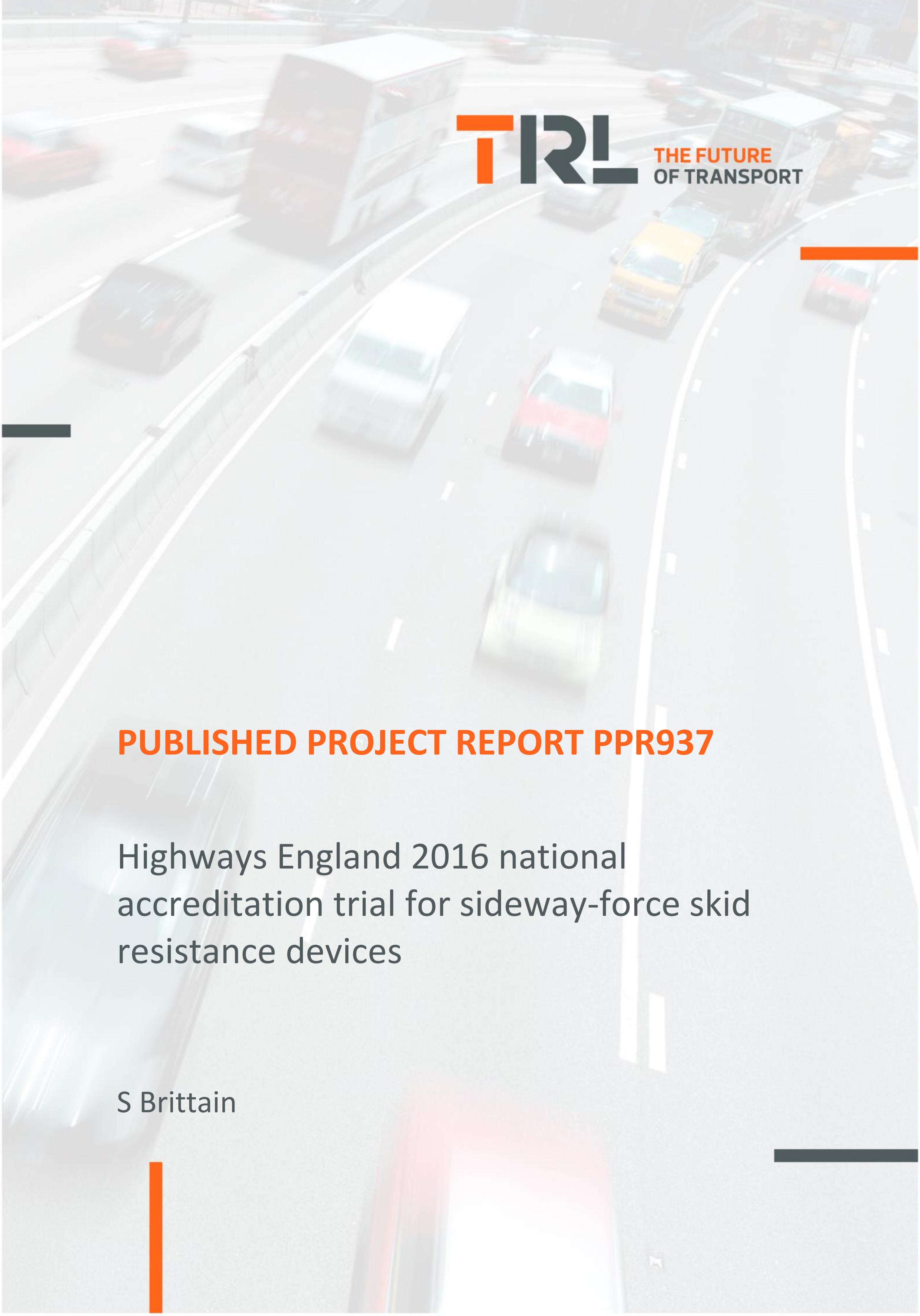

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PUBLISHED PROJECT REPORT PPR937

Highways England 2016 national accreditation trial for sideway-force skid resistance devices

S Brittain

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Executive Summary

The national accreditation trials for sideway-force skid resistance devices are organised annually by TRL, on behalf of Highways England. The purpose of the trials is to verify the performance of all sideway-force skid resistance devices operating on the UK trunk roads so that consistency is maintained throughout the fleet. The measurements by these machines are used to monitor the skid resistance of the motorway and trunk road network in support of Highways England standards HD28/15 (Design Manual for Roads and Bridges, 2015). By examining the results from the machines operating on specified test sections it is possible to assess:

- The performance of individual machines.
- The consistency of the whole UK fleet.

The 2016 accreditation trial was held during the week beginning 4th April 2016. The trial followed a similar format to one that has been used successfully by TRL in previous years. The accreditation trial criteria are specified in "Accreditation and Quality Assurance of Sideways Force Skid Resistance Survey Devices" (TRL, 2013). Sixteen machines from the UK fleet attended, including two machines from the Republic of Ireland which sometimes carry out surveys in the UK.

The following principal conclusions were drawn in relation to the mandatory tests and assessments.

- Fifteen machines met the criteria for the skid resistance measurements.
- Fifteen machines achieved a high performance with regards to the measurement of distance.
- Thirteen machines fitted with 3 dimensional spatial coordinate systems for the provision of Ordnance Survey Grid Reference (OSGR) and altitude were assessed. Twelve machines achieved a high performance for OSGRs, and one a low performance. Eight machines achieved a high performance for altitude, four machines a medium performance and one machine achieved a low performance.
- Fifteen machines met the criteria for the measurement and recording of survey speed.

The following principal conclusions were drawn in relation to the various additional tests and assessments.

- All sixteen machines had satisfactory water flow and direction.
- All sixteen machines were within the tolerance for test wheel weight.

Overall, the trials demonstrated that the UK fleet continues to perform at a level suitable for use in supporting skid resistance standards.

The results from the trial are discussed in this report and are provided in the accreditation certificates issued to the trial participants. These certificates are also accessible at:

http://www.ukroadsliaisongroup.org/en/asset-condition/road-condition-information/data-collection/skid-resistance/Sideway_force_skid_resistance_survey_devices/index.cfm.

Contents

1 Introduction

The 2016 accreditation trial for sideway-force coefficient routine investigation machines was held on the MIRA proving ground and the Longcross test track close to TRL, on behalf of Highways England. This work was conducted under framework arrangement contract 422/4/45/12 Pavement Assessment Accreditation and Assurance (PAAQA).

The purpose of the trial is to verify the performance of all sideway-force skid resistance devices operating on the UK trunk road network so that consistency is maintained throughout the fleet. This is important because the results of measurements by these machines are used to monitor the motorway and trunk road network in support of the Highways England standards (set out in the Design Manual for Roads and Bridges Vol.7, Chapter 3, HD28).

By examining the results from the machines operating on specified test sections it is possible to assess:

- The performance of individual machines.
- The consistency of the whole UK fleet.

TRL has been responsible for planning and running the trials since 1995 and the 2016 exercise followed a similar format to one that has been successfully used for several years. The accreditation trial criteria are specified in "Accreditation and Quality Assurance of Sideways Force Skid Resistance Survey Devices" (TRL, 2013).

The trial comprised six general stages:

1. **Preparations**: During the days immediately preceding the trial, the test track, documentation and support facilities were checked and made ready.
2. **Inspection day (MIRA)**. On this day, the incoming machines are inspected and a series of static tests are made to verify vertical wheel weights, force transducer calibration and water flow control. This day also includes surveys of the network route.
3. **Main running trials day 1 (MIRA)**. This is the first main test day, in which all the machines that proved satisfactory in the initial checks run extensive dynamic tests and the results are reviewed as the data are collected.
4. **Main running trials day 2 (MIRA)**. Following the testing on the main trials day 1, survey crews are notified if their machine appears to be an outlier with regards to skid resistance measurement and given an opportunity to investigate their machine. After this investigation time, additional dynamic tests are conducted. The results of these tests are reported informally to operators in the week following the tests and are confirmed in this report and in the accreditation certificates issued.
5. **3 Dimensional positional system assessments (Longcross)**. The assessments of the 3 dimensional positional systems are conducted at Longcross. This part of the assessment is only conducted by machines which have 3 dimensional positional systems fitted and seeking accreditation for these systems.

6. **Follow-up tests**. Sometimes machines are unable to attend the main trial, or problems are identified that cannot be resolved during the main trial. If machines fail to pass the main trial sponsored by Highways England, any necessary modifications and follow-up tests are arranged by and carried out at the expense of the machines' owners. Depending upon the issues that need to be addressed, these may include a repeat accreditation trial.

The 2016 main trials were held during the week beginning 4th April 2016 and sixteen machines based in the UK and Ireland attended. This included two machines from the Republic of Ireland which sometimes carry out surveys in the UK.

For convenience, throughout this report machines are referred to using the running number assigned at the trial. For ease of comparison, machines usually retain the same running numbers from one year to the next. To avoid confusion with earlier vehicles, when a machine is replaced or re-built on a new chassis, the new vehicle is assigned a new running number in sequence when it first appears at the trials. Appendix A lists all the machines, their running numbers (ID) and their operating organisations as they were in April 2016.

2 Trial Format

2.1 Pre-trial preparation

Although it has been found generally to not be a large source of variation, small variations in skid resistance measurements can be caused by differences between tests tyres fitted to different machines. For this reason, a set of "matched" tyres were requested from the tyre supplier for use in the trial. These tyres were scrubbed in prior to the trial and the data produced was checked for consistency.

The parts of the MIRA proving ground used in the trial are prepared on the days leading up to the trials. The reference points at the start of each test length are identified using cones and marker flags and the track was visually inspected.

There is always an element of variability in the measurements that is a result of drivers following different test lines. This manifests itself both in variation between runs with the same driver and in different general lines followed by different drivers. For this reason, the test line to follow is explicitly identified on appropriate parts of the test track. This was achieved by placing cones either side of the lane to create a corridor for the machines to travel within.

2.2 Inspection day – MIRA

The inspection day is used to conduct inspections and calibrations of the machines attending the trial along with a survey of the network route:

1. Water flow checks
2. Wheel weight checks and vertical calibration
3. Distance calibration
4. Survey of the network route

2.3 Main running trial days – MIRA

The main running trials are designed to test, firstly, whether individual machines are operating consistently and, secondly, whether different machines obtain comparable readings over a range of skid resistance levels.

Each crew is given instructions and a copy of the planned running order and organisation of the machines, so that they knew approximately when they would be running, with which tyre, and with which other machines. Due to unexpected events such as minor problems with vehicles or operating errors this running order is occasionally amended in situ.

All machines are operated with the dynamic vertical load measurement system turned on, which is the default condition in which they operate on the network. In addition, the machines are set up to report the average skid readings at 10m intervals. After each set of tests the data is collected and checked to verify that the location referencing codes have been inserted correctly by the operator.

2.4 3 Dimensional positional system assessment – Longcross and network route

The 3 dimensional positional systems are assessed on the network route (near MIRA) and on the Longcross test track. This assessment determines if the machines identify the correct position of section marker points (identified with retro-reflective markers and cones), in addition to accurately plotting the route between these markers. After each test lap the data is collected and checked to verify that the location referencing codes have been correctly identified (either via automatic detection if fitted, or by manual entry if not).

3 Test sections

The trial uses two areas of the MIRA proving ground (the Twin Straights and the Straight Line Wet Grip Area), along with a network route in the surrounding area. In addition the Longcross test track is also used for the machines which are undergoing the 3 dimensional positional systems assessment.

3.1 Twin straights

This area is used for distance calibration, the location referencing tests (including speed measurement), and for skid resistance testing. The overview of the Twin Straights and the position of the marker points A-H are given in Figure 3.1.

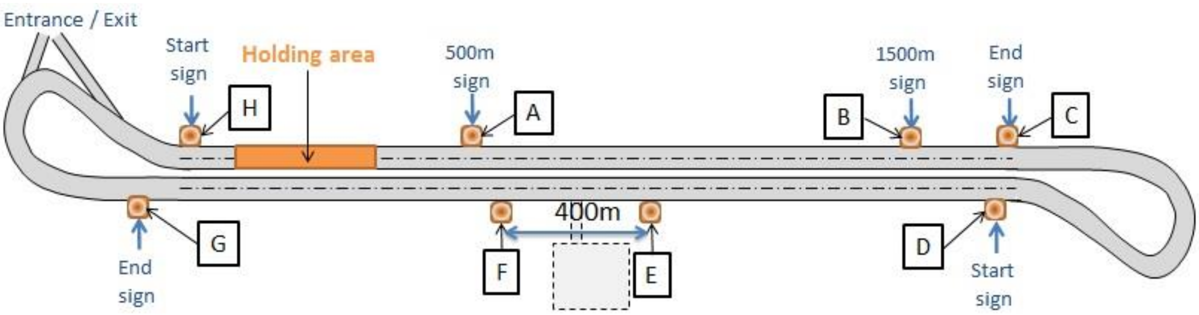

Figure 3.1 Overview of Twin Straights and position of marker points

The skid resistance data is assessed on the length between markers E and G, and utilises the Highways England calibration site. Six sections on this length have been selected for analysis. The position of these sections is shown in Figure 3.2. Details of the surfaces are given in Table 3.1.

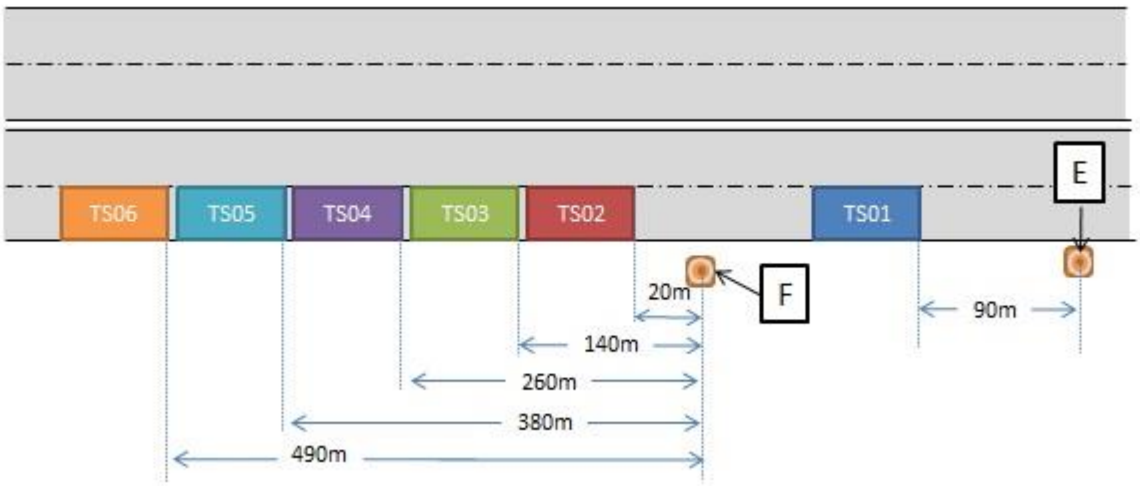

Figure 3.2 Skid resistance test sections on Twin Straights

Table 3.1 Skid resistance test sections on Twin Straights

Section	Length (m)	Surface description
TS01	130	Normal track surface, thin surfacing applied in October 2013
TS02	100*	A proprietary thin surfacing material using 6 mm coarse aggregate and polymer-modified bitumen. The small-size particles are closely packed and the texture is formed by large numbers of relatively narrow and shallow gaps between them. This type of surfacing generates very low levels of traffic noise but it has a relatively lower texture depth (compared with other thin surfacings with coarser aggregates). Laid in October 2010.
TS03	100*	A proprietary thin surfacing material using 10 mm coarse aggregate and a fibre-reinforced bitumen. This is typical of low-noise asphalt materials laid on many roads. Laid in October 2010.
TS04	100*	A proprietary thin surfacing material using 14 mm coarse aggregate. It has a rather more open grading, and hence greater texture depth, than the surfacings with the smaller aggregate. Laid in October 2010
TS05	50*	A hot-rolled asphalt mat into which 20 mm chippings that have been lightly pre-coated with bitumen are rolled while the asphalt is still hot. This is the "traditional" material used commonly on UK main roads until the introduction of thin surfacings from about 1990. Laid in October 2010
TS06	100	Normal track surface, thin surfacing applied in October 2013

* The trial lengths on the Calibration Site did not include the full length of each surfacing in order to exclude the transitions between the different surfaces.

3.2 Straight Line Wet Grip area

The Straight Line Wet Grip area on the MIRA proving ground is utilised to provide lengths with low skid resistance levels. The position of the sections are given in Figure 3.3 and details of the sections are given in Table 3.2

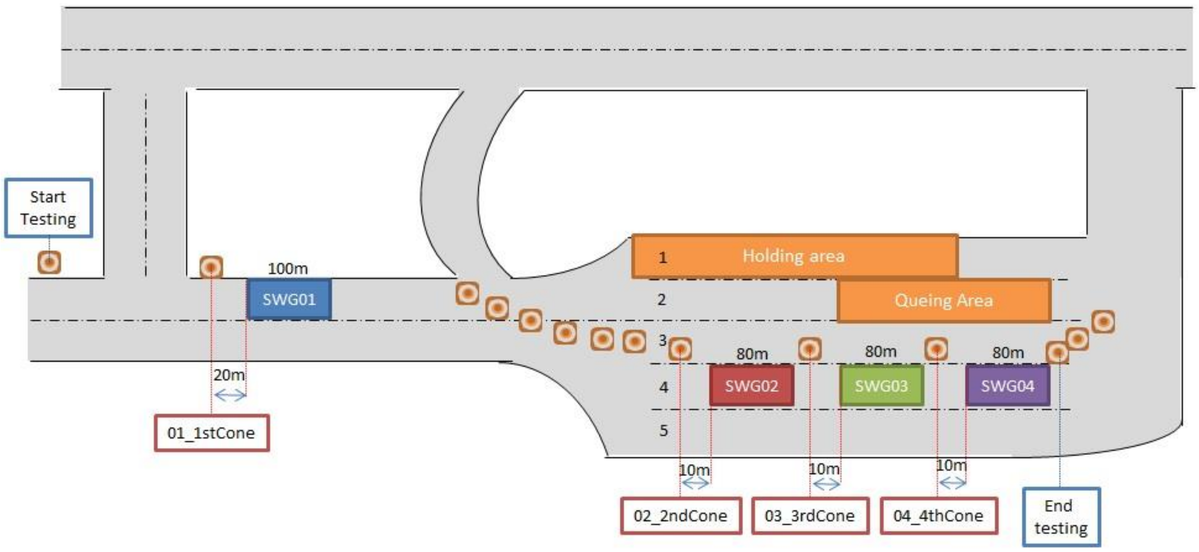

Figure 3.3 Skid resistance test sections on the Straight Line Wet Grip area

Table 3.2 Skid resistance test sections on the Straight Line Wet Grip area

Section	Length (m)	Surface description
SWG01	100	Transverse grooved Portland cement concrete
SWG02	60	Worn bitumen macadam
SWG03	60	Bridport gravel (with quartzite) exposed aggregate concrete
SWG04	60	Smooth asphalt concrete

3.3 Network route to Sheepy Magna

A network has been included in the accreditation trial to provide supporting data for the assessment of skid resistance and location referencing. The first marker of the route is at the entrance of MIRA, the route then loops round to Sheepy Magna and returns to MIRA as shown in Figure 3.4. Details of the route are given in Table 3.3.

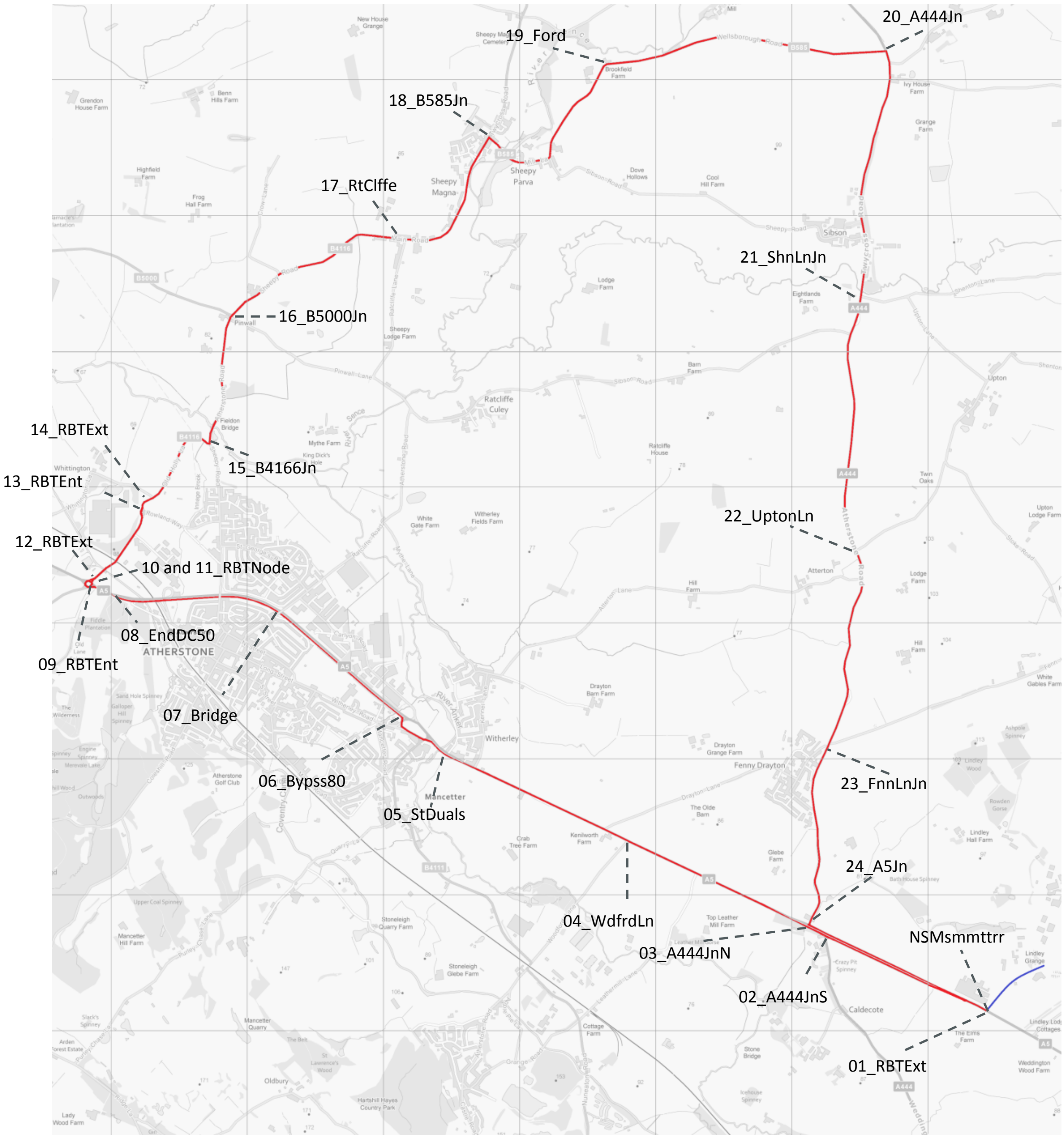

Figure 3.4 Network route to Sheepy Magna

Table 3.3 Details of network route, including marker positions

Survey distance (km)	Section length (m)	Markers	Marker position	Driving Instructions
n/a	n/a	**NSMsmmttrr**	Entry to MIRA roundabout	Turn right at the MIRA exit roundabout (A5 WB)
0	1260	**01_RBTExt**	Node at exit of MIRA roundabout	Continue on A5, testing in Lane 1
1.26	192	**02_A444JnS**	Node at entry to gyratory at junction with A444 south	Continue on A5
1.45	1454	**03_A444JnN**	Node at exit of gyratory at Junction with A444 North	Continue on A5
2.91	1379	**04_WdfrdLn**	Node at centre of Junction with Woodford lane (has sign for Dobbie's Garden world)	Continue on A5
4.28	543	**05_StDuals**	Start of duals	Dual carriageway commences. Take right lane and continue to second exit on to A5 Atherstone by-pass towards Tamworth.
4.83	1199	**06_Bypss80**	Mancetter circulatory system exit	Return to testing on Lane 1 for exit of circulatory system on to A5.
6.03	1249	**07_Bridge**	Centre of 1st road bridge going over A5	Continue on A5
7.28	178	**08_EndDC50**	Node at end of dual carriageway	Continue testing for approx 200m on approach to roundabout
7.45	128	**09_RBTEnt**	Entry to roundabout junction with B4116	Test roundabout as per HD28
7.58	147	**10_RBTNode**	Roundabout "Node"	Continue survey of roundabout
7.73	111	**11_RbtNode**	Roundabout "Node"	7.73
7.84	640	**12_RBTExt**	Roundabout exit	Take exit, B4116 towards Twycross.
8.48	30	**13_RBTEnt**	Roundabout (access to Aldi distribution depot)	Take second exit (straight on)
8.51	836	**14_RbtExt**	Roundabout exit	Continue testing on B4116
9.35	970	**15_B4166Jn**	At T-junction	Turn left and continue testing on B4116 towards Twycross
10.32	1486	**16_B5000Jn**	Junction with B5000 (on left) at the Red Lion	Continue testing on B4116
11.80	1100	**17_RtClffe**	Centre of junction with Ratcliffe Ln (on right)	Continue on B4116 and enter Sheppy Magana
12.90	1333	**18_B585Jn**	At exit of T-Junction	Turn right on to B585 (Mill Lane) towards Market Bosworth.
14.24	2108	**19_Ford**	Centre of junction with sign post for ford.	Continue on B585
16.34	1847	**20_A444Jn**	At junction with A444	Turn right onto A444 towards Nuneaton.
18.19	1910	**21_ShnLnJn**	At Junction with Shenton Lane (signposted Upper Shenton)	Continue on A444
20.10	1476	**22_UptonLn**	At junction with Upton Lane (on left, is sign posted for Upton)	Continue on A444
21.58	1385	**23_FnnLnJn**	At junction with Fenn Lanes (on left, is sign posted for Bosworth Battlefield)	Continue on A444
22.96	n/a	**24_A5Jn**	Centre of A444/A5 Junction	Turn left on to A5 towards Hinkley. Continue along the A5. On dual carriageway in Lane 1 This marks the end of the route.

Fourteen 100m lengths of varying skid resistance levels are selected from the Network Route for the analysis. These lengths have been selected for homogeneity during the length and low indications of variation due to test line. As parts of the route may be maintained between accreditation trials, the lengths used in the analysis are reviewed in each accreditation trial and modified as necessary. Therefore the locations of these lengths (and the typical skid resistance values) may vary between trials.

3.4 Longcross test track

This site includes more corners and tree coverage than the sites used on the MIRA proving ground, providing a more challenging test environment for the assessment of the 3 dimensional positional systems. The site contains eight marker points and five assessment sections (highlighted in red) as shown in Figure 3.5 and Table 3.4.

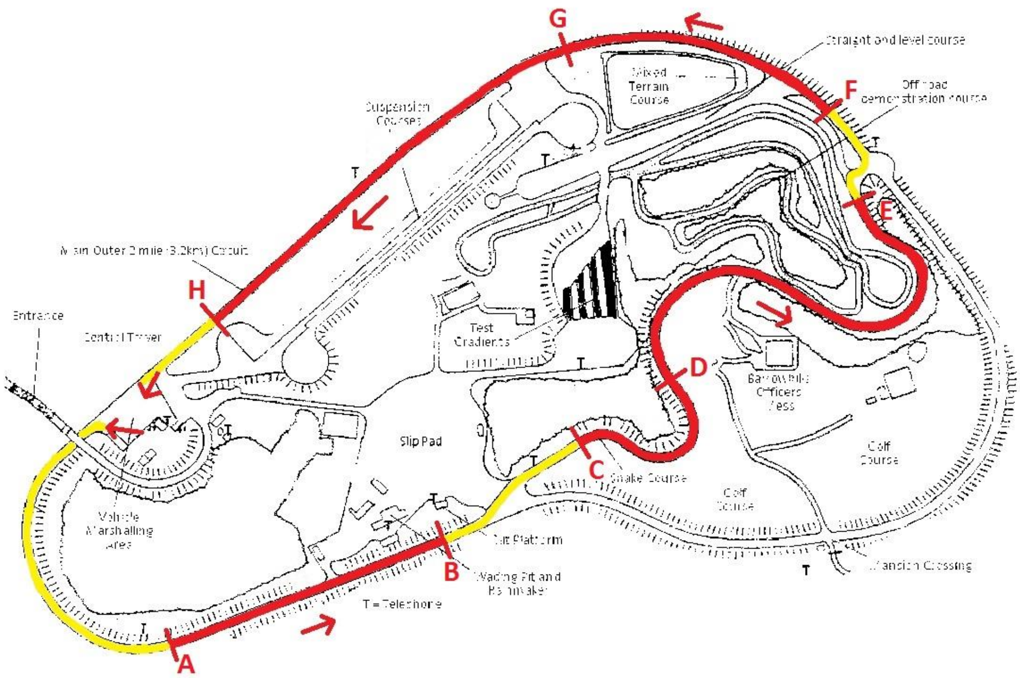

Figure 3.5 Longcross test track site map

Table 3.4 Details of Longcross test track, including marker positions

Section	Length (m)	Easting	Northing	Section identifier
Start to A	>200	N/A	N/A	Run-in
A to B	290.1	498377.2642	165348.1812	AB
B to C	240.2	498643.7988	165462.5819	BC
C to D	246.3	498837.211	165596.6619	CD
D to E	637.8	498961.4243	165672.3736	DE
E to F	155.8	499199.0944	165908.341	EF
F to G	367.0	499150.9436	166034.2452	FG
G to H	472.6	498806.0321	166098.0752	GH
to End	>200	498440.6401	165803.5887	Run-out

4 Assessment criteria

The majority of the accreditation trial criteria are specified in "Accreditation and Quality Assurance of Sideways Force Skid Resistance Survey Devices" (TRL, 2013). The QA document is a live document (i.e. is subject to change) and the December 2013 version of the document was used for the trial. The relevant section of the document is copied verbatim below (section 4.1). Additional criteria not detailed in that document are presented in section 4.2. Note in the text below, "Equipment" is a defined term and refers to the overall machine being assessed, incorporating the measuring systems and the survey vehicle. "System" refers to an individual measurement system installed on the Equipment e.g. the side-force measurement system, GPS, distance measurement system etc. "Employer" refers to the organisation that commissions the Survey Contractor to complete a survey and will generally be the final user of the data provided. "Owner" refers to the organisation or individual to which Equipment belongs and to whom Accreditation Certificates are awarded.

4.1 Trial criteria from the Accreditation and QA document

A1.1 Production of Data in Specific File Formats

A1.1.1 Some Employers require the production of data in specific data formats, for example the Highways Agency requires data to be produced as Raw Condition Data (RCD) or Base Condition Data (BCD). Where required, Owners will be required to deliver accreditation data files in the required format. These will be assessed to determine whether the data is being correctly processed.

A1.2 Skid resistance measurements

A1.2.1 Measurements will be collected from the test sections at target test speeds of 50 km/h and 80km/h.

A1.2.2 The between-run standard deviation (BRSD) will be used to assess the repeatability of each Equipment. The BRSD is calculated from the average values of 100m lengths (or the length of the test section if shorter). The BRSD criterion is given in Table 5.

A1.2.3 Where the BRSD criterion is exceeded, the data will 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 will be regarded as unacceptable.

A1.2.4 The between-Equipment standard deviation (BESD) will be used to assess the consistency of the fleet. The BESD is acceptable if it is below the criterion given in Table 5. If the BESD exceeds this criterion then the data will be further examined to identify outlying Equipment. Outlying Equipment will be rejected and the data reassessed until the fleet performance is acceptable.

A1.2.5 In addition, any Equipment that deviates by more than 3 times the BESD criterion from the all-Equipment mean will be rejected. Any Equipment that is between two and three times the BESD criterion from the all-Equipment mean will be subject to further investigation.

A1.2.6 The data from any Equipment rejected due to the BRSD, BESD or identified as an outlier from the all-Equipment mean, will be removed from the calculation of the reference data.

Table 5 – 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)	≤2.7 SR

A1.1 Location Referencing

A1.1.1 The measurement of the locational referencing of data in relation to distance travelled in section and lane will be assessed for accuracy (against a reference) and repeatability (against repeat survey runs) of the measurements of elapsed distance of any given point from a fixed location referencing point (e.g. from a section start point).

A1.1.2 There are two mechanisms for recording location referencing points in the survey data during testing. The first (push button entry) relies on the survey operator pushing a button to enter the location of the point manually. The second (Automatic markers) uses a system which automatically detects the markers. As the push button entry approach will include some operator error, it is expected that Equipment using automatic marker recognition will be more accurate than those using the push button approach.

A1.1.3 There are three levels of performance for the measurement of elapsed distance depending on the capability of the Equipment. The acceptable tolerances for High, Medium and Low levels of performance are shown in Table 6 (note a specific performance level may be requested by some Employers).

A1.1.4 Reference data for the assessment of elapsed distance shall be obtained using a suitable calibrated reference method such as a measurement wheel, measuring tape or a mobile measurement system selected by the Employer (for example the Highways Agency HARRIS vehicle).

Table 6 – Acceptance Criteria for Location Referencing (distance travelled)

Performance level	Push button entry	Automatic markers (where available)
High	80% within 5m	80% within 1m
Medium	80% within 10m	80% within 2m
Low	Otherwise	Otherwise

A1.1 3 Dimensional Spatial Coordinates

A1.1.1 The measurement of 3 Dimensional Spatial Coordinates will be assessed for the accuracy and repeatability of the reported 3 Dimensional Spatial Coordinates against the True 3 Dimensional Spatial Coordinates of that point.

A1.1.2 There are again three levels of performance for the measurement of 3 Dimensional Spatial Coordinates depending on the capability of the Equipment. The acceptable tolerances for High, Medium and Low levels of performance are shown in Table 7 and Table 8 (note a specific performance level may be requested by some Employers).

A1.1.3 Reference data for the assessment of 3 Dimensional Spatial Coordinates shall be obtained using a suitable reference method such as a static dGPS, total station, or a suitable accurate mobile measurement system selected by the Employer (for example the Highways Agency HARRIS vehicle).

Table 7 - Acceptance Criteria for High level performance in measurement of 3 Dimensional Spatial Coordinates

Marker entry method	Test	OSGR	Altitude
Site level tests			
Push Button	Position of Location Referencing Points	80% within 5m 90% within 10m 100% within 20m	80% within 2m 90% within 5m 100% within 20m
Automatic	Position of Location Referencing Points	90% within 2m 95% within 4m 100% within 20m	90% within 2m 95% within 5m 100% within 20m
Push Button	Individual 10m data points	80% within 5m 90% within 10m 100% within 25m	80% within 2m 90% within 5m 100% within 20m
Automatic	Individual 10m data points	90% within 2m 95% within 4m 100% within 20m	90% within 2m 95% within 5m 100% within 20m
Network Level tests			
Push button (or fitting by section length)	Position of Location Referencing Points	95% within 10m 100% within 25m	95% within 6m 100% within 20m
OSGR fitting	Position of Location Referencing Points	95% within 4m 100% within 20m	95% within 6m 100% within 20m
Push button (or fitting by section length)	Individual 10m data points	90% within 12m 100% within 25m	90% within 6m 100% within 20m
OSGR fitting	Individual 10m data points	90% within 6m 100% within 20m	90% within 6m 100% within 20m

Table 8 - Acceptance Criteria for Medium level performance in measurement of 3 Dimensional Spatial Coordinates

Marker entry method	Test	OSGR	Altitude
Site level tests			
Push Button	Position of Location Referencing Points	80% within 10m 90% within 15m 100% within 20m	80% within 4m 90% within 6m 100% within 20m
Automatic	Position of Location Referencing Points	80% within 2m 90% within 4m 100% within 20m	80% within 4m 90% within 6m 100% within 20m
Push Button	Individual 10m data points	80% within 10m 90% within 15m 100% within 25m	80% within 4m 90% within 6m 100% within 20m
Automatic	Individual 10m data points	80% within 2m 90% within 4m 100% within 20m	80% within 4m 90% within 6m 100% within 20m
Network Level tests			
Push button (or fitting by section length)	Position of Location Referencing Points	95% within 15m 100% within 30m	95% within 6m 100% within 20m
OSGR fitting	Position of Location Referencing Points	95% within 8m 100% within 20m	95% within 6m 100% within 20m
Push button (or fitting by section length)	Individual 10m data points	90% within 17m 100% within 30m	90% within 6m 100% within 20m
OSGR fitting	Individual 10m data points	90% within 12m 100% within 25m	90% within 6m 100% within 20m

A1.1 Vehicle Speed

A1.1.1 Accreditation of vehicle speed measurement will be based on the speed measured by an independent, calibrated measurement system. The test speed measurement will be carried out 50 and 80km/h target test speeds.

A1.1.2 The assessment will be in two parts:

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

A1.1.3 The acceptance criteria for vehicle speed measurement are given in Table 9.

Table 9 – Acceptance Criteria for Vehicle Speed Measurement

Parameter	Acceptability Limit
Vehicle Speed recorded by the Equipment	± 1km/h of the independently measured speed ± 3km/h of required target speed

4.2 Additional test criteria

4.2.1 Skid resistance measurements on Network Route

Due to increased variations in test speed and driving line it is expected that the results from the Network Route are likely to be more variable than data collected on the test track. To account for this, separate criteria to be applied to the skid resistance measurements from the Network Route have been generated. These are shown in Table 4.10

Table 4.10 Acceptance Criteria for skid resistance measurements on the Network route

Parameter	Acceptability Limit
Between Equipment standard deviation (BESD)	≤2.8 SR

4.2.2 Test wheel weight

Electronic weigh pads are used for checking the static vertical load on the test wheel. Ramped wooden pads are used to raise the vehicle tyres to the same level as the top of the weigh pad so that the test wheel of each machine can be weighed with its tyre and shaft bearings in the normal running position.

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 load is measured both as initially applied and 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). The process of raising and lowering the wheel on to the weigh pad is repeated three times. The results from these three tests are compared to the criteria given in Table 4.11.

Table 4.11 Acceptance Criteria for test wheel weight

Parameter	Acceptability Limit
"Bounced" test wheel weight	200 ±8kg

4.2.3 Water flow

The water delivery system is inspected (checking for damage to the outlet nozzles, for example), and the flow rate is measured to confirm that the Equipment is delivering water at an acceptable rate.

The flow rate is checked by measuring the quantity of water released during a measured time period. The timed period and volume of water criteria are given in Table 4.12.

Table 4.12 Acceptance Criteria for water flow

Parameter	Acceptability Limit
Without speed control	25 litres±10% in 26 seconds
With speed control	Set at 50km/h: 25 litres±10% in 51 seconds Set at 80km/h: 25 litres±10% in 32 seconds

5 Machine inspections

5.1 Water flow rate checks

After minor adjustments to some machines, it was deemed that all machines had satisfactory water flow and direction.

5.2 Left test wheel weight checks

Each machine was weighed when the level of water in its tank was half full. The results of these checks are given in Table 5.1.

Table 5.1 Acceptance Criteria for test wheel weight

Machine	Average static wheel weight							
	"Un-bounced"				"Bounced"			
	Check 1	Check 2	Check 3	Mean	Check 1	Check 2	Check 3	Mean
1	201.2	197.2	199.2	199.2	201.6	201.2	203.6	202.1
3	200.0	200.5	200.5	200.3	202.0	202.5	202.5	202.3
14	203.2	203.2	203.0	203.1	204.0	204.4	204.8	204.4
16	203.0	202.5	203.0	202.8	204.0	204.0	204.0	204.0
17	200.0	200.5	200.0	200.2	203.5	203.5	204.0	203.7
18	205.0	205.0	205.5	205.2	203.5	203.5	203.5	203.5
19	196.6	196.6	196.8	196.7	200.6	200.8	200.6	200.7
21	196.0	196.4	196.4	196.3	198.6	199.4	199.4	199.1
22	199.0	199.0	198.5	198.8	199.5	199.5	199.5	199.5
23	197.5	198.0	198.5	198.0	202.5	202.5	202.5	202.5
24	196.0	196.5	196.5	196.3	200.5	201.0	201.0	200.8
25	199.0	199.0	199.0	199.0	202.4	202.0	202.2	202.2
26	195.8	197.0	197.2	196.7	201.4	202.6	202.6	202.2
28	195.4	195.6	195.6	195.5	199.6	199.8	199.8	199.7
29	204.5	205.0	205.0	204.8	206.0	206.5	206.5	206.3
31	195.6	195.8	196.0	195.8	200.0	200.2	200.2	200.1

It can be seen in Table 5.1 that all of the "bounced" mean weights of the machines fell within the tolerances given in section 4.2.2. There is a noticeable difference in the bounced and un-bounced wheel weight values for some of the machines (e.g. Machine 23, 24 and 26). The owners of these machines should be aware that this may be an indication of some deterioration in shaft assembly and may cause issues at a future date.

In 2009, British Standards published a CEN Technical Specification for these devices (British Standards Institution, 2009). This is a Draft for development document that can be used voluntarily over a period so that experience can be gained before being accepted and introduced (if appropriate) as a full EN (European Norme). This is one of a series of documents for skid resistance measurement devices intended to encourage consistent standards in use of similar machines in different European countries. It is envisaged that the requirements in this document will eventually supersede those in the current British Standard (British Standards Institution, 2006).

This DD was developed from BS 7941-1 so it is already largely consistent with current UK practice. However, some aspects were revised to take account of wider experience of use of similar devices in Europe and one of these is the reduction of the tolerance for static wheel weight to ±1 kg.

All of the machines were well within the current ±8 kg tolerance. However, had the CEN TS requirement been applied to the fleet this year, only six machines would have been acceptable at ±1 kg. In future trials it may be appropriate to review this aspect more closely, both in terms of how the weight is measured and the tolerances that are practically achievable (or necessary where dynamic vertical load is measured), so that the British Standards Committee that deals with these matters can be advised of the practical experience and take this into account in their deliberations and their discussions when the CEN document is due for review.

5.3 Vertical and horizontal load calibration

During the static wheel weight checks, the vertical load calibration check was also carried out, followed by a full vertical load calibration and a further vertical load calibration check. Vertical calibrations were successfully carried out on all machines.

The crews were also asked to conduct a horizontal calibration during the inspection day before conducting the network route tests.

5.4 Distance calibration

All crews undertook a distance calibration of their machine on a defined length at the test site. No issues were reported during this process.

5.5 Speed

The assessment of speed (the attainment of the target speed and the accurate recording of speed in the survey data) was carried out using data collected during the tests on the Twin Straights.

The time taken for the machines to travel between markers E and F, along with the distance between these two markers was used to determine an independent measure of the average speed of the machines over this length. The elapsed time was recorded using a set of timing gates which recoded the time in seconds to 2 decimal places.

The differences between the survey data and the independent measure are shown in Table 5.2. The differences between the independent measure and the target speed are shown in Table 5.3. Instances where the value exceeds the criteria levels in section 4.1 are highlighted in bold red text. It was not possible to record valid independent data on all runs therefore some data are missing from the tables. Machine 1 had developed a fault and did not take part in these tests.

Table 5.2 Difference between speed recorded in data and independent measure

ID	Speed recorded in data – independent measure of speed								Percentage within criteria
	Target speed 50km/h				Target speed 80km/h				
	Run 1	Run 2	Run 3	Run 4	Run 1	Run 2	Run 3	Run 4	
1	.	.	.	.	.	.	.	.	n/a
3	0.19	0.17	0.13	0.15	0.46	0.37	0.32	0.34	100%
14	.	-0.14	-0.16	-0.16	0.20	0.04	-0.04	-0.09	100%
16	-0.52	0.08	0.06	0.05	0.15	0.16	0.08	0.04	100%
17	0.38	0.31	0.25	.	-0.11	0.18	-0.22	-0.19	100%
18	0.79	0.77	0.75	0.66	**1.04**	0.96	0.96	0.96	88%
19	0.20	0.34	0.13	0.27	0.15	0.10	0.15	0.10	100%
21	-0.03	-0.05	-0.07	-0.10	0.41	0.34	0.37	0.30	100%
22	.	-0.15	-0.12	.	-0.21	-0.13	0.02	0.38	100%
23	0.27	0.28	**1.05**	.	0.47	.	0.44	0.44	83%
24	.	**-1.09**	-0.15	0.10	0.09	.	-0.08	-0.17	83%
25	0.10	0.08	-0.12	.	0.06	.	**1.05**	-0.02	83%
26	.	0.09	0.08	0.89	0.17	.	0.13	0.08	100%
28	-0.06	-0.10	-0.24	-0.07	0.27	0.27	0.22	0.22	100%
29	-0.27	0.81	0.23	.	0.26	0.19	0.07	0.02	100%
31	0.14	0.12	0.10	0.10	0.23	0.23	0.14	0.14	100%

Table 5.3 Difference between independent measure and target speed

ID	Independent measure of speed- target speed								Percentage within criteria
	Target speed 50km/h				Target speed 80km/h				
	Run 1	Run 2	Run 3	Run 4	Run 1	Run 2	Run 3	Run 4	
1	.	.	.	.	.	.	.	.	n/a
3	-1.19	0.83	0.87	0.85	-0.49	-0.44	-0.40	-0.44	100%
14	.	0.14	0.16	0.16	1.73	1.96	0.04	0.09	100%
16	0.62	0.00	0.03	0.03	0.90	0.85	0.94	0.99	100%
17	0.62	0.62	0.72	.	0.18	0.31	0.22	0.27	100%
18	0.21	0.23	0.03	0.10	-0.04	0.04	0.04	0.04	100%
19	**3.63**	2.61	2.73	2.73	2.85	2.90	2.85	2.90	88%
21	0.03	0.05	0.07	0.10	0.45	0.49	-0.40	-0.44	100%
22	0.09	-0.85	0.12	.	-0.79	-0.79	-0.75	-1.35	100%
23	-1.27	-0.28	-0.05	.	-2.66	.	**-3.44**	-0.44	83%
24	.	0.09	-1.58	-1.74	**-4.09**	.	**-4.84**	**-3.81**	**50%**
25	-1.00	-0.94	-0.34	.	-0.79	.	-1.95	-0.88	100%
26	.	0.35	-0.05	0.09	-1.95	.	-1.44	-1.74	100%
28	0.17	0.23	0.24	0.24	-0.27	-0.27	-0.22	-0.22	100%
29	0.24	-0.46	-0.38	.	-1.18	-0.97	-1.61	-0.70	100%
31	-0.14	-0.12	-0.10	-0.10	-1.23	-1.23	-1.14	-1.14	100%

From these tables it can be seen that all but one machine achieved at least 80% of their data within the criteria. The remaining machine (Machine 24) failed to meet the target speed on the 80km/h. It is believed that this is due to the machine being unable to accelerate up to the target speed within the test length rather than a fault with the equipment. Due to the good performance of this machine in the 50km/h tests and the accuracy of the speed measurement, this machine has been awarded a pass for the measurement of survey speed. Therefore all machines are deemed acceptable with regards to measurement of survey speed.

6 Skid resistance measurements

Skid resistance measurements were taken on three sites (Twin Straights, Straight Line Wet Grip, and on the network route). The assessment of skid resistance measurements falls into two parts; machine repeatability and variation between machines (see section 4.1).

6.1 Amendments to survey machines

At the end of the main running trials day 1, survey crews are given preliminary feedback using a red/amber/green scale on the performance of their machines based on the results from the first set of tests on the straight line wet grip area. They are then given an opportunity to investigate their machines before additional testing takes place. These categories are defined as:

- **Green** – the machine is producing skid resistance value within the required criteria for skid resistance based on the current fleet average.
- **Amber** – the machine is producing skid resistance values within the required criteria but close to the thresholds.
- **Red** – the machine is producing skid resistance values outside of the criteria for accreditation for skid resistance.

For the 2016 trial one machine (Machine 29) was found to be outside of the criteria and was assigned the red category. One Machine (Machine 1) developed a fault early on in the testing and did not take part in the trial.

6.2 Machine repeatability

The between run standard deviation (BRSD) data for the survey data is given in Appendix B.

On examination of the between run standard deviation and plots of the individual runs the following conclusions were made:

- The data from the network route shows several instances where the data lies between 1 and 2 times the BRSD criteria, and a several instances greater than this. However, it is expected that the between run standard deviation will be greater than the thresholds more often on the network route. Two Machines were found to have consistently high BRSD values (Machine 18 and 21).
- The data from the first set of tests on the Straight Line Wet Grip shows a high BRSD for all of the machines on SWG04. This may be due to variations in driving line and/or track conditioning effects. To reduce variations in driving line cones were added to constrain the test line. Variations due to track conditioning effects should naturally reduce for the second set of tests as the track has been significantly trafficked. There were no machines identified from this testing with consistently high BRSD.
- The second set of tests on the Straight Line Wet Grip showed a reduction in the BRSD on SWG04 (although still higher than the other surfaces). No machines were identified from this testing as having a high BRSD.

- The sections on the Twin Straights appear to be slightly more variable than the Straight Line Wet Grip surfaces (excluding SWG04), as seen by the slightly higher average BRSD values per section. This is likely due to the fact that these surfaces have not experienced much traffic, variations in test line for the machines and the lower number of test passes (four instead of five). These sections are therefore not used in the formal assessment of SR during this year's trial. Instead the data is used as supporting evidence. It is expected that in future years the variation of these sections will decrease allowing for use in future trials.

No machine consistency exceeds the BRSD criterion during the trial and therefore all of the machines (that took part in the testing part of the trial) are performing acceptably with regards to between run variation.

6.3 Variation between machines

The average SR values produced by the machines for each of the test sites are shown in the tables below. At the base of each table are the average and standard deviation calculated for the fleet (indicated as "All mean" and "All BESD" respectively). All of the machines taking part in the trial have taken part (and met the criteria) in previous trials and therefore are all considered as part of the "Fleet" (the reference devices) for this assessment.

As noted previously Machine 1 developed a fault early on in the trial and did not take part in the running trials. In addition to this the immobiliser activated on Machine 26 prior to the 2nd set of tests on the Straight Line Wet Grip area and it could not take part in this test. Machine 29 was unable to take part in the Twin Straights testing at the same time as the other machines and therefore its data has been excluded from the analysis on this site.

Machine SR values are highlighted in green if they lie within 2 times the BESD criteria (see sections 4.1 and 4.2.1) of the reference mean, in orange if they lie between 2 and 3 times the BESD criteria, and in red if they are greater than 3 times the BESD criteria. The BESD values are highlighted in green if they are below the BESD criteria, in orange if they are below 1.5 times the BESD criteria and in red if they exceed this value.

6.3.1 Inspection day tests

Table 6.1 Average SR from the network route surveys

ID	Average SR for network route sections														
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	Avg
3	66.5	89.1	79.4	82.6	83.8	63.6	77.5	85.2	72.8	61.2	79.4	54.9	48.4	63.7	72.0
14	64.5	85.1	78.3	83.0	84.7	63.9	77.2	84.4	73.7	61.8	77.4	53.5	48.8	67.2	71.7
16	72.0	97.1	86.4	93.2	93.9	67.3	80.8	93.4	74.0	65.5	80.7	57.4	52.1	67.8	77.3
17	63.9	85.1	75.0	81.1	82.7	62.5	76.0	83.8	70.2	58.3	71.6	59.0	52.9	65.9	70.6
18	77.0	85.9	87.6	90.1	92.7	66.2	73.0	79.5	71.1	63.0	76.2	62.0	56.4	68.4	74.9
19	63.8	85.3	76.5	83.0	84.7	63.0	75.6	86.5	73.7	61.8	78.3	53.7	48.2	67.2	71.5
21	66.9	88.3	82.0	85.1	87.5	66.5	78.3	90.6	73.2	64.1	80.5	54.8	51.2	66.5	74.0
22	68.1	89.5	82.3	86.8	90.1	68.0	78.1	88.0	75.7	62.5	81.7	55.6	50.9	67.8	74.6
23	64.6	85.2	76.6	80.6	82.7	59.6	73.8	83.6	69.3	58.8	75.1	51.7	46.5	62.7	69.3
24	65.2	85.3	77.5	83.2	83.8	62.6	75.4	84.2	72.0	60.2	76.7	55.7	50.8	68.3	71.5
25	65.6	87.0	79.8	85.8	88.5	61.8	75.5	84.4	71.4	60.4	76.2	57.8	49.1	66.6	72.1
26	60.6	81.5	73.1	82.1	82.3	58.2	71.6	76.9	67.2	58.2	73.5	49.9	44.6	63.7	67.4
28	65.8	83.7	75.6	82.1	82.0	59.7	75.2	84.9	69.9	58.8	75.6	53.7	48.5	61.6	69.8
29	74.1	97.0	87.9	95.9	95.6	73.5	86.2	93.1	81.7	70.5	90.0	65.5	58.3	78.0	81.9
31	67.0	86.4	77.3	83.5	85.6	63.6	75.2	83.2	73.8	63.3	78.6	54.5	50.8	66.0	72.1
Fleet mean	67.0	87.4	79.7	85.2	86.7	64.0	76.6	85.4	72.6	61.9	78.1	56.0	50.5	66.8	72.7
Fleet BESD	4.28	4.39	4.64	4.52	4.48	3.87	3.49	4.47	3.34	3.25	4.29	3.95	3.52	3.75	3.53

On examination of the data collected on the network route (Table 6.1) we can see that the Fleet BESD for the average of the sections exceeds the criterion for the network route (see section 4.2.1). In addition Machine 29 can be seen to be more than 3 times the BESD criteria away from the mean for several sections and for the average. This identifies Machine 29 as being a potential outlier. If Machine 29 is excluded from the Fleet calculations then the Fleet BESD meets the criterion and the remaining machines show similar performance against the amended Fleet Mean. The amended fleet mean and BESD in Table 6.2

Table 6.2 Fleet mean and BESD for the Network Route following exclusion of Machine 29

ID	Average SR for network route sections														
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	Avg
Fleet mean	66.5	86.7	79.1	84.4	86.1	63.3	75.9	84.9	72.0	61.3	77.2	55.3	50.0	66.0	72.1
Fleet BESD	3.96	3.63	4.20	3.55	3.89	2.95	2.35	4.09	2.29	2.29	2.85	3.06	2.90	2.18	2.53

6.3.2 Main running trial day 1 tests

The first set of tests on the Straight Line Wet Grip area (Table 6.3) show that the fleet BESD is between 1 and 1.5 times the criteria for two of the sections (SWG01 and SWG03) and for the average for the site. The BESD for the remaining sections (SWG02 and SWG04) are more than 1.5 times the criteria. As with the Network Route survey Machine 29 provides consistently high readings and is more than 3 times the BESD criteria away from the Fleet mean for the site.

Table 6.3 Average SR from the 1st set of tests on the Straight Line Wet Grip

ID	Average SR on Straight Line Wet Grip				
	SWG01	SWG02	SWG03	SWG04	Avg
3	70.9	92.1	28.0	73.2	66.3
14	71.3	94.7	30.2	76.4	68.3
16	72.3	97.6	30.3	76.6	69.4
17	64.3	85.8	26.3	66.1	60.8
18	73.6	98.7	33.6	76.5	70.8
19	65.2	88.9	25.9	69.9	62.6
21	69.8	92.9	29.8	73.2	66.6
22	70.7	94.2	28.3	74.0	67.0
23	69.7	94.3	28.9	74.8	67.1
24	65.2	88.0	26.8	71.5	63.0
25	65.0	87.8	28.4	70.4	63.0
26	65.5	86.7	24.7	67.0	61.2
28	68.2	90.4	28.8	72.4	65.1
29	76.8	104.8	36.5	81.5	75.0
31	63.4	85.1	26.7	66.1	60.5
Fleet mean	68.8	92.1	28.9	72.7	65.8
Fleet BESD	3.93	5.47	3.04	4.33	4.08

If Machine 29 is excluded from the Fleet calculations then the Fleet BESD improves but does not meet the criteria as shown in Table 6.4.

Table 6.4 Fleet mean and BESD for the 1st set of tests on the Straight Line Wet Grip following exclusion of Machine 29

ID	Average SR on Straight Line Wet Grip				
	SWG01	SWG02	SWG03	SWG04	Avg
3	70.9	92.1	28.0	73.2	66.3
14	71.3	94.7	30.2	76.4	68.3
16	72.3	97.6	30.3	76.6	69.4
17	64.3	85.8	26.3	66.1	60.8
18	73.6	98.7	33.6	76.5	70.8
19	65.2	88.9	25.9	69.9	62.6
21	69.8	92.9	29.8	73.2	66.6
22	70.7	94.2	28.3	74.0	67.0
23	69.7	94.3	28.9	74.8	67.1
24	65.2	88.0	26.8	71.5	63.0
25	65.0	87.8	28.4	70.4	63.0
26	65.5	86.7	24.7	67.0	61.2
28	68.2	90.4	28.8	72.4	65.1
29	.	.	.	.	.
31	63.4	85.1	26.7	66.1	60.5
Fleet mean	68.2	91.2	28.3	72.0	65.1
Fleet BESD	3.37	4.36	2.27	3.70	3.30

After exclusion of Machine 29, the next machine that would be considered is Machine 18. This is because it is between 2 and 3 times the BESD criteria away from the Fleet mean for the average of the site (after exclusion of Machine 29). However, removal of Machine 18 would not bring the Fleet BESD within the criteria. Examination of the BRSD data (discussed in section 6.2) found a high degree of variation, most likely due to track conditioning effects and variations in test line.

Based on these results Machine 29 was identified as an outlier and was excluded from the Twin straights testing and the crew given the opportunity to investigate the performance of the machine. If the issue was resolved with the machine then it would undertake tests on the Twin Straights on the morning of the main running trial day 2 (for the assessment of distance measured and survey speed). They would also be required to repeat the Network Route surveys following the resolution of the issue.

Historic data from the Twin Straights has found that the sections are more variable than those for the Straight Line Wet Grip site. This is due to fact that the site has not had much traffic since it was laid. The variable nature of the site is also reflected in the measurements collected during this accreditation trial at 50km/h (Table 6.5) and at 80km/h (Table 6.6).

Table 6.5 Average SR from the 50km/h tests on the Twin Straights

ID	Average SR for 50km/h tests on Twin Straights						
	TS01	TS02	TS03	TS04	TS05	TS06	Avg
3	84.7	95.8	87.7	84.8	85.3	73.5	85.3
14	86.1	95.1	86.9	85.1	85.0	73.7	85.4
16	93.2	104.3	93.4	92.2	92.1	79.0	92.4
17	82.4	90.6	81.9	81.2	80.3	71.5	81.4
18	93.8	104.7	95.8	94.0	92.7	79.6	93.5
19	83.2	91.1	85.2	86.6	85.2	72.8	83.9
21	84.6	95.5	87.6	85.2	85.1	74.1	85.3
22	80.7	92.3	83.6	82.3	81.2	69.3	81.6
23	85.2	95.3	86.1	84.3	84.3	71.1	84.4
24	78.1	87.0	80.1	81.0	78.7	67.4	78.7
25	79.5	90.2	81.9	80.6	79.2	68.3	80.0
26	81.2	89.6	81.0	79.6	77.0	66.6	79.4
28	82.0	93.5	85.6	83.8	84.0	71.0	83.2
29	.	.	.	.	.	.	.
31	72.9	88.4	80.6	78.6	77.0	66.3	77.1
Fleet mean	83.4	93.8	85.5	84.2	83.4	71.7	83.7
Fleet BESD	5.47	5.31	4.67	4.44	4.90	4.14	4.74

Table 6.6 Average SR from the 80km/h tests on the Twin Straights

ID	Average SR for 80km/h tests on Twin Straights						
	TS01	TS02	TS03	TS04	TS05	TS06	Avg
3	73.7	89.6	83.7	81.1	81.2	68.7	79.3
14	76.4	86.9	81.2	80.5	80.1	67.0	78.5
16	81.6	92.5	86.1	86.9	86.2	72.5	84.0
17	67.7	77.8	74.0	76.4	73.5	63.1	71.8
18	82.0	91.4	88.7	87.8	86.5	71.7	84.4
19	65.8	82.4	78.5	78.6	78.1	63.5	73.8
21	71.8	87.8	84.1	83.3	82.7	68.7	79.1
22	79.4	94.5	88.9	89.1	88.4	72.9	85.0
23	76.6	89.2	82.1	83.2	83.1	67.8	79.9
24	68.3	82.2	78.1	77.1	77.1	64.2	74.0
25	73.1	85.4	79.2	78.3	77.3	64.6	76.1
26	67.2	82.5	77.6	76.4	76.0	62.9	73.3
28	77.2	90.8	83.7	82.4	82.6	68.6	80.6
29	.	.	.	.	.	.	.
31	71.0	86.0	81.2	78.1	75.8	62.4	75.5
Fleet mean	73.7	87.1	81.9	81.4	80.6	67.0	78.2
Fleet BESD	5.36	4.69	4.28	4.25	4.52	3.66	4.33

A few machines (16, 17, 18 and 22) appeared to be showing a consistent difference in the average SR from the rest of the fleet. On examination of the between run standard deviations (Table B.4 and Table B.5) it can be seen that the BRSD is higher for Machines 16 and 18 particularly for the 80km/h tests. Given the good BRSD values for these machines on the other sites at the trial, this suggests that this variability could be due to differences in driving line (and transverse variability of skid resistance on the site). It is possible during the 50km/h tests these machines are traversing a slightly different line to the other machines, and during the 80km/h tests they were traversing a mixture of test lines (hence the increased BRSD).However, the main focus of the testing on the Twin Straights is the assessment of distance measured (section 7.1) and survey speed (section 5.5).

At the end of the first main running trial day one machine (Machine 29) was identified as being in the red category, one machine (Machine 18) in the amber category and one machine (Machine 1) did not take part in the assessments. The remaining machines were in the green category.

6.3.3 Additional main running trial day 1 tests

During the testing on the Twin Straights testing the crew of Machine 29 investigated their machine and found that the voltages for the load cell were incorrect and adjusted these to the correct values. Following this they undertook repeat surveys of the Network Route. The results from these surveys and the resulting Fleet mean and Fleet BESD are shown in Table 6.7.

Table 6.7 Second set of tests from Machine 29 and amended Fleet mean and BESD

ID	Average SR for network route sections														
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	Avg
29	70.2	93.1	82.8	91.0	92.8	68.0	81.6	91.8	76.8	63.9	82.0	58.7	52.0	68.5	76.7
Fleet mean	66.8	87.2	79.3	84.9	86.5	63.7	76.3	85.4	72.3	61.5	77.5	55.5	50.1	66.1	72.4
Fleet BESD	3.93	3.87	4.16	3.82	4.14	3.22	2.69	4.33	2.53	2.31	3.01	3.08	2.84	2.20	2.72

From this updated dataset it can be seen that performance of Machine 29 is much more consistent with the Fleet and the resulting Fleet BESD is within the criterion.

6.3.4 Main running trial day 2 tests

At the start of the second main running trial day (prior to the arrival of the other machines and during set-up), Machine 29 undertook tests of the Twin straights to provide data for the distance measured and speed assessments (discussed in sections 7.1 and 5.5 respectively).

Machine 1 continued to produce unsuitable results and therefore did not take part in the testing. In addition the immobiliser on Machine 26 activated and therefore it was unable to take part in the testing on this day.

During the processing of the 2nd set of tests from the Straight Line Wet Grip it was found that Machine 18 was producing values higher than the average. The crew was notified and they investigated the machine and additional laps were added to the test programme to allow for a full set of tests to be conducted after the investigation (other machines took part in these tests to make sure that the track surface did not vary between these surveys and the earlier tests). The results from these latest tests are provided in Table 6.8.

Table 6.8 Average SR from the 2nd set of tests on the Straight Line Wet Grip

ID	Average SR on Straight Line Wet Grip				
	SWG01	SWG02	SWG03	SWG04	Avg
3	71.0	90.6	24.5	65.1	63.2
14	69.0	92.1	27.0	66.7	64.0
16	75.8	99.6	28.3	72.0	69.3
17	67.1	89.5	25.1	65.9	62.2
18	80.3	105.8	30.8	73.7	73.1
19	69.9	93.5	26.4	67.3	64.6
21	70.2	93.4	27.3	67.7	65.0
22	70.7	94.3	26.5	67.6	65.1
23	68.2	92.5	25.7	65.8	63.3
24	71.5	97.5	29.3	70.5	67.4
25	67.7	93.0	24.8	67.9	63.6
26	.	.	.	.	.
28	68.2	91.3	25.7	65.6	63.0
29	74.8	100.2	28.9	73.0	69.5
31	65.6	86.9	25.6	64.1	60.8
Fleet mean	70.7	94.3	26.8	68.1	65.3
Fleet BESD	3.94	4.93	1.87	3.05	3.37

It can be seen from this data that there is a general improvement in the fleet in comparison to the 1st set of tests. In particular Machine 29 is now producing results consistent with the fleet. However the fleet BESD criterion is not met for the average of the site and Machine 18 is now appearing to be an outlier. If this machine is excluded from the Fleet calculations then the fleet BESD criterion is met for the average of the site as shown in Table 6.9.

Table 6.9 Fleet mean and BESD for the 2nd set of tests on the Straight Line Wet Grip following exclusion of Machine 18

ID	Average SR on Straight Line Wet Grip				
	SWG01	SWG02	SWG03	SWG04	Avg
Fleet mean	70.0	93.4	26.5	67.6	64.7
Fleet BESD	2.91	3.81	1.54	2.68	2.62

Further examination of the data from Machine 18 over the course of the trial found that this machine performed suitably at the start of the trial and performed progressively worse on each subsequent test.

6.4 Summary of skid resistance testing

All machines that took part in the skid resistance testing part of the trial (i.e. all but Machine 1), produced suitable results with regards to repeatability of skid resistance measurement (BRSD criterion, see section 4.1).

Machine 18 was identified having a fault which got progressively worse as the trial progressed and therefore based on its performance at the end of the trial was not deemed to be acceptable with regards to the reproducibility of skid measurement (BESD criterion, see section 4.1). The remaining fourteen machines which took part in the skid resistance testing part of the trial produced suitable results with regards to reproducibility of skid measurement.

6.5 Additional testing following the trial

The owners of Machine 18 investigated the machine following the trial and found that the readings from the horizontal load cell were more erratic than usual causing an upwards drift in SR over time. It was identified through additional investigations that the likely cause of the issue was a faulty horizontal load cell and amplifier. These were replaced and back to back testing with their other machine (Machine 14) found that this appears to have resolved the issue and the two machines were producing very consistent results.

Due to the good performance of Machine 18 at the start of the trial and the very close results to Machine 14 (which was close to the mean at the trial), it was agreed that this machine would be awarded a temporary accreditation trial certificate (set to expire within 2 months of the trial) subject to additional monitoring. If the additional monitoring showed that the two machines continued to provide consistent results over this time then Machine 18 would be awarded a full accreditation certificate (i.e. set to expire within 13 months of the trial).

7 Location referencing

7.1 Distance measurement

To provide data for the assessment of distance measurement, the survey vehicles performed eight passes of the Twin Straights (4 passes at 50km/h and 4 passes at 80km/h), marking positions A-H as shown in Figure 3.1. This data was then assessed against the reference data collected from an optical survey of the site.

For this assessment there are criteria for the push button entry and for the entry of markers via automatic detection of retro-reflective markers (given in section 4.1). The criteria for the push button entry are more lenient to allow for the additional uncertainty added by the reaction times of the operator. However it has been noted by one of the survey contractors that the additional buffer added to the push button criteria make it easier to pass the push button criteria than the automatic marker detection criteria (i.e. to switch off the automatic marker detection and manually enter the markers). To make the test fairer (and not punish those who have fitted automatic marker detection) all of the machines have been assessed against the push button criteria. During the next review of the Accreditation and QA specification for these devices this should be reviewed and the criteria amended to rectify this discrepancy.

The results from these distance measurement assessment are shown in Table 7.1.

Table 7.1 Distance measurement assessment

ID	Percentage of data within				Assessment criteria used	Awarded performance
	1m	2m	5m	10m		
3	43%	65%	98%	100%	Push	High
14	28%	48%	93%	100%	Push	High
16	63%	98%	100%	100%	Push	High
17	65%	98%	100%	100%	Push	High
18	15%	48%	95%	100%	Push	High
19	68%	98%	100%	100%	Push	High
21	65%	83%	95%	95%	Push	High
22	43%	69%	100%	100%	Push	High
23	14%	37%	100%	100%	Push	High
24	58%	100%	100%	100%	Push	High
25	73%	100%	100%	100%	Push	High
26	50%	98%	100%	100%	Push	High
28	13%	70%	100%	100%	Push	High
29	48%	85%	100%	100%	Push	High
31	44%	92%	100%	100%	Push	High

It can be seen from this table that all of the machines met the high performance level for the measurement of distance (when assessed against the push button criteria). If these machines were assessed against the automatic markers criteria then machines 16, 17, 19, 21, 24, 25, 26, 29 and 31 would achieve a medium performance and the others a low performance.

7.2 3 dimensional spatial coordinates data

The assessment of 3 dimensional spatial coordinates is mandatory for any device that is to be used on the central Highways England contract and optional for the other devices. Thirteen machines took part in these tests: Machines 14, 16-19, 22-26, 28, 29, and 31.

The assessment is carried out on the Longcross test track and the Network Route near MIRA. The reference data from the Longcross test track was obtained from a static GPS survey of the site, and the Network Route reference data was supplied by Highways England's HARRIS2 survey vehicle.

The results from the OSGR and altitude assessments are given in Appendix C and are summarised in Table 7.2 and Table 7.3. All of the machines were assessed against the push button criteria (as discussed in section 7.1). The assessment criteria are given in section 4.1.

Table 7.2 Summary of OSGR assessments

Machine	Section start points Longcross	10m data points		Awarded Performance
		Longcross	Network Route	
14	*High*	*High*	*High*	*High*
16	*High*	*High*	*High*	*High*
17	*High*	*High*	*High*	*High*
18	*High*	*High*	*Low*	*Low*
19	*High*	*High*	*High*	*High*
22	*High*	*High*	*High*	*High*
23	*High*	*High*	*High*	*High*
24	*High*	*High*	*High*	*High*
25	*High*	*High*	*High*	*High*
26	*High*	*High*	*High*	*High*
28	*High*	*High*	*High*	*High*
29	*High*	*High*	*High*	*High*
31	*High*	*High*	*High*	*High*

Table 7.3 Summary of Altitude assessments

Machine	Section start points Longcross	10m data points		Awarded Performance
		Longcross	Network Route	
14	*Low*	*Medium*	*High*	*Medium*
16	*Low*	*Medium*	*High*	*Medium*
17	*Low*	*Medium*	*High*	*Medium*
18	*Low*	*Low*	*Low*	*Low*
19	*High*	*High*	*High*	*High*
22	*High*	*High*	*High*	*High*
23	*High*	*High*	*High*	*High*
24	*High*	*High*	*High*	*High*
25	*High*	*High*	*High*	*High*
26	*High*	*High*	*High*	*High*
28	*High*	*High*	*High*	*High*
29	*High*	*High*	*High*	*High*
31	*Low*	*Medium*	*High*	*Medium*

8 File formats

All of the machines supplied suitable ".S10" and ".loc" files. There is a mandatory requirement that any device that is to be used on the central Highways England contract shall provide RCD and BCD data.

The following machines provided RCD data:

- Machine 14
- Machine 16
- Machine 17
- Machine 18
- Machine 19
- Machine 22
- Machine 23
- Machine 24
- Machine 25
- Machine 26
- Machine 28
- Machine 29
- Machine 31

The following machines provided BCD data:

- Machine 17
- Machine 19
- Machine 22
- Machine 23
- Machine 24
- Machine 25
- Machine 26
- Machine 29
- Machine 31

Examination of the supplied RCD and BCD found that the data formatting was suitable.

9 Conclusions

The 2016 sideway-force skid resistance accreditation trials were held during the week beginning the 4th April 2016. The trials were held on and around the MIRA proving ground and at the Longcross test track. Sixteen machines from the UK fleet attended. One of the sixteen machines did not take part in the main running trials.

The following conclusions were drawn in relation to the various mandatory tests and assessments (note: OSGR and Altitude is mandatory for machines operating on the central Highways England contract and optional for others):

(i) Skid resistance measurement

Fourteen machines met the criteria for the measurement of skid resistance at the trial. One additional machine has met the criteria subject to additional monitoring.

(ii) Distance measurement

Fifteen machines achieved a high performance with regards to the measurement of distance.

(iii) Measurement of OSGRs

Thirteen machines fitted with 3 dimensional spatial coordinate systems were assessed for the measurement of OSGRs. Twelve machines achieved a high performance and one machine a low performance.

(iv) Measurement of Altitude

Thirteen machines fitted with 3 dimensional spatial coordinate systems were assessed for the measurement of altitude. Eight machines achieved a high performance, four machines a medium performance and one machine achieved a low performance.

(v) Speed measurement and recording

Fifteen machines were deemed to be acceptable with regards to the measurement and recording of survey speed.

The following conclusions were drawn in relation to the various additional tests and assessments:

(vi) Water flow

All sixteen machines were found to provide satisfactory water flow and direction

(vii) Left test wheel weight

All sixteen machines met the current ±8 kg tolerance for test wheel weight. However, it is noted that there is a draft for development CEN technical specification for these devices which would tighten the tolerance to ±1 kg. Six of the eighteen machines meet this tighter tolerance.

A summary of the machines that attended the 2016 accreditation trial and the criteria that they met can be found in Appendix A.

References

British Standards Institution. (2006). *BS 7941-1. Methods for measuring the skid resistance of pavement surfaces - Sideway-force coefficient routine investigation machine.* London: BSi.

British Standards Institution. (2009). *DD CEN/TS15901-6:2009. Road and airfield surface characteristics. Procedure for determining the skid resistance of a pavement surface by measurement of the sideway force coefficient (SFCS).* BSi.

Design Manual for Roads and Bridges. (2015). *Volume 7 Section 3, HD29/15, Data for surface assessment*. London: The Stationery Office.

TRL. (2013). *Accreditation and Quality Assurance of Sideways Force Skid Resistance Survey Devices.* http://www.UKRoadsLiaisonGroup.org.

Appendix A Machine identification and performance

Table A.1 Machine identification and performance summary

ID	Current Owner	Registration number	Performance Summary						
			Skid resistance measurement	Speed	Distance travelled[1]	OSGR[1]	Altitude[1]	RCD file	BCD file
1	PTS Ltd	W965 SVG	Fail	-	-	-	-	-	-
3	DRDNI	IKZ 2203	Pass	Pass	*High*	-	-	-	-
14	PMS Eire	01 KK 1138	Pass	Pass	*High*	*High*	*Medium*	Pass	-
16	Highway Surveyors Ltd	S66 HSL	Pass	Pass	*High*	*High*	*Medium*	Pass	-
17	WDM Ltd	S800 WDM	Pass	Pass	*High*	*High*	*Medium*	Pass	Pass
18	PMS Eire	04G13042	Pass	Pass	*High*	*Low*	*Low*	Pass	-
19	WDM Ltd	S900 WDM	Pass	Pass	*High*	*High*	*High*	Pass	Pass
21	Surrey CC	KX07YXH	Pass	Pass	*High*	-	-	-	-
22	PTS Ltd	KX07YVH	Pass	Pass	*High*	*High*	*High*	Pass	Pass
23	WDM Ltd	S11 WDM	Pass	Pass	*High*	*High*	*High*	Pass	Pass
24	WDM Ltd	S12 WDM	Pass	Pass	*High*	*High*	*High*	Pass	Pass
25	WDM Ltd	S13 WDM	Pass	Pass	*High*	*High*	*High*	Pass	Pass
26	WDM Ltd	S14 WDM	Pass	Pass	*High*	*High*	*High*	Pass	Pass
28	Operated by TRL on behalf of Highways England	WX60 AXN	Pass	Pass	*High*	*High*	*High*	Pass	-
29	PTS Ltd	YD02 XSN	Pass	Pass	*High*	*High*	*High*	Pass	Pass
31	WDM Ltd	S16 WDM	Pass	Pass	*High*	*High*	*Medium*	Pass	Pass

[1] Performance assessed using the push button criteria are shown with a lighter colour shade and grey italic text.

Appendix B Between run standard deviation

Values that are within the BRSD criteria (see section 4.1) are shaded in green. Values up to 1 standard deviation greater than the criteria are shaded in orange, values greater than this are shaded in red.

Table B.1 Machine repeatability for the Network route

ID	Between run SD														
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	Avg
1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
3	2.09	3.02	1.40	1.60	1.74	1.03	1.06	0.46	1.24	1.33	0.47	1.45	1.43	1.38	1.54
14	1.26	0.35	1.22	1.07	0.88	0.46	1.52	3.39	1.46	4.44	2.63	0.29	2.97	2.19	2.10
16	1.73	2.09	0.63	0.33	0.75	0.81	3.00	1.61	2.79	1.73	2.62	0.95	3.55	4.69	2.30
17	1.24	1.75	1.26	2.19	1.06	0.29	1.49	2.66	1.50	1.54	5.85	11.34	5.89	5.33	4.24
18	5.86	18.83	2.10	8.90	5.08	3.18	6.26	8.55	8.05	2.79	11.26	10.60	8.02	3.85	8.50
19	2.33	1.43	1.35	1.87	1.01	0.91	1.07	1.49	3.04	2.07	2.92	1.81	0.24	1.93	1.83
21	4.40	4.56	4.79	5.21	6.44	5.41	2.69	1.86	4.02	1.52	3.96	2.42	2.78	3.89	4.09
22	3.44	3.47	4.60	3.68	4.23	3.52	2.89	4.00	2.42	2.83	3.49	2.23	3.26	3.18	3.43
23	1.30	1.38	2.79	2.99	2.85	2.57	3.13	1.59	3.39	4.51	4.00	2.34	2.67	1.82	2.82
24	1.02	0.26	0.27	0.13	0.74	0.50	0.43	3.70	1.67	1.27	1.25	2.43	1.45	2.81	1.64
25	1.66	0.66	0.16	0.90	2.67	3.26	0.36	0.47	0.47	3.16	1.24	5.05	1.69	0.57	2.11
26	0.75	0.83	0.15	2.93	3.80	1.93	1.00	1.85	1.47	1.19	2.15	0.85	1.41	4.01	2.06
28	1.26	2.20	1.70	1.19	2.11	1.39	0.61	1.53	2.10	2.14	2.76	0.61	2.55	2.35	1.87
29[1]	1.12	0.91	1.61	1.78	0.84	2.52	1.04	3.22	2.68	0.98	1.10	2.10	3.56	0.85	1.95
31	0.50	1.94	1.40	1.55	1.51	1.56	0.97	2.43	2.40	2.64	1.00	2.95	0.96	1.08	1.78
Avg	2.46	5.28	2.18	3.24	2.94	2.40	2.37	3.21	3.10	2.52	4.04	4.54	3.42	3.01	3.31

Table B.2 Machine repeatability for the 1st set of tests on the Straight Line Wet Grip

ID	Between run SD				
	SWG01	SWG02	SWG03	SWG04	Avg
1	.	.	.	.	.
3	0.88	1.62	1.96	7.22	3.76
14	1.30	1.25	1.90	5.96	3.18
16	1.19	0.79	2.20	6.50	3.42
17	0.17	1.22	0.57	3.21	1.70
18	0.79	1.46	2.21	6.69	3.53
19	0.88	1.09	0.96	6.24	3.15
21	0.90	0.61	0.63	4.40	2.24
22	1.59	1.33	1.32	5.57	2.99
23	1.32	0.57	1.36	5.03	2.65
24	0.60	1.14	1.42	2.39	1.50
25	0.47	0.93	1.14	3.17	1.72
26	0.62	1.27	1.04	3.73	2.01
28	1.00	1.01	1.55	6.00	3.10
29	0.46	1.07	3.14	5.83	3.27
31	0.47	0.30	2.23	3.50	2.04
Avg	0.92	1.08	1.94	6.29	3.28

[1] Between run Standard Deviation for the second set of surveys for Machine 29, see section 6.3.1

Table B.3 Machine repeatability for the 2nd set of tests on the Straight Line Wet Grip

ID	Between run SD				
	SWG01	SWG02	SWG03	SWG04	Avg
1	.	.	.	.	.
3	1.85	1.75	1.62	3.82	2.41
14	1.47	1.88	1.08	3.90	2.31
16	2.12	0.60	1.34	3.59	2.20
17	0.99	1.81	0.32	2.06	1.44
18	1.57	1.17	0.39	1.18	1.19
19	1.59	2.60	0.91	1.17	1.69
21	0.92	1.81	0.81	2.42	1.60
22	2.43	2.43	0.84	3.69	2.55
23	0.86	0.89	0.55	1.65	1.06
24	1.26	1.16	0.55	1.88	1.30
25	1.20	1.57	0.63	1.74	1.35
26	.	.	.	.	.
28	1.43	1.52	0.83	5.43	2.88
29	1.76	1.91	0.98	2.98	2.02
31	1.06	1.01	0.45	1.62	1.11
Avg	1.53	1.67	0.88	2.92	1.88

Table B.4 Machine repeatability for the 50k/h tests on the Twin Straights

ID	Between run SD						
	TS01	TS02	TS03	TS04	TS05	TS06	Avg
1	.	.	.	.	.	.	.
3	1.39	3.17	1.03	1.42	3.37	2.02	2.11
14	1.18	2.07	0.71	2.21	3.35	3.18	2.18
16	2.37	2.41	0.66	1.83	3.43	2.79	2.31
17	0.67	1.99	1.05	2.54	2.53	3.41	2.16
18	1.16	0.86	0.45	0.92	1.30	1.66	1.11
19	4.81	2.69	1.15	3.20	1.86	2.97	3.18
21	1.03	0.95	0.69	1.09	1.51	1.36	1.10
22	2.76	1.47	1.20	1.80	1.10	0.14	1.72
23	3.14	2.49	2.43	1.93	3.82	0.86	2.53
24	1.37	0.74	0.88	2.65	1.94	0.88	1.53
25	2.09	1.98	1.21	1.30	0.73	1.47	1.61
26	3.62	2.43	1.11	1.23	0.85	0.24	2.10
28	4.09	3.69	3.50	3.08	3.90	2.82	3.54
29	.	.	.	.	.	.	.
31	1.49	1.68	1.68	0.98	1.81	0.96	1.44
Avg	2.55	2.20	1.49	2.01	2.50	2.06	2.16

Table B.5 Machine repeatability for the 80km/h tests on the Twin Straights

ID	Between run SD						
	TS01	TS02	TS03	TS04	TS05	TS06	Avg
1	.	.	.	.	.	.	.
3	2.45	2.70	1.43	1.39	1.29	2.53	2.12
14	3.88	4.35	2.11	0.55	1.09	1.13	2.77
16	2.19	5.06	5.76	6.43	4.71	7.72	5.53
17	0.96	0.60	0.56	1.04	0.32	0.35	0.73
18	6.47	4.43	4.13	3.45	1.59	0.57	4.22
19	1.38	1.90	1.47	0.59	2.65	0.60	1.48
21	0.54	0.49	1.08	0.72	0.55	0.40	0.67
22	3.45	2.10	1.01	1.00	1.25	0.96	2.00
23	2.01	1.41	0.97	1.13	0.64	0.44	1.30
24	1.43	0.67	1.08	0.84	1.08	0.66	1.02
25	4.77	2.34	0.66	1.07	0.31	0.71	2.51
26	1.34	0.47	0.45	0.75	0.53	0.26	0.78
28	3.54	1.19	1.63	1.25	0.31	0.69	1.95
29	.	.	.	.	.	.	.
31	4.16	3.02	1.67	1.03	1.26	0.98	2.52
Avg	3.20	2.66	2.23	2.15	1.69	2.26	2.50

Appendix C Assessment of 3 dimensional spatial coordinates data

Performance assessed using the push button criteria are shown with a lighter colour shade and grey italic text.

C.1 OSGR data– Section start points

Table C.1 Assessment of OSGR measurements against the reference for section start points: Test track

ID	Assessment type	Section start and end points on test track: % within						Performance level
		2m	4m	5m	10m	15m	20m	
14	Manual	76%	100%	100%	100%	100%	100%	*High*
16	Manual	71%	93%	98%	100%	100%	100%	*High*
17	Manual	76%	95%	98%	100%	100%	100%	*High*
18	Manual	5%	71%	93%	100%	100%	100%	*High*
19	Manual	79%	98%	100%	100%	100%	100%	*High*
22	Manual	95%	100%	100%	100%	100%	100%	*High*
23	Manual	100%	100%	100%	100%	100%	100%	*High*
24	Manual	95%	100%	100%	100%	100%	100%	*High*
25	Manual	95%	100%	100%	100%	100%	100%	*High*
26	Manual	98%	100%	100%	100%	100%	100%	*High*
28	Manual	67%	100%	100%	100%	100%	100%	*High*
29	Manual	86%	100%	100%	100%	100%	100%	*High*
31	Manual	100%	100%	100%	100%	100%	100%	*High*

C.2 OSGR data– 10m data points

Table C.2 Assessment of OSGR measurements against the reference for 10m data points: Test track

ID	Assessment type	10m data points on test track: % within							Performance level
		2m	4m	5m	6m	10m	15m	20m	
14	Manual	72%	99%	100%	100%	100%	100%	100%	*High*
16	Manual	62%	91%	96%	100%	100%	100%	100%	*High*
17	Manual	70%	96%	99%	100%	100%	100%	100%	*High*
18	Manual	11%	69%	90%	100%	100%	100%	100%	*High*
19	Manual	82%	98%	100%	100%	100%	100%	100%	*High*
22	Manual	75%	95%	99%	100%	100%	100%	100%	*High*
23	Manual	91%	99%	100%	100%	100%	100%	100%	*High*
24	Manual	95%	100%	100%	100%	100%	100%	100%	*High*
25	Manual	82%	100%	100%	100%	100%	100%	100%	*High*
26	Manual	92%	100%	100%	100%	100%	100%	100%	*High*
28	Manual	67%	98%	100%	100%	100%	100%	100%	*High*
29	Manual	68%	97%	98%	100%	100%	100%	100%	*High*
31	Manual	88%	100%	100%	100%	100%	100%	100%	*High*

Table C.3 Assessment of OSGR measurements against the reference for 10m data points: Network route

ID	Assessment type	10m data points Network Route: % within							Performance level
		3m	6m	12m	17m	20m	25m	30m	
14	Manual	64%	82%	98%	100%	100%	100%	100%	High
16	Manual	59%	92%	100%	100%	100%	100%	100%	High
17	Manual	96%	99%	100%	100%	100%	100%	100%	High
18	Manual	0%	0%	0%	0%	0%	0%	0%	Low
19	Manual	87%	98%	100%	100%	100%	100%	100%	High
22	Manual	89%	99%	100%	100%	100%	100%	100%	High
23	Manual	67%	94%	100%	100%	100%	100%	100%	High
24	Manual	96%	100%	100%	100%	100%	100%	100%	High
25	Manual	96%	100%	100%	100%	100%	100%	100%	High
26	Manual	92%	100%	100%	100%	100%	100%	100%	High
28	Manual	21%	81%	100%	100%	100%	100%	100%	High
29	Manual	83%	100%	100%	100%	100%	100%	100%	High
31	Manual	91%	99%	100%	100%	100%	100%	100%	High

C.3 Altitude data – Section start points

Table C.4 Assessment of altitude measurements against the reference for section start points: Test track

ID	Assessment type	Section start and end points on test track: % within					Performance level
		2m	4m	5m	6m	20m	
14	Manual	17%	100%	100%	100%	100%	Low
16	Manual	71%	100%	100%	100%	100%	Low
17	Manual	57%	81%	90%	95%	100%	Low
18	Manual	2%	24%	55%	81%	100%	low
19	Manual	81%	100%	100%	100%	100%	High
22	Manual	86%	100%	100%	100%	100%	High
23	Manual	100%	100%	100%	100%	100%	High
24	Manual	81%	100%	100%	100%	100%	High
25	Manual	98%	100%	100%	100%	100%	High
26	Manual	90%	100%	100%	100%	100%	High
28	Manual	100%	100%	100%	100%	100%	High
29	Manual	100%	100%	100%	100%	100%	High
31	Manual	50%	100%	100%	100%	100%	Low

C.4 Altitude data – 10m data points

Table C.5 Assessment of altitude measurements against the reference for 10m data points: Test track

ID	Assessment type	10m data points on test track: % within					Performance level
		2m	4m	5m	6m	20m	
14	Manual	24%	100%	100%	100%	100%	*Medium*
16	Manual	75%	99%	100%	100%	100%	*Medium*
17	Manual	60%	89%	95%	98%	100%	*Medium*
18	Manual	2%	28%	62%	88%	100%	*Low*
19	Manual	86%	100%	100%	100%	100%	*High*
22	Manual	91%	100%	100%	100%	100%	*High*
23	Manual	99%	100%	100%	100%	100%	*High*
24	Manual	83%	100%	100%	100%	100%	*High*
25	Manual	98%	100%	100%	100%	100%	*High*
26	Manual	96%	100%	100%	100%	100%	*High*
28	Manual	99%	100%	100%	100%	100%	*High*
29	Manual	96%	100%	100%	100%	100%	*High*
31	Manual	61%	100%	100%	100%	100%	*Medium*

Table C.6 Assessment of altitude measurements against the reference for 10m data points: Network route

ID	Assessment type	10m data points on Network Route Section start and end points on test track: % within					Performance level
		2m	4m	5m	6m	20m	
14	Manual	9%	61%	90%	100%	100%	*High*
16	Manual	72%	100%	100%	100%	100%	*High*
17	Manual	15%	64%	87%	98%	100%	*High*
18	Manual	0%	0%	0%	0%	0%	*Low*
19	Manual	100%	100%	100%	100%	100%	*High*
22	Manual	55%	100%	100%	100%	100%	*High*
23	Manual	98%	100%	100%	100%	100%	*High*
24	Manual	99%	100%	100%	100%	100%	*High*
25	Manual	85%	100%	100%	100%	100%	*High*
26	Manual	98%	100%	100%	100%	100%	*High*
28	Manual	57%	100%	100%	100%	100%	*High*
29	Manual	54%	99%	100%	100%	100%	*High*
31	Manual	99%	100%	100%	100%	100%	*High*

Highways England 2016 national accreditation trial for sideway-force skid resistance devices

A key element in the successful maintenance of a road network is the availability of accurate, reliable and consistent survey data. To this aim, Highways England commission annual accreditation trials for Sideways Force Skid Resistance devices supported by ongoing QA for the devices. In order to undertake accredited surveys, the survey devices are required to meet the mandatory criteria of the trial.

This report covers the 2016 trial run by TRL and held on the Horiba-MIRA proving ground between 5th and 7th April 2016 and on the Longcross test track on 8th April 2016.

Other titles from this subject area

PPR 938	Highways England 2015 national accreditation trial for sideway-force skid resistance devices. S Brittain. 2020
CPR 1874	Highways Agency 2014 national accreditation trial for sideway-force skid resistance devices. S Brittain. 2014
CPR 1650	Highways Agency 2013 national accreditation trial for sideway-force skid resistance devices. S Brittain. 2013
CPR 1448	SCRIM accreditation transitional trial. P Roe, S Brittain, P D Sanders. 2011

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