Equipment will be assessed.

E4.2.3 The Equipment shall undertake laps so that the following criteria are met:

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- At least 3 laps are undertaken that comply with the requirements for Reference Data (see Appendix B, App B.3).
- Survey data is collected at the target test speed.

E4.2.4 The Contractor shall supply the skid resistance measurements for their Equipment from each test lap in the file formats specified by the Auditor.

E4.2.5 The Auditor shall calculate:

- The mean values for the Equipment for each 100m length test section or the length of the test section if shorter (averaging together the repeat measurements).
- The standard deviation of these mean values for the Fleet and for all of the Equipment at the trial, referred to as the Fleet between-Equipment standard deviation (BESD) and the Trial BESD. These values shall be used to assess the consistency of the Equipment at the Trial.
- The standard deviation of the skid resistance values between runs for the Equipment for 100m lengths (or the length of the test section if shorter). This data is referred to as the between-run standard deviation (BRSD). These values shall be used to assess the repeatability of each individual Equipment.

E4.2.6 The BRSD assessment criterion is given in Table 1. Where the BRSD criterion is exceeded, the data shall be examined for any obvious error, for example as a result of significant variation in test line, and if necessary individual runs on that section may be excluded from subsequent analysis. If Equipment consistently records data with unacceptable between-run standard deviation, the data from that Equipment shall be regarded as unacceptable.

E4.2.7 The Trial BESD shall be acceptable if it is below the criterion given in Table 1. If the Trial BESD exceeds this criterion then the data shall be further examined to identify outlying Equipment. This should include examining the fleet BESD and data from individual Equipment. Outlying Equipment shall be rejected and the data reassessed until the performance is acceptable.

E4.2.8 In addition, any Equipment that deviates by more than 3 times the BESD criterion from the Fleet mean shall be rejected. Any Equipment that is between two and three times the BESD criterion from the all-Equipment mean shall be subject to further investigation.

E4.2.9 The data from any Equipment rejected due to the BRSD, BESD or otherwise identified as an outlier shall not be used in the calculation of the Reference Data (App B.3.1).

Table 1 – Acceptance Criteria for Skid resistance measurements

Parameter	Acceptability Limit
Between run standard deviation (BRSD)	Investigate if >3 SR on 100m lengths
Between Equipment standard deviation (BESD) on closed site (e.g. test track)	≤2.7 SR
Between Equipment standard deviation (BESD) on live site (e.g. network route)	≤2.8 SR

E4.2.10 The Auditor should also review the vertical load Parameter in the data collected at the trial with the aim to identify anomalies and to develop tests for this Parameter to be included in future specifications. If the Auditor identifies anomalies in this data, this may lead to additional testing of Equipment, Accreditation for Equipment being withheld and/or issuing of Improvement Notices (see Section H).

E4.2.11 In addition to the above assessments the Auditor should review the profiles of the Survey Data over the site for each Equipment and investigate any anomalies. Based on the results of the investigation the Auditor may withhold Accreditation for Equipment and/or issue an Improvement Notice as detailed in Section H.

E4.3 Vehicle Speed – Mandatory Requirement

E4.3.1 The assessment of vehicle speed is split into two parts:

- The speed recorded by the Equipment compared with the independently measured speed
- The speed recorded by the independent measure compared with the required target survey speed.

E4.3.2 The test shall be carried out on at least 3 test laps at each target survey speed.

E4.3.3 The acceptance criteria for vehicle speed measurement are given in Table 2.

Table 2 – Acceptance Criteria for Vehicle Speed Measurement

Parameter	Acceptability Limit
Vehicle Speed recorded by the Equipment compared to independent measure	≥80% within ± 1km/h of the independently measured speed
Vehicle speed recorded by the independent measure compared to the target speed	≥80% within ± 3km/h of required target speed

E4.4 Location Referencing – Distance Criteria

E4.4.1 The Accreditation of distance measurement shall be carried out using at least 6 measurements of distance made using the Equipment.

E4.4.2 There are three mechanisms for recording location referencing points in the survey data:

- Push button entry relies on the survey operator pushing a button to enter the location of the point manually.
- Automatic marker uses a system which automatically detects the markers.
- OSGR fitted utilises the coordinate data to identify the elapsed chainage of the location reference points within the survey data.

E4.4.3 The push button entry approach will include some operator error and therefore it is expected that Equipment using this approach will be less accurate than the other methods. The criteria applied to the test measurements for the push button and automatic markers are given in Table 3.

Table 3 – Criteria for measurement of distance travelled for repeatability and reproducibility

Parameter	Push button entry	Automatic markers (where available)
Distance measured	≥80% within 5m	≥80% within 2m

E4.4.4 If the Survey Contractor will be supplying data to a Customer with OSGR fitted location reference points then the original survey data for these Equipment (i.e. not OSGR fitted) shall be assessed on the automatic markers criteria (regardless of the marker entry method used during the survey).

E4.5 Test wheel weight

E4.5.1 The Accreditation of test wheel weight shall be carried out using at least 3 measurements. There can be a tendency for the shaft bearings to stick slightly when the wheel is first lowered (without the shaking action that would be experienced on the moving vehicle at the start of a survey run). For this reason, the assessment shall be carried out after the bearings have been released (achieved by applying foot pressure to the wheel arm bearing and “bouncing” the back-plate against the suspension damper and spring).

E4.5.2 For this assessment the test wheel shall be raised/lowered and the “un-bounced” measurement taken. The System shall then be bounced and the “bounced” measurement taken. This process shall be repeated until at least 3 sets of measurements have been taken. The Auditor should review the differences between the bounced and un-bounced values and the ranges for the three sets of measurements. The “bounced” measurements made shall be averaged together and the criteria applied are given in Table 4.

Table 4 – Criteria for test wheel weight

Parameter	Acceptability Limit
“Bounced” test wheel weight	200±8kg

E4.6 Water flow

E4.6.1 The water delivery system shall be inspected and checked to confirm that the Equipment is delivering water at an acceptable rate and to the correct position on the road surface. The water flow delivery system is required to achieve a target water film thickness of 0.5mm at 50km/h. Due to differences in design (e.g. position of the nozzle) the target flow rate to achieve this will differ between Equipment. The target flow rate for each Equipment shall be determined (through consultation between the Auditor and the Developer). Each Equipment shall be tested to confirm that the flow rate supplied is within the criteria given in Table 5. In the cases where the Equipment incorporates a speed controlled water flow system, the flow rate will be assessed using both 50km/h and 80km/h test pulses.

Table 5 – Criteria for water flow rate

Parameter	Acceptability Limit
Water flow rate	Within 10% of the target flow rate

E.5 Additional Tests

E5.1 Overview

E5.1.1 This sub-section describes the additional criteria which may be assessed to provide additional information on the capabilities of the Equipment. These criteria are assessed as High, Medium and Low levels of performance. These criteria typically include the assessment of Systems not fitted to all Equipment and/or tests which are not as mature as the mandatory assessments. In future revisions to this document some or all of these criteria may become mandatory criteria.

E5.1.2 Some Employers may require a specific level of performance in some or all of these additional tests to carry out Accredited Surveys on their Network.

E5.2 Location Referencing – OSGR data

E5.2.1 As noted in E4.4.2 there are three mechanisms for recording the location of location referencing points. The differences in these approaches result in different criteria for OSGR assessment. However, it is noted that automatic marker detection is normally not possible on a network route test and as such no automatic marker criteria are given for the network route.

E5.2.2 OSGR Systems shall be assessed using both the OSGR fitted criteria and the marker entry criteria (Push or Automatic) matching the method used during the survey. The criteria applied shall be noted on the Accreditation certificate. If the Survey Contractor does not supply OSGR fitted data, then the data will be fitted by the Auditor and noted as such on the Accreditation Certificate.

E5.2.3 OSGR data collected from the closed test sections shall be assessed using the criteria given in Table 6.

Table 6 – Closed test section: Criteria for OSGR data of individual 10m data points

Performance level	Push button entry	Automatic markers (where available)	OSGR fitted
High	90% within 5m 95% within 7m 100% within 20m	90% within 2m 95% within 4m 100% within 20m	90% within 2m 95% within 4m 100% within 20m
Medium	80% within 5m 90% within 7m 100% within 20m	80% within 2m 90% within 4m 100% within 20m	80% within 2m 90% within 4m 100% within 20m
Low	80% within 8m 100% within 20m	80% within 5m 100% within 20m	80% within 5m 100% within 20m
Not suitable	Otherwise	Otherwise	Otherwise

E5.2.4 OSGR data collected from a live traffic route shall be assessed using the criteria given in Table 7

Table 7 – Live traffic route: Criteria for OSGR data of individual 10m data points

Performance level	Push button entry	OSGR fitted
High	90% within 12m 100% within 25m	90% within 6m 100% within 20m
Medium	90% within 17m 100% within 25m	90% within 12m 100% within 25m
Low	100% within 25m	100% within 25m
Not suitable	Otherwise	Otherwise

E5.2.5 The OSGR performance recorded on the Accreditation Certificate shall correspond to the lowest performance of all of the test sites used and the criteria applied, unless it is identified that some data should be disregarded. If any data is disregarded then this should be recorded on the Accreditation Certificate along with the reasons.

E5.3 Location Referencing – Altitude data

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E5.3.1 Altitude data collected shall be assessed using the criteria given in Table 8.

Table 8 –Criteria for Altitude data of individual 10m data points

Performance level	Criteria
High	90% within 2m 95% within 5m 100% within 20m
Medium	80% within 4m 90% within 6m 100% within 20m
Low	100% within 20m
Not suitable	Otherwise

E.6 Checking of file formats

E6.1.1 Some Employers require the production of data in specific data formats, for example Highways England requires data to be produced as Raw Condition Data (RCD) and Base Condition Data (BCD). Where required, Owners shall be asked to deliver accreditation data files in the required format. These should be assessed to determine whether the data are being correctly processed.

Section F Contractor's Quality Assurance

F.1 Introduction

F1.1 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 effective and documented Quality Assurance regime should cover all aspects of the surveys including, but not limited to:

- Equipment operation and maintenance
- Calibration of the Equipment
- Driver and operator training and instruction – the Equipment should only be driven and operated by competent personnel
- Survey operation and record keeping
- Data recording, processing, and analysis
- Delivery of Survey Data

F.2 Summary of the processes

F2.1 The following QA tests are required:

- Contractor's Calibration check within the defined time frame of the Accreditation/Re-accreditation Trial
- Contractor's Calibration check at the end of a Lay Off Period prior to conducting surveys
- Contractor's Calibration check no more than 30 days apart during the Period of Work
- Weekly check (no more than 7 days apart) during the Period of Work
- Contractor's Calibration Check before entering a Lay Off Period
- Daily Check every day testing is carried out

F2.2 The Contractor should also check that any other Systems/Components are working satisfactorily between calibrations (e.g. no damage to the water flow System).

F.3 The Contractor's Calibration Site and Primary Check Site(s)

F3.1.1 The Contractor shall establish a number of fixed test sites to achieve the QA test programme. This shall include a Contractor's Calibration site, and may optionally include Primary Check Site(s). The sites chosen by the Contractor should be reported to the Auditor. The sites may be subject to monitoring by the Auditor at any time.

F3.2 If the condition of a test site is affected by maintenance or other external factors at any time, the Contractor should notify the Auditor. The Contractor may be required to establish the changed characteristics of the site by repeated testing, or to establish another site as agreed with the Auditor.

F3.3 The Contractor should consult the local highway authority responsible for the test site location and obtain its agreement before making any marking on or modification of the site.

F3.4 A summary of the requirements for the sites required for QA is given in Appendix D.

F3.5 Contractor's Calibration site

F3.5.1 The Contractor's Calibration site provides a reference site for monitoring the performance of the Equipment since the last successful Accreditation or Re-accreditation of the Equipment.

F3.5.2 Typically the Contractor's Calibration site would be a single site close to the Contractor's base where measurements can be taken safely and without unreasonable disruption to other users of the site. The site should contain:

- At least two lengths providing significantly different levels of skid resistance.
- A length of at least 400m of straight and level pavement for the assessment and calibration of distance measurements.

F3.5.3 It may be necessary to form the Contractor's Calibration site from 2 or more locations to meet these requirements.

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- F3.5.4* To obtain skid Reference Data for the site, a reference survey should be carried out on the site with the Equipment within 7 days of successfully carrying out an Accreditation/Re-accreditation Trial.
- F3.5.5* Locational reference data should be obtained on the site in the form of the length measured to an accuracy of $\pm 0.5\text{m}$, using steel tape or other reliable device. The OSGR co-ordinates of the site should also be accurately recorded if an OSGR System is fitted to the Equipment.
- F3.5.6* The test site Reference Data shall include all of the Survey Data and derived Parameters required for the corresponding QA test (see Table 9).
- F3.5.7* The Survey Data obtained from the reference survey shall constitute the test site Reference Data. The Contractor should build up a “historical data set” which can include data collected in the current and previous years whilst conducting Accredited Surveys.
- F3.5.8* The Contractor should carry out more than one survey at the test site when collecting the Reference Data as a measure of consistency and repeatability.
- F3.5.9* In some cases it may be necessary or desirable to establish a new Contractor’s Calibration Site. This shall be done by collecting Reference Data for the new site within a maximum of 7 days of a successful completion of a Check on the existing site but ideally on the same day.

F3.6 Primary Check Site(s)

- F3.6.1* The aim of the Primary Check Sites is to provide a controlled reference site(s) for the Weekly Check.
- F3.6.2* The Primary Check site(s) should be a site where measurements can be taken safely and without unreasonable disruption to other users of the site. The site should contain:
- At least two lengths providing significantly different levels of skid resistance.
 - A length of at least 400m of straight and level pavement for the assessment of distance measurements.
- F3.6.3* It may be necessary to form the Primary Check site from 2 or more locations to meet these requirements.
- F3.6.4* For operational convenience the Contractor may, if it desired, set up a number of Primary Check Sites. These can be established throughout the year and at different geographical locations within the UK.
- F3.6.5* To obtain skid Reference Data for the site, a reference survey should be carried out on the site with the Equipment within 7 days of a successful survey of the Contractor’s calibration Site.
- F3.6.6* Location reference data should be obtained on the site in the form of the length measured between known points. This can be obtained using the distance measurement System on the Equipment during the reference survey.
- F3.6.7* The test site Reference Data shall include all of the Survey Data and derived Parameters required for the corresponding QA test (see Table 9).
- F3.6.8* The Survey Data obtained from the reference survey will constitute the test site Reference Data. The Contractor should build up a “historical data set” which can include data collected in the current and previous years whilst conducting Accredited Surveys.
- F3.6.9* The Contractor should carry out more than one survey at the test site when collecting the Reference Data as a measure of consistency and repeatability.

F.4 Contractor’s Calibration Check

F4.1 Overview

- F4.1.1* The aim of the Contractor’s Calibration Check is to provide long term monitoring of the Equipment and to check the performance of the Equipment since the last Accreditation/Re-accreditation trial. The Contractor’s Calibration Check may also incorporate the calibration of the location referencing System if required.
- F4.1.2* During the Period of Work, Contractor’s Calibration Checks shall be carried out no more than 30 days apart.
- F4.1.3* As part of the Contractor’s Calibration Check, the Contractor should also carry out a visual inspection of the Equipment for any obvious mechanical defects and that the Equipment and all of its Systems

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are operating correctly. The checks should ensure the Equipment is correctly configured for the survey to be undertaken.

F4.2 Test process – Vertical Load System

F4.2.1 The Contractor shall undertake a calibration of the Vertical Load System as per the Developer’s instructions.

F4.3 Test process – Distance measurement

F4.3.1 The Contractor shall undertake a check of the distance measurement System. This shall be achieved by measuring the test length with the Equipment and comparing the results to the Reference Data. The distance measurement System is required to provide the same performance band achieved at the Accreditation/Re-accreditation Trial. If the measurements are not within these requirements then the device shall be re-calibrated and the performance check repeated.

F4.4 Test process – Skid resistance and OSGR

F4.4.1 The Contractor shall survey the selected test site and process the Survey Data to obtain the Parameters listed in Table 9 (for the applicable Systems). The Contractor shall then compare the Survey Data and derived Parameters against the Reference Data set and other relevant data collected for the site whilst under accredited status.

Table 9 - Parameters to be calculated for the Contractor’s Calibration Check

Parameter	Units	Reporting Interval
Skid Resistance	SR	Average for each test section (it is recommended that the 10m data is also examined)
National Grid Co-ordinates at marker points	m	Start and end of each section, and any other marker points on the site
Horizontal offset at marker points		
Altitude offset at marker points		
National Grid Co-ordinates at 10m intervals	m	For each 10m data point
Horizontal offset at 10m intervals		
Altitude offset at 10m intervals		

F4.4.2 It is expected that the skid resistance measurements collected on test sites will not necessarily be the same at every visit (for example, they will change due to seasonal variation). With no absolute reference measurement of skid resistance the assessment of the results is not straightforward. The Contractor is expected to have a basic understanding of the behaviour of skid resistance and the Equipment to determine that the skid resistance measurements are “sensible” when compared to the reference (and other relevant data from the site) and taking into consideration all variables (such as time of year). However some guidance for the assessment of skid resistance is given in Table 10.

Table 10 – Criteria for the Contractor’s Calibration Check

Parameter	Units	Guidance criteria
Skid Resistance	SR	Within 5 SR of previous results and consistent with expected trends

F4.4.3 The OSGR and altitude System (if fitted) shall provide the same performance band as achieved at the Accreditation/Re-accreditation trial, using the live traffic route criteria (see Table 7 and Table 8).

F4.4.4 If a deviation from the expected performance trend is noted then the survey of the site shall be repeated. If after three repeat runs, the differences still exist then the Auditor shall be immediately informed, and no further Accredited Surveys carried out until a resolution of the issue has been successfully demonstrated to the Auditor. The results of all surveys by the Equipment since the last previous successful Weekly Check are then considered suspect.

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F4.4.5 The Contractor shall undertake an investigation to identify the source of error and, once identified and resolved, demonstrate acceptable performance through a successful QA check (level of which is to be agreed with the Auditor).

F4.5 **Reporting**

F4.5.1 All Contractor's Calibration Check reports shall be supplied to the Auditor within 14 days of completion of the survey.

F4.5.2 The Survey Data for the Contractor's Calibration Check shall be retained by the Contractor and Owner (if different) for examination by the Auditor if required. Any Contractor's Calibration Check Survey Data requested by the Auditor should be provided within 14 days of receipt of the request.

F.5 **Weekly checks (at least every 7 days)**

F5.1 **Overview**

F5.1.1 The aim of the Weekly Check is to provide a check on the medium term skid resistance data trending of the Equipment and to check that the calibration of the distance measurement and OSGR systems remain valid.

F5.1.2 Weekly Checks shall be carried out during the Period of Work and be no more than 7 days apart. The site used for this check shall be either the Contractor's Calibration Site or one of the Primary Check Sites.

F5.1.3 As part of the Weekly Check, the Contractor should also carry out a visual inspection of the Equipment for any obvious mechanical defects and that the Equipment and all of its Systems are operating correctly. The checks should ensure the Equipment is correctly configured for the survey to be undertaken.

F5.2 **Test process – Distance measurement**

F5.2.1 The Contractor shall undertake a check of the distance measurement System. This shall be achieved by measuring the test length with the Equipment and comparing the results to the Reference Data. The distance measurement System shall provide the same performance as achieved at the Accreditation/Re-accreditation Trial. If the measurements are not within these requirements then the device shall return to the Contractor's Calibration site to be re-calibrated and a check on the performance repeated.

F5.3 **Test process – Skid resistance and OSGR**

F5.3.1 Tests for the skid resistance and OSGR data are the same as for the Contractor's Calibration Check.

F5.4 **Reporting**

F5.4.1 The records of the Weekly Checks shall be maintained by the Contractor for examination by the Auditor as required. Any Weekly Checks records requested should be provided to the Auditor within 14 days.

F.6 **Daily Check**

F6.1 **Overview**

F6.1.1 The aim of the Daily Check is to provide a check on the operational capacity the Equipment.

F6.2 **Test process**

F6.2.1 A Daily check shall be conducted each day before conducting a survey. Checks and calibrations that shall be carried out include (but are not limited to);

- Calibration of horizontal load cell
- Calibration check on vertical load measurement System
- Check on vehicle tyre and test tyre pressures
- Check on test tyre condition
- Checks on the condition of the water flow delivery System

F6.2.2 The Contractor shall provide the Auditor with a description of the procedures to be applied in the performance of Daily Checks.

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- F6.2.3 Survey Data shall **only** be considered valid if the checks and calibrations described above were successfully conducted before the survey and within 24 hours of the end of the survey. If the testing will continue over 24 hours then the checks and calibrations shall be repeated in order to achieve this.
- F6.2.4 Checks should also be carried out during the survey day e.g. recalibration when a tyre is changed, tyre pressure checks etc.
- F6.2.5 The Contractor should also carry out a visual inspection of the Equipment for any obvious mechanical defects and to check that the Equipment and all of its Systems are operating correctly. The checks should ensure the Equipment is correctly configured for the survey to be undertaken.
- F6.3 **Reporting**
- F6.3.1 The records of the Daily Checks shall be maintained by the Contractor for examination by the Auditor as required. Any Daily Checks records requested should be provided to the Auditor within 14 days of receipt of the request.

F.7 Equipment Checks Following Routine Maintenance or alterations

- F7.1 It is expected that between annual 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 Contractor's Calibration 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.
- F7.2 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 should be provided to the Auditor within 14 days of receipt of the request.

Section G Quality Assurance checks by the Auditor

G.1 Checks on Contractor's QA

- G1.1 One of the Auditor's roles is to carry out assessments of the Contractor's Quality Assurance procedures and offer advice where necessary.
- G1.2 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
- G1.3 If there are doubts in 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 spot checks as discussed below. Spot checks may also be conducted if requested by the Employer.
- G1.4 If during the Contractor's QA checks the Auditor identifies a lack of competence which may affect the ability of the Contractor to record and deliver accurate Survey Data then the Auditor may issue an Improvement Notice to the Owner and/or Contractor as discussed in Section H.

G.2 Additional investigations

- G2.1 The Contractor may be subject to additional investigations on the operation and performance of their surveys. These investigations may include checks on survey planning, carrying out of the surveys, survey processing and/or quality procedures.
- G2.2 Additional investigations may include but are not limited to:
- A representative of the Auditor may attend the premises of the Contractor to ensure that QA processes are being carried out to an appropriate standard. The Auditor shall provide at least 5 working days' notice of the intention to carry out such a Spot Check.
 - A representative of the Auditor may accompany the Contractor on randomly selected surveys to ensure that the surveys are being carried out to an appropriate standard. When requested, the Contractor shall provide the Auditor, with the current and anticipated location of the Equipment during the following 24 hour period and any access requirements of the site (if applicable), so that the Auditor can determine if it would be appropriate to undertake a Spot Check on the survey.
 - An "Auditor's Repeat Survey" (ARS) is where the Auditor will utilise a different Accredited Equipment to repeat a survey undertaken by the Equipment undergoing an investigation. The Auditor shall determine whether another Equipment from the same Owner is suitable for this test, or if Equipment from a different Owner shall be used. The Auditor shall compare the data collected from the ARS with the Contractor's original survey and ascertain if the Equipment is measuring "as would be expected" for the conditions experienced during that particular survey. The Contractor shall be required to provide an explanation for any unexpected differences between the two surveys. This may include the Contractor re-surveying the test site to confirm the results of the original survey.
- G2.3 If the additional investigation identifies a lack of competence or issue with the Equipment which may affect the ability of the Contractor to record and deliver accurate Survey Data then the Auditor may issue an improvement Notice to the Owner and/or Contractor as discussed in Section H.

Section H Improvement Notices

H.1 Improvement Notices procedure

- H1.1* An 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.
- H1.2* 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.
- H1.3* 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 attend a re-accreditation trial to demonstrate the improvement. However the Auditor may identify a different route to demonstrate the improvement if a suitable one exists.
- H1.4* The Improvement Notice shall detail any restrictions to the use of the Equipment prior to satisfactory completion of the Improvement.
- H1.5* The Auditor shall inform the Employer of any Improvement Notices issued and changes of Accreditation status.

Appendix A Requirements on the Auditor

App A.1 Roles of the Auditor

- App A.1.1 As discussed in B.4 the Auditor is split into two main roles:
- Conducting and reporting the Accreditation/Re-accreditation process
 - Monitoring the QA performed by the Contractor and conducting additional (within Period of Work) checks where necessary.
- App A.1.2 These roles can be carried out by the same or by separate bodies. The requirements that these bodies must meet for these two roles are given in the sections below.
- App A.1.3 The Auditor for Accreditation and Re-accreditation Trials shall:
- Organise and host Accreditation and Re-accreditation Trials, including designing and developing the methodology of the trials, all administrative duties, arranging and maintaining suitable sites for Accreditation/Re-accreditation, together with the processing, interpretation and reporting of results.
 - Periodically assess the performance of the site chosen for Accreditation/Re-accreditation so that the longer-term behaviour of the site can be monitored.
 - Issue Accreditation Certificates showing the performance achieved by Equipment at the Accreditation/Re-accreditation Trial in a timely fashion. This should be within 2-3 weeks of the corresponding Trial.
 - Maintain a publically available list of Accredited Equipment.
- App A.1.4 The QA Auditor shall:
- Conduct checks on the QA conducted by the Contractor to the requirements of the Employer (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.
- App A.1.5 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. Copies of these improvement notices shall also be supplied to the Employer.

App A.2 Capabilities of the Auditor

- App A.2.1 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 a suitable test site to undertake the Accreditation/Re-accreditation testing. 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.
- App A.2.2 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.

Appendix B Site and Reference Data requirements for Accreditation/Re-accreditation

App B.1 Test site

- App B.1.1 The Accreditation/Re-accreditation Trial shall incorporate a site that can be closed to traffic to ensure that testing can be completed in a controlled environment. This is referred to as the closed site in the text below.
- App B.1.2 The Trial should also include a site which involves live traffic (a network route). This is referred to as the live site in the text below.
- App B.1.3 The skid resistance test site(s) shall be separated into at least 3 test sections on the closed site, and (if used) 3 test sections on the live site. These sections shall cover a range of skid resistance values and are further described in App B.2. Where possible each section should be approximately 100m in length.
- App B.1.4 The closed test site shall contain a marked length to facilitate calibration of the Distance Measurement Instrument (DMI).
- App B.1.5 The closed test site shall contain one or more sections of straight and level pavement (minimum 500m) for the assessment of the DMI. The start and end points of this section(s) shall be clearly marked (e.g. with a marker post and/or markings on the surface of the pavement).
- App B.1.6 The closed test site shall contain one section of straight and level pavement (minimum 400m) for the assessment of the Equipment survey speed. The start and end points of this section(s) shall be clearly marked (e.g. with a marker post and/or markings on the surface of the pavement).
- App B.1.7 The closed test site shall contain at least 3 test sections, which involve curves and tree coverage for the assessment of the OSGR Systems.

App B.2 Skid resistance test sections

- App B.2.1 The closed site shall include at least 3 skid resistance test sections such that:
- At least one section should have an average SR less than 30.
 - At least one section should have an average SR more than 70
 - The remaining test section(s) should have average SR distributed between those of the other two test sections.
- App B.2.2 The live site should be selected and a test plan implemented so that it can be tested with minimal disruption to other road users. The live site should be selected such that:
- It includes at least one section where the target survey speed should be 50km/h and at least one section where the target speed should be 80km/h (as per the rules in CS 228)
 - It includes at least one roundabout
 - It includes at least one section with multiple bends

App B.3 Reference Data

App B.3.1 Skid resistance

- App B.3.1.1 The Reference Data for the skid resistance assessment is made up from at least three different currently Accredited Equipment that are representative of the currently Accredited Equipment. These representative Equipment shall come from at least two different Owners.
- App B.3.1.2 When designing the test programme and processing the data (both the Reference Data and the data from the other Equipment), the Auditor shall take into consideration:
- Track conditioning effects
 - Tyre variability

App B.3.2 Location Referencing – Distance

- App B.3.2.1 The Reference Data for distance measurement is the elapsed distance for the distance measurement test section(s), as measured by the Auditor using an optical survey or a suitably calibrated and accurate distance measurement device.

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App B.3.3 Location Referencing – OSGR coordinates

App B.3.3.1 The Reference Data for OSGR measurement are the grid coordinates of the test sections measured by the Auditor using an independently calibrated location reference device such as a total station.

App B.3.4 Survey speed

App B.3.4.1 The Reference Data set for speed measurement shall be provided using an independent calibrated measurement device.

Appendix C Worked Example of Accreditation assessment

App C.1 Skid resistance assessment

App C.1.1 **Between run standard deviation (BRSD)**

- App C.1.1.1 Each Equipment undertakes repeat surveys of the test sections and supplies the skid Survey Data to the Auditor. This is processed to produce mean values for each section, wheel path (if applicable) and survey.
- App C.1.1.2 These values are then processed to produce the mean skid and the BRSD for each section and wheel path. The BRSD values are then compared against the criteria. An example of this for one Equipment (referred to as Equipment "A") is shown in Table 11.
- App C.1.1.3 During the analysis of the BRSD values the Auditor may also examine plots of skid values within the sections to see if variability has been caused by differences in test line.

Table 11 – Calculation of mean and BRSD for Equipment A

	Mean skid resistance					Mean skid resistance	BRSD	Within criteria
	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5			
NS Section 1	74.7	73.8	74.7	73.7	71.4	73.7	1.35	Y
NS Section 2	96.1	94.2	92.6	90.4	89.2	92.5	2.79	Y
NS Section 3	30.5	29.2	28.9	25.8	23.5	27.6	2.86	Y

App C.1.2 **Between-Equipment standard deviations (BESD), Fleet means and BESD criteria**

- App C.1.2.1 The Equipment and section means are collected and the average and standard deviation of these values is calculated for each of the wheel paths (if applicable) on each section and for the site as a whole. These Average values are known as the Trial Mean and the standard deviation is known as the Trial Between-Equipment Standard Deviation (Trial BESD).
- App C.1.2.2 The average and standard deviation of the Fleet (the Equipment which currently has Accredited status) is also calculated and this is referred to as the Fleet Mean and the Fleet BESD.
- App C.1.2.3 The Trial BESD is deemed unsuitable if it exceeds the BESD criterion. If the Trial BESD exceeds the criterion then the Fleet BESD is examined. The data from individual Equipment will also be investigated to identify outliers.
- App C.1.2.4 In addition Equipment is marked as requiring investigation if its mean is more than 2 x BESD criteria away from the Fleet Mean, and will not receive Accreditation if it is more than 3 x BESD criteria away from the Fleet Mean.
- App C.1.2.5 An example of these values is given in Table 12 (in this case all of the Equipment taking part in the trial are part of the Fleet and therefore the Trial and Fleet values are the same). Instances where the BESD does not meet the criteria are highlighted in red. Instances where an Equipment's mean skid resistance is more than 3 x BESD criteria away from the Fleet mean are also highlighted in red, and if it is more than 2 x BESD criteria it has been highlighted orange.

Table 12 – Calculation of Fleet Mean and Between Equipment Standard Deviation (BESD)

	Load corrected Mean			
	Section 1	Section 2	Section 3	For the site
Equipment A	73.7	92.5	27.6	64.6
Equipment B	74.0	93.1	29.3	65.5
Equipment C	70.8	88.1	27.9	62.3
Equipment D	75.1	94.0	28.1	65.7
Equipment E	65.6	83.0	18.6	55.7
Equipment F	69.2	86.8	25.8	60.6
Fleet Mean	71.4	89.6	26.2	62.4
BESD	3.59	4.33	3.90	3.82

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App C.1.2.1 It can be seen that Equipment E is consistently lower than the Fleet Mean by between 2 and 3 times the BESD criteria. Although not resulting in an immediate removal from Accreditation, it is flagged for investigation. It can also be seen that the BESD values exceed the criteria. Therefore Equipment E would not receive Accreditation for skid resistance. This machine is then removed from the analysis of skid resistance and the Fleet Mean and the BESD are recalculated. These new values can be seen in Table 13.

Table 13 – Calculation of Fleet Mean and Between Equipment Standard Deviation (BESD)

	Load corrected Mean			
	Section 1	Section 2	Section 3	For the site
Fleet Mean	72.6	90.9	27.7	63.7
BESD	2.46	3.23	1.26	2.44

App C.1.2.2 These new BESD values are all within the BESD criteria except for section 2. Further examination of the data and the site found that this section is particularly prone to between-run variation and therefore will only be used as supporting information. Based on these results Equipment A, B, C, D, and F would receive a pass for skid resistance measurements and Equipment E would not. Note, if the BESD values (or the distance of an individual Equipment from the fleet mean) was unsuitable, the process would be repeated (removing the outliers) until suitable results were obtained.

Appendix D QA check sites summary

App D.1 QA Check sites summary

App D.1.1 The following table provides a summary of the requirements for the Quality Assurance check sites used in the Contractor's Quality Assurance. Further details of the sites and analysis required are given in Section F.

Table 14 – Summary details of Quality Assurance check sites

Site Type	Minimum length	Location referencing method	When shall reference data be collected?	When shall QA checks be carried out using this site?	Test site characteristics
Contractor's Calibration site	400m	<p>The length of the distance check and calibration interval (minimum 400m) shall be measured using steel tape or other reliable device.</p> <p>Where required Grid reference co-ordinates shall be established at 10m intervals along the whole test site.</p>	<p>Within 7 days of the Accreditation/Re-accreditation trial.</p> <p>If establishing a new Contractor's calibration site, within 7 days of a successful Contractor's Calibration Check (or Weekly Check if no suitable Contractor's Calibration data is available – consult with Auditor).</p>	Within 7 days of the Accreditation/Re-accreditation trial	<p>The site should contain at least two lengths with significantly different levels of skid resistance.</p> <p>The site shall contain a test section of straight and level pavement for the assessment and calibration of distance measurements</p>
				At the end of a Lay Off Period prior to conducting surveys	
				No more than 30 days apart (while not in a Lay Off Period)	
				Within 7 days of the last weekly check or Contractor's Calibration Check (while not in a Lay Off Period). This check may be carried out on a Primary Site instead.	
				Before entering a Lay Off Period	
Primary Check Site(s) (Optional)	400m	<p>The length of the distance check interval (minimum 400m) shall be measured using the measuring system on-board the Equipment or from another suitable device.</p> <p>Where required Grid reference co-ordinates shall be established at 10m intervals along the whole test site.</p>	<p>Within 7 days of a successful Contractor's Calibration Check.</p>	<p>Within 7 days of the last weekly check or Contractor's Calibration Check (while not in a Lay Off Period). This check may be carried out on the Contractor's Calibration site instead.</p>	<p>The site (or sites) should contain at least two lengths with significantly different levels of skid resistance.</p> <p>The site (or sites) shall contain a test section of straight and level pavement for the assessment of distance measurements</p>