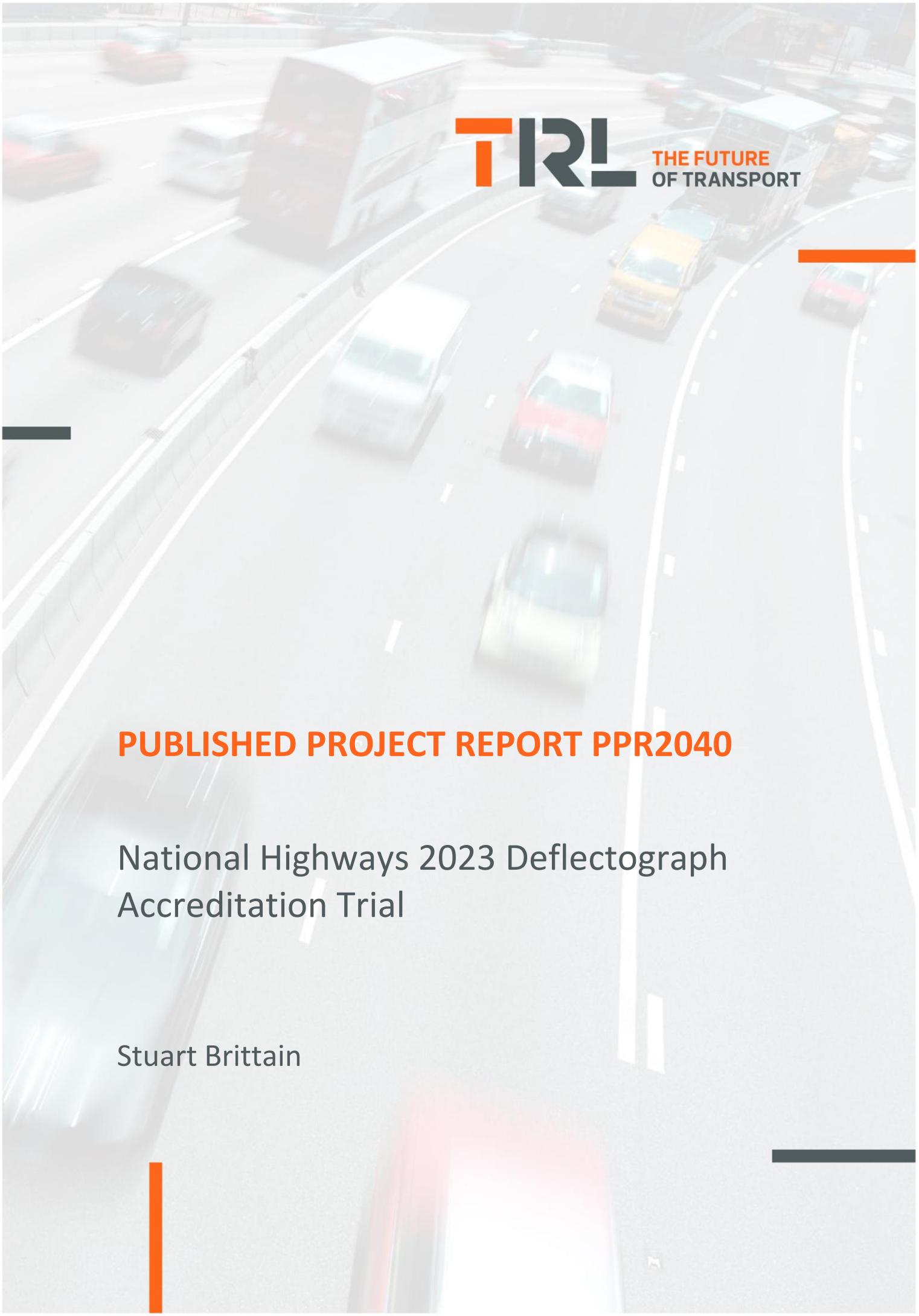

THE FUTURE OF TRANSPORT

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National Highways 2023 Deflectograph Accreditation Trial

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Executive summary

Deflectograph accreditation trials are held annually by TRL on behalf of National Highways. The objective is to monitor the performance of all Deflectographs operating on the National Highways Strategic Road Network (SRN) and other road networks. By examining and monitoring the results from the machines operating on specified test sections of the reference site, the performance of individual machines, and the performance of the whole UK fleet, are assessed.

The 2023 trial was held from the 21st to the 23rd February 2023. The site used was the twin horizontal straights of the Horiba-MIRA proving ground. This was the twenty-eighth year in which TRL has taken full responsibility for the planning and running of the trials. Ten machines attended the trial which represents the entirety of the known UK fleet.

The beginning of the first day of the trial was used to weigh the Deflectographs and undertake distance calibrations. On the second half of the first day, the machines tested the deflection site. The second day was used to repeat the deflection assessment and to obtain distance and temperature assessments.

All ten machines met the mandatory requirements of the trial (i.e. weight, deflection measurement and distance measurement) and can therefore be considered for approval to survey the National Highways SRN.

With regards to the measurement of pavement temperature at depth, nine of the ten machines achieved a high performance rating, and one machine achieved a low performance rating.

Participants were also asked to provide surface and air temperature measurements (if they had the equipment fitted) and five machines provided these measurements. With regards to the measurement of surface temperature, two machines achieved a high performance, two achieved a medium and one was identified as not suitable. With regards to measurement of air temperature, all five machines achieved a high performance.

1 Introduction

Deflectograph accreditation trials are held annually by TRL on behalf of National Highways. The objective is to monitor the performance of all Deflectographs operating on the National Highways Strategic Road Network. By examining and monitoring the results from the machines operating on specified test sections, the performances of individual machines, and the whole UK fleet can be assessed.

The 2023 trial was held from 21st to the 23rd February 2023. The site used was the twin horizontal straights of the Horiba-MIRA proving ground - which is further discussed in Section 2. This was the twenty-eighth year in which TRL has taken full responsibility for the planning and running of the trials and the eleventh full trial at Horiba-MIRA. Ten machines attended the trial. The trial process and the criteria used for the 2023 trial are discussed in Section 3 and Appendix D of this report, respectively. The results from the trial are discussed in Sections 4 to 6.

For convenience, throughout this report, the machines are referred to by their running numbers rather than by the owner. For ease of record keeping, running numbers are retained from year to year with any new machines being assigned new numbers. By agreement with National Highways, Appendix A lists the machines, owner and performance at the trial. This approach was also agreed with the ADEPT (formerly CSS) Deflectograph Operators Group before it disbanded.

2 Test site

2.1 Details of the test site

The twin horizontal straights area of the Horiba-MIRA Proving Ground comprises two lengths of straight and essentially level track just over 1.5km long. They are joined by banked bends at either end. During October 2010, National Highways arranged for a length of the nearside lane on one of the straights to be reconstructed, in order to produce three sections of different constructions/strength levels. These three sections were designed specifically for use in the accreditation of Deflectographs and other pavement deflection measuring devices. These sections are referred to as NHCP_01, NHCP_02 and NHCP_03 (National Highways Calibration Pavement) in this report. The sections are each 70m in length (however the beginning and end 5m are excluded in the analysis to help avoid alignment issues, resulting in effectively 60m sections) and the layout and test route are shown in Appendix B. Nominal construction details of the test sections can be found in Appendix C.

2.2 Suitability of site and management of site-dependent between run variability

In order to demonstrate the suitability of the sections constructed at Horiba-MIRA, a transitional trial was held on the 12th and 13th September 2011 (Brittain & Sanders, 2012). This trial compared a sub-set of the UK Deflectograph fleet, initially following the traditional approach using the historic test sections of the TRL track, and then moving to follow the proposed new procedures and sections at Horiba-MIRA. The work demonstrated that the Horiba-MIRA site was suitable for the accreditation of Deflectograph machines. Following the 2011 transitional trial, the trial process and the accreditation criteria were reviewed.

During the transitional trial it was found that there was a localised high deflection area on the site. This caused an increase in the between run variability in the data due to small changes in driving line. This was further investigated at the 2013 trial, and it was found that this variability could be removed by placing small cones on the test track to mark the survey test line for the whole test site. These cones were placed either side of the machines' test path (as shown in Figure 2.1), so that any deviation in the test line would cause a cone to be knocked over which could be recorded. It was too windy to apply this approach in the 2023 trial, the wind moving or knocking-over the cones, therefore lines were sprayed onto the surface marking the test line.



Figure 2.1: Image illustrating cone positions during testing

3 Trial format

In preparation for the 2021 trial, changes were made to the test programme to mitigate the risks from COVID-19. The changes made were also found to be beneficial for the efficiency of the trial. Therefore, a variation of this approach has been used in subsequent trials. The format applied to the 2023 trial is described in this section.

Each crew is required to carry out a machine inspection in advance of the trials and a certified checklist is submitted before the machine is allowed to take part in the running trials.

3.1 Day 1 – Weighing, distance calibration and test laps

On arrival, all staff signed in at the Horiba-MIRA Gatehouse. They then reported to the TRL reception staff. When all participants had arrived, a briefing was given by TRL to ensure that everyone involved is aware of the programme and what is required of them to ensure that the testing is completed safely and correctly.

All machines were weighed, and this data was used to allow for corrections for rear wheel weight to be applied to the deflection data. The weight measurements are presented in Section 4.2. During this period, the machines also undertook a distance calibration on the test track.

After completion of the weighing and distance calibrations, each machine undertook a static calibration followed by 6 test laps covering the three test sections (some machines also undertook a 7th lap, but this lap was stopped before completion due to track availability). The machine running order is randomised and all machines complete the testing in convoy (with suitable gaps left between them) to cover all the sections in a single measurement run.

To improve the alignment of the measurements, at the start of each run, crews were asked to stop their machines and align the deflection beam frame to the forward-most position of the test cycle with the truck wheels at a defined “beam down” point.

CS 229 (DMRB CS 229, 2020) sets a maximum rate of temperature increase of 2.5˚C per hour at 40mm for deflection testing on the UK trunk road network. This requirement is intended to ensure that temperature corrections used to adjust deflections to a standard temperature of 20˚C stay within the validity of the equations.

Although temperature corrections are not carried out in analysing data from the accreditation trial, the pavement temperature is monitored before and after the deflection test sections (the same locations the operators measure during the main testing) at 40 and 100mm depths to inform any conclusions drawn. Air and pavement surface temperature measurements are also collected at these locations. Automatic data-loggers are used to provide a reading every minute during deflection testing.

While the machines were running, TRL staff observed the dynamic operation of each machine, including a timed section in order to verify that operating speeds are acceptable.

Survey data, collected via USB memory sticks, was transferred via a secure FTP site to offsite data processors to allow interpretation of the data to be carried out.

The initial conclusions of the testing on this day were provided to participants via e-mail in the evening of day 1 after the processing and interpretation of the data.

3.2 Day 2 – Machine alterations and Main testing

The results from day 1 identified no outliers and therefore no machine alterations were required or undertaken on the morning of this day.

After staff were signed in, a morning briefing was held. Crews undertook a static calibration of their machines and then proceeded to undertake the main testing. This involved undertaking deflection test laps as on day 1. In addition, during this testing, operators were asked to measure a marked-out length and to record temperature measurements. The temperature measurements were taken in two pre-drilled holes (40mm depth, the same ones used for the loggers) and also in a water bucket (set up after the marked-out length). If the Deflectograph had air and surface temperature sensors fitted, then the crews were asked to also provide this data for the three measurement stations.

Eight laps were undertaken on this day with deflection, distance and temperature measurements collected by operators on each lap.

3.3 Day 3

Day 3 was not required for the 2023 trial.

4 Inspections and wheel weights

4.1 Inspections

All ten machines arrived with completed inspection checklists and in acceptable condition.

4.2 Wheel weights

Prior to the 2020 trial, Deflectographs had been weighed in the maintenance building on the HORIBA-MIRA proving ground. During the 2020 trial a member of staff slipped over during this process (on the smooth floor); this coupled with the fact that the use of this facility required a number of vehicle reversing operations all within a tight space, meant that this site was deemed unsuitable on safety grounds.

Therefore, for the 2021 trial, the weight measurements were undertaken (successfully) on the twin straights (in the open air). During the 2022 trial it was identified that it was too windy to obtain accurate measurements on the twin straights. Fortunately, it was possible to undertake measurements in a workshop on site (a different location from the maintenance building used in previous years). However, the availability of this workshop could not be guaranteed for future trials as it can only be booked a week in advance. Therefore, to mitigate this risk for the 2023 trial, operators were asked to make weight measurements of their devices and provide this information before the trial if they were able (i.e. if they had access to suitable, calibrated weigh pads). Operators of three of the ten machines were unable to provide these measurements before the trial.

Fortunately, the workshop which was used for the weighing during the 2022 trial was available and therefore all machines were weighed on the inspection day. Due to the risk of this facility not being available for future trials, it is recommended that collection of weight data before the trial is further pursued for the 2024 trial. Given that not all operators have access to suitable calibrated weigh pads, it may be necessary for the Auditor to provide opportunities to weigh devices at their site or some other suitable location.

The weight values measured during the 2023 trial are given in Table 4.1. To aid comparison against the criteria, the percentage of the target weight (100% corresponds to matching the target) are shown in brackets beneath the Total front, Rear NS and Rear OS values. If any machines were outside of the criteria then they would be highlighted in bold red text.

Table 4.1: Deflectograph weight distribution including crew (kg)

Machine	Front NS	Front OS	Total Front	Rear NS	Rear OS	Total rear	Total Machine
2	2469	2597	5066 (112.6%)	3228 (101.7%)	3377 (106.4%)	6605	11671
3	2346	2510	4856 (107.9%)	3468 (109.2%)	3364 (106%)	6832	11688
5	2331	2339	4670 (103.8%)	3253 (102.5%)	3291 (103.7%)	6545	11214
8	2243	2369	4612 (102.5%)	3293 (103.7%)	3152 (99.3%)	6445	11057
9	2319	2357	4676 (103.9%)	3415 (107.6%)	3293 (103.7%)	6708	11384
10	2402	2427	4829 (107.3%)	3453 (108.7%)	3159 (99.5%)	6612	11441
12	2272	2327	4599 (102.2%)	3260 (102.7%)	3334 (105%)	6593	11192
14	2361	2404	4765 (105.9%)	3343 (105.3%)	3461 (109%)	6804	11569
15	2424	2526	4951 (110%)	3444 (108.5%)	3356 (105.7%)	6801	11751
16	2291	2400	4690 (104.2%)	3333 (105%)	3181 (100.2%)	6514	11205

All machines are within the front axle and rear wheel limits given in the Accreditation and QA specification (TRL, 2020).

4.3 Beam calibration check

Prior to each set of testing, each crew carried out a static beam calibration check on their machine. No machines were identified to TRL as not meeting the limits specified in the accreditation and QA specification (TRL, 2020).

5 Day 1 (21st February 2023) – Initial laps

On this day, six test laps were undertaken. However, the first lap was disregarded (after analysis) to take account of the fact that the machines were likely to be warming-up.

5.1 Temperatures recorded by the data loggers

Data loggers connected to thermocouples recorded the 40mm and 100mm depth temperatures along with the air and pavement surface temperatures. The loggers were set to record the measurements every minute. This data was then smoothed by taking a 9-point moving average (4 points before the time, the time and 4 points after). This smoothed data is shown in Figure 5.1 and Figure 5.2.

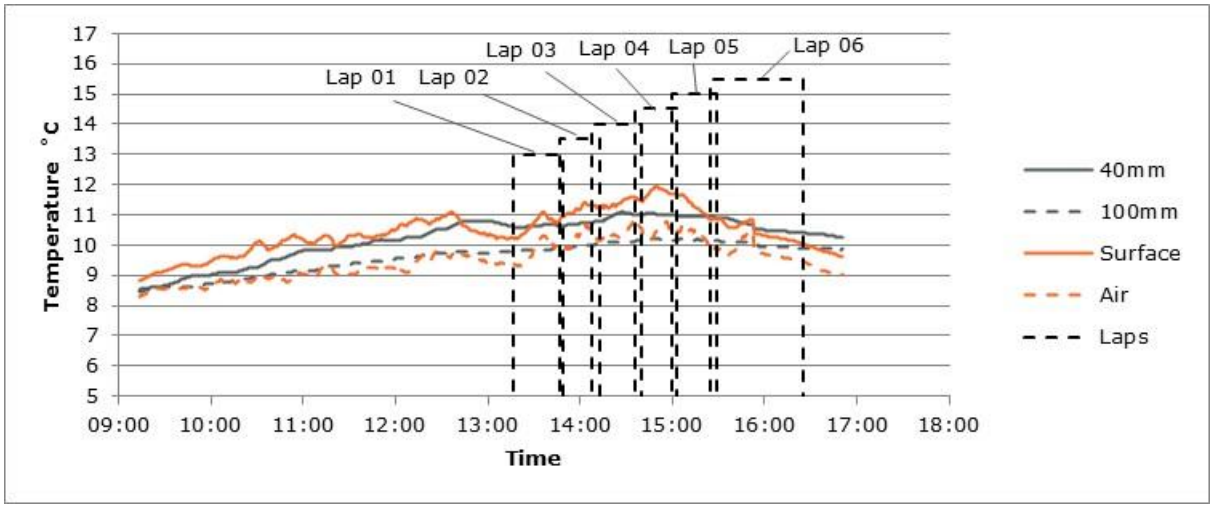

Figure 5.1: Temperature measurements from station 1 (before test sections) on day 1

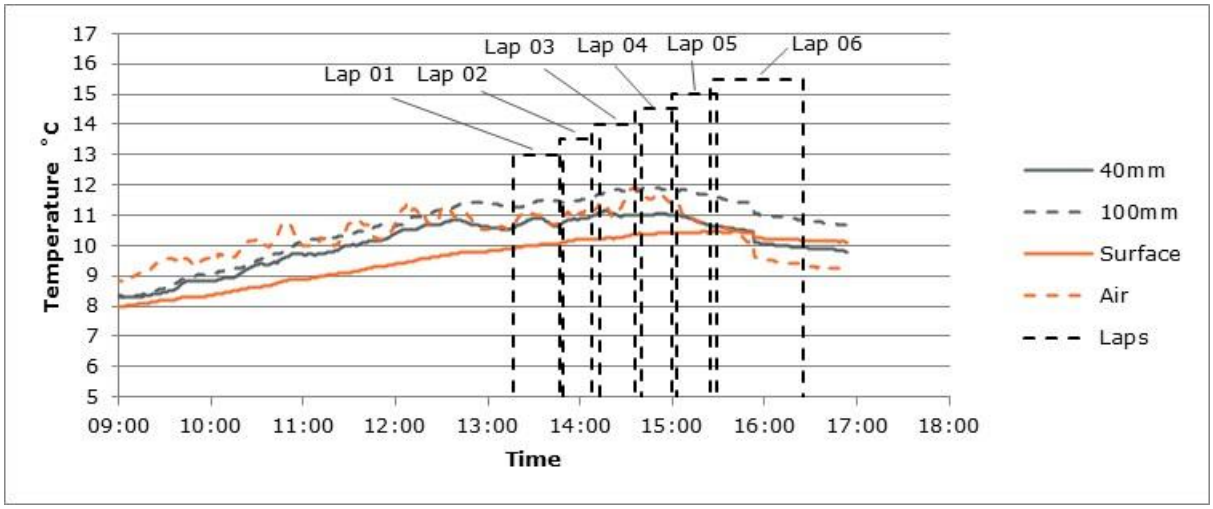

Figure 5.2: Temperature measurements from station 2 (after test sections) on day 1

Temperatures recorded at the test track increased slowly during the morning and then were relatively stable from 12:30 onwards during the testing. During testing, the 40mm depth measurement temperature varied between 10 and 11˚C for both stations.

5.2 Between-run standard deviation for deflection values

No criteria are set relating to the between-run standard deviation (BRSD) of each machine. This is due in part to the BRSD being affected by both the machine performance and also due to temperature changes over the testing period. It is, however, useful to consider this parameter when investigating anomalies in the behaviour of machines in case an individual machine's mean result has been unduly influenced by variations between runs, perhaps as a result of a significant variation from the expected test line. The BRSD for each machine, is shown in Table 5.1. Values (where present) which are more than two times the fleet average for the section and wheel path are highlighted in bold red text.

Table 5.1: Between-run standard deviation for day 1 (laps 2-6)

Machine Number	NHCP_01 NS	NHCP_01 OS	NHCP_02 NS	NHCP_02 OS	NHCP_03 NS	NHCP_03 OS
2	1.7	2.0	17.3	6.7	12.2	10.2
3	3.3	3.1	22.4	7.0	12.3	7.2
5	**10.5**	4.0	9.9	4.2	12.5	8.3
8	1.0	2.6	14.4	6.3	12.1	6.1
9	4.3	5.7	16.9	12.0	16.3	18.9
10	7.2	4.9	8.6	5.2	9.7	10.0
12	2.2	2.8	10.9	4.2	24.3	18.2
14	5.4	3.6	19.0	9.8	11.5	11.0
15	4.3	4.3	36.2	4.2	18.8	3.2
16	2.8	2.8	7.1	4.7	7.5	6.5

It can be seen from Table 5.1 that although there is a reasonably large spread of BRSD values, only one value (Machine 5 for the NS measurement on NHCP_01) was noticeably higher than the rest of the fleet for the section and wheel path combination. This machine was not noticeably higher for other sections and wheel path combinations, therefore, this analysis did not identify any particular concerns.

5.3 Mean deflection values

Table 5.2 shows the mean deflections recorded on each section, together with summary statistics. Instances where the between-equipment standard deviation (BESD) meets the criterion are highlighted in green and instances where the criterion is not met are shown in red. This table is used to identify if the overall fleet distribution meets the BESD criterion. Table 5.3 shows the deviations from the overall mean and these are highlighted if they are more than 2 or 3 times the BESD criteria (orange and red respectively). This table helps to identify if any machines are significant outliers and provides further information on the distribution of the fleet.

Table 5.2: Mean deflection (µm) by section: day 1

Machine number	NHCP_01 NS	NHCP_02 OS	NHCP_02 NS	NHCP_02 OS	NHCP_03 NS	NHCP_03 OS	Average NS	Average OS
2	53	49	313	266	152	143	173	153
3	45	42	301	247	150	142	165	144
5	60	43	316	244	170	146	182	144
8	47	41	314	250	157	141	173	144
9	49	66	324	297	142	156	171	173
10	59	58	313	273	169	174	180	168
12	48	41	335	270	168	149	184	154
14	79	52	340	260	186	150	202	154
15	53	54	316	261	160	147	176	154
16	53	50	320	273	171	165	181	163
Mean	55	50	319	264	162	151	179	155
BESD	9.8	8.2	11.2	15.8	12.8	10.6	9.8	10.2
BESD criterion	11.3	11.2	18.1	16.7	14.1	13.8	14.5	13.9
CoV	17.8%	16.4%	3.5%	6.0%	7.9%	7.0%	5.5%	6.5%

Table 5.3: Deviation (µm) from overall mean deflection by section: day 1

Machine number	NHCP_01 NS	NHCP_02 OS	NHCP_02 NS	NHCP_02 OS	NHCP_03 NS	NHCP_03 OS	Average NS	Average OS
2	-1.5	-1.0	-6.1	2.2	-10.0	-8.0	-5.8	-2.2
3	-9.5	-7.4	-18.0	-17.6	-12.9	-9.1	-13.4	-11.4
5	5.3	-6.4	-3.0	-20.5	7.4	-5.6	3.2	-10.8
8	-7.4	-8.8	-5.3	-14.2	-5.1	-10.3	-5.9	-11.1
9	-5.9	16.2	4.6	33.0	-20.6	4.3	-7.3	17.8
10	4.4	8.1	-6.4	8.9	6.2	22.3	1.4	13.1
12	-6.6	-8.4	15.3	6.2	5.7	-2.0	4.8	-1.4
14	24.1	2.3	20.8	-3.9	23.6	-1.2	22.8	-0.9
15	-1.4	4.7	-3.0	-3.2	-2.7	-4.1	-2.4	-0.9
16	-1.5	0.6	1.2	8.9	8.4	13.6	2.7	7.7
2x BESD criterion	22.6	22.3	36.2	33.3	28.1	27.5	28.9	27.7
3x BESD criterion	33.9	33.5	54.3	50.0	42.2	41.3	43.4	41.6

From Table 5.2 it can be seen that the BESD criterion is met for the average of the site (and all three sections) for both wheel paths. On examination of Table 5.3, it can be seen that there is only one instance (machine, section and wheel path) where the more than 2 times the BESD criterion from the fleet mean was observed (Machine 14, NHCP_01, NS). It can also be seen that there were no instances which were more than 3 times the BESD criterion away from the fleet mean.

After completion of the day 1 testing, all operators were given a copy of Table 5.2, and notified that no outliers were identified. Therefore, no machine alterations were required on day 2 of the trial.

6 Day 2 (23rd February) – Main test Laps

To differentiate from the testing on day 1, the laps on day 2 were prefixed with 1 so the first lap on day 2 was labelled as lap 11.

6.1 Machine alterations

No machine alterations were undertaken following the feedback from the testing on day 1.

6.2 Temperatures

6.2.1 Temperatures recorded by the data loggers

In addition to the two stations used on day 1, a third station was set up (after the distance check length). At station 3, the temperature of a water bucket was recorded along with the air and surface temperatures. As before, the data was then smoothed by taking a 9-point moving average. This smoothed data is shown in Figure 6.1, Figure 6.2 and Figure 6.4.

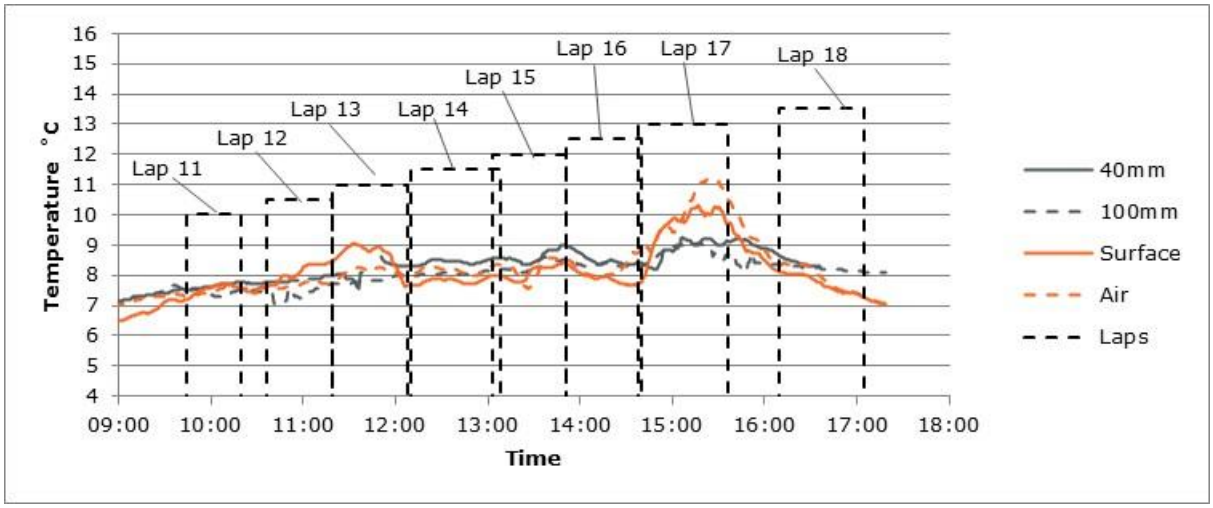

Figure 6.1: Temperature measurements from station 1 (before test sections) on day 2

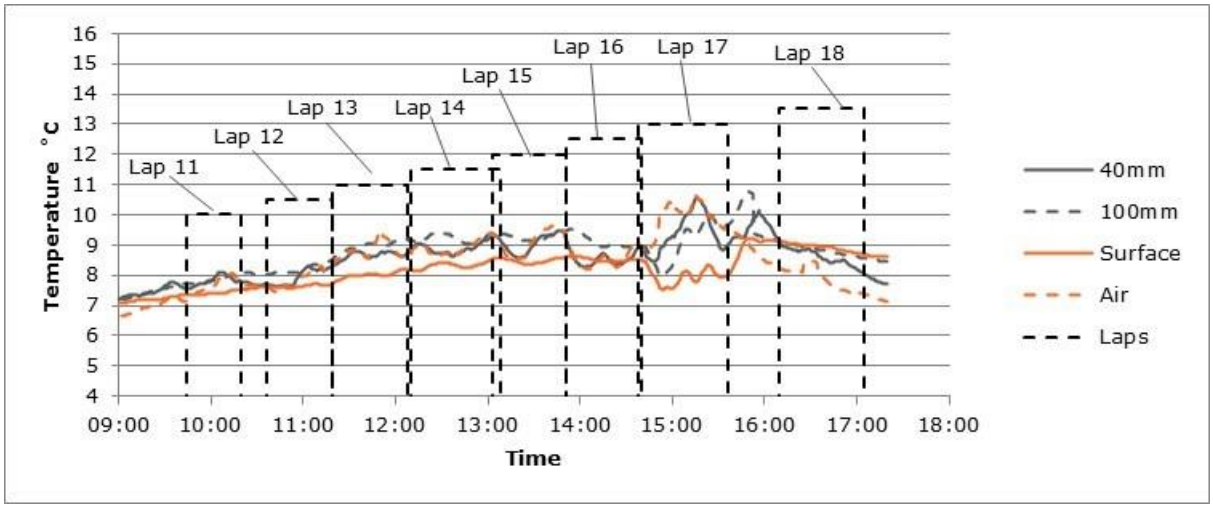

Figure 6.2: Temperature measurements from station 2 (after test sections) on day 2

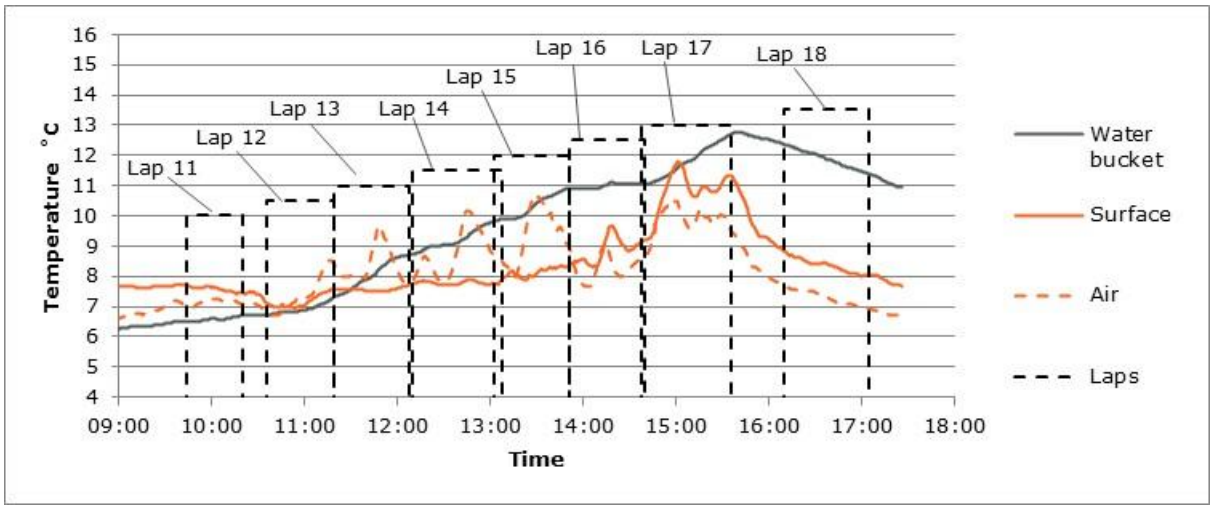

Figure 6.3: Temperature measurements from station 3 (after distance check length) on day 2

In general, during day 2, temperatures for the 40mm depth, surface and air were relatively stable with an average temperature around 8°C.

As discussed in Section 3.1, CS 229 sets a maximum rate of temperature change of 2.5˚C per hour at 40mm for deflection testing. The temperature change per hour (calculated for each 15-minute interval) for stations 1 and 2 (either side of the deflection sections) is shown in Figure 6.4.

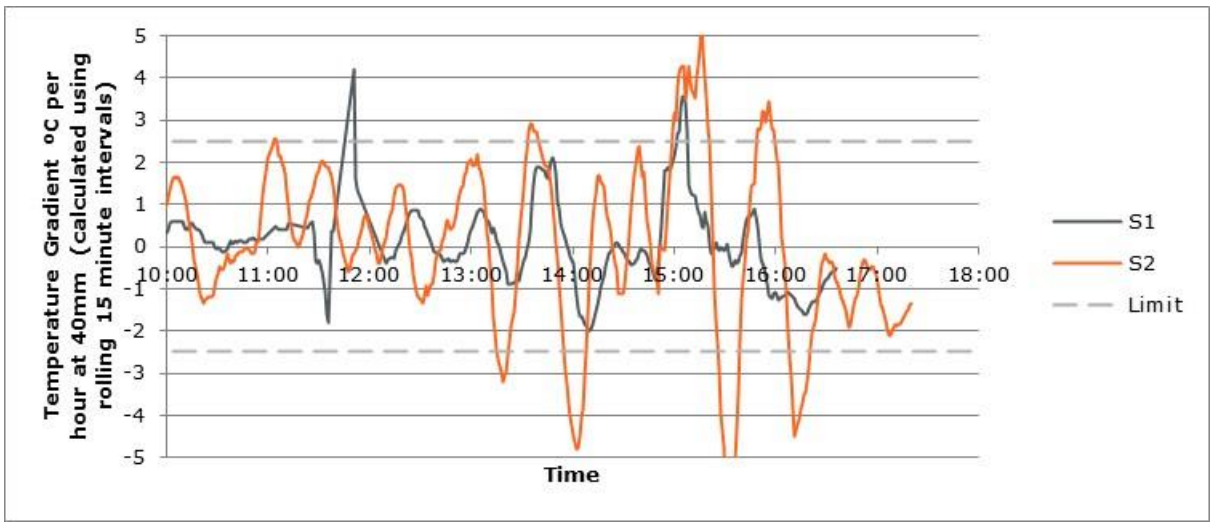

Figure 6.4: 40mm depth temperature changes day 2 (stations 1 and 2)

It can be seen from Figure 6.4 that the rate of change in temperature exceeds the limit on station 1 at two points (around 11:50 and 15:10). In addition, the rate of change exceeds the limit on station 2 at 8 points (around 11:05, 13:20, 13:35, 14:05, 15:10, 15:30, 16:00 and 16:10). This means that the rate of change of temperature was exceeded (on at least one station) on laps 12, 14, 15, 16 and 17. Therefore there may be some additional variability in deflections obtained during these laps due to the relatively rapid changes in temperature.

6.2.2 *Temperatures at depth and water bucket, recorded by operators*

The Deflectograph crews made measurements of temperature from the two temperature test stations at 40mm depth and, in addition, they measured the temperature of a water bucket at the third temperature measurement station. The results for the three stations are shown in Figure 6.5, Figure 6.6 and Figure 6.7.

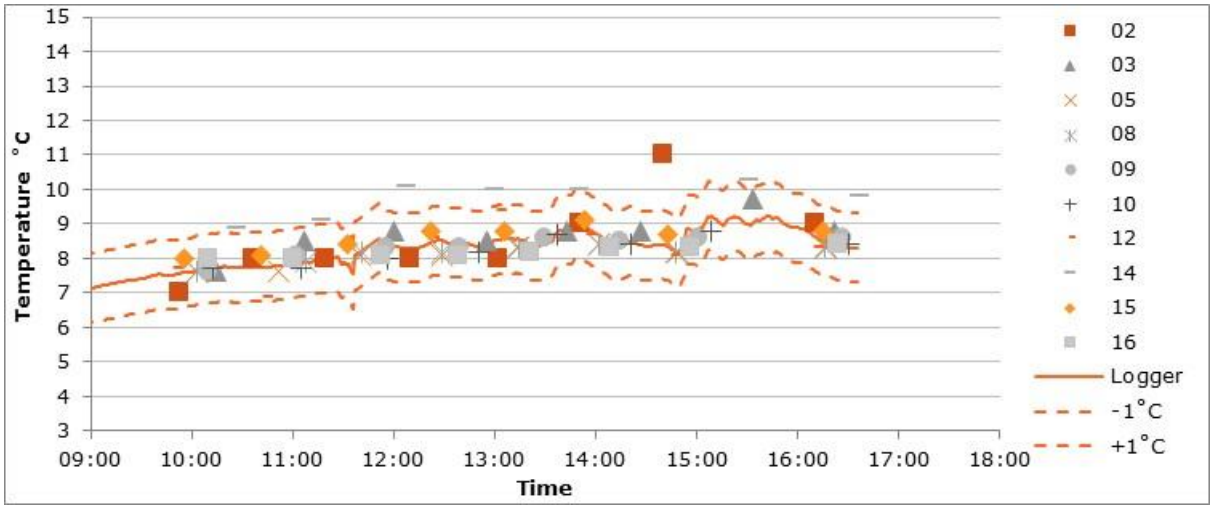

Figure 6.5: Comparison of operators' measurements against reference – Temperature test station 1, day 2

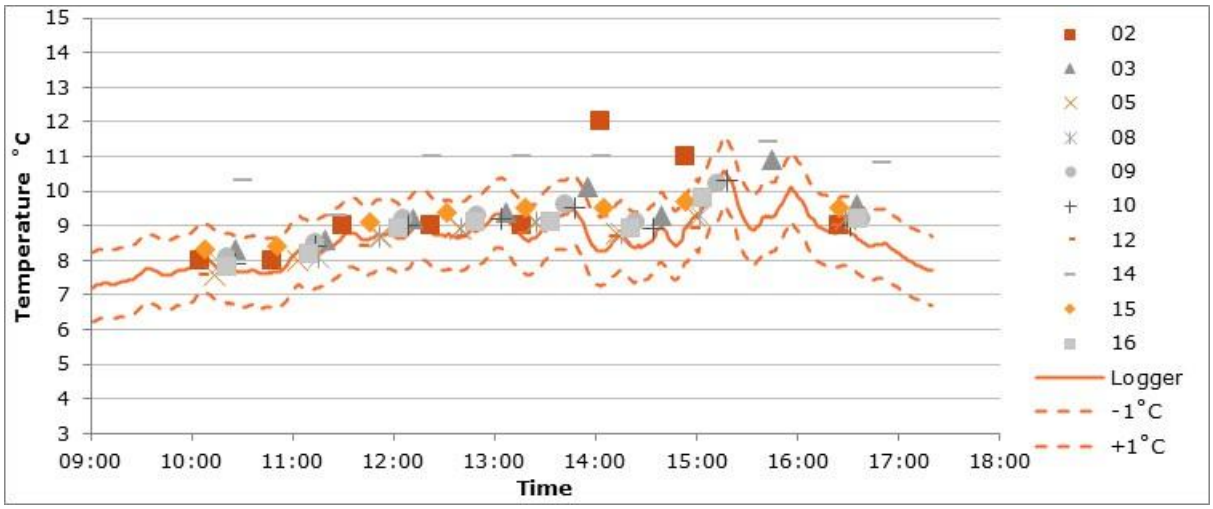

Figure 6.6: Comparison of operators' measurements against reference – Temperature test station 2, day 2

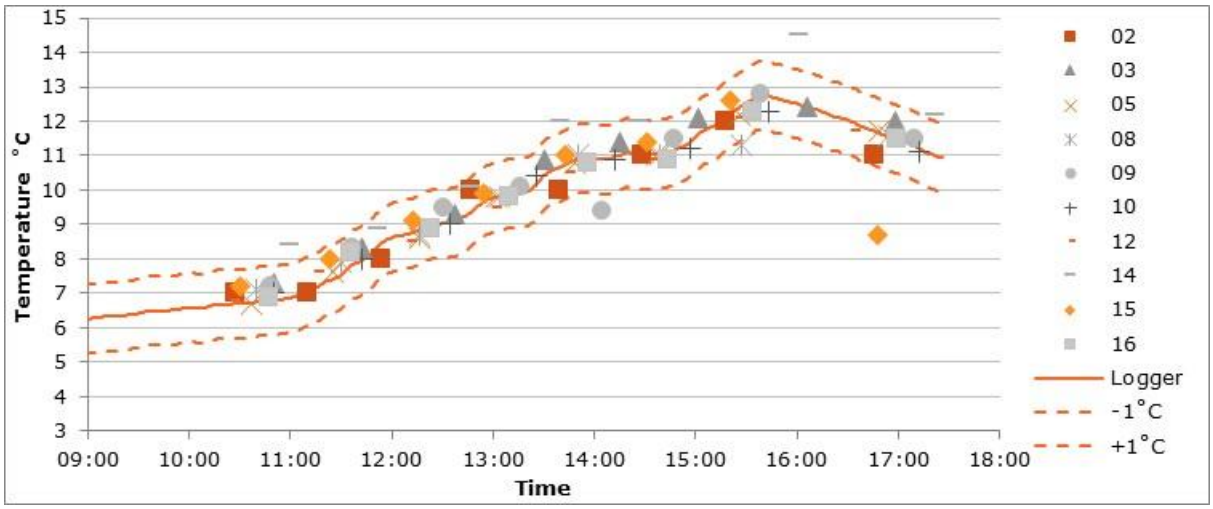

Figure 6.7: Comparison of operators' measurements against reference – Temperature test station 3 (water bucket), day 2

The differences between the operators' measured values and the reference values recorded by the loggers are shown in Table 6.1 for station 1 , Table 6.2 for station 2 and Table 6.3 for the water bucket. Any measurements outside of the criterion are highlighted in red bold text. The overall summary performance for these measurements and performance band awarded to the operator is presented in Table 6.4.

Table 6.1: Difference between operators' 40mm measured values and the reference: station 1

ID	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	% within criteria
2	-0.6	0.3	0.0	-0.3	-0.5	0.0	**2.6**	0.4	88%
3	-0.1	0.6	0.5	0.1	0.0	0.4	0.7	0.4	100%
5	-0.1	-0.2	.	-0.4	-0.3	-0.3	0.0	-0.2	100%
8	-0.1	0.0	.	-0.3	-0.3	-0.3	0.0	-0.2	100%
9	-0.1	.	-0.1	-0.2	0.2	0.1	-0.2	0.3	100%
10	0.0	-0.2	-0.4	-0.2	0.0	-0.1	-0.4	0.1	100%
12	0.2	-0.9	-0.1	0.1	0.9	-0.2	-0.2	-0.3	100%
14	**1.2**	**1.1**	**1.8**	**1.5**	**1.0**	.	**1.3**	.	0%
15	0.4	0.3	0.6	0.3	0.2	0.2	0.4	0.3	100%
16	0.3	.	-0.3	-0.4	-0.2	-0.1	-0.5	0.0	100%

Table 6.2: Difference between operators' 40mm measured values and the reference: station 2

ID	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	% within criteria
2	-0.1	0.3	0.3	0.1	0.3	**3.7**	**2.1**	0.2	75%
3	0.6	0.3	0.3	0.1	**1.4**	0.3	**1.6**	1.0	75%
5	-0.3	-0.3	0.0	0.2	0.5	0.2	0.0	0.3	100%
8	0.1	-0.1	-0.1	0.2	0.4	0.1	-0.1	0.3	100%
9	0.3	0.3	0.5	0.4	0.3	0.7	0.1	0.7	100%
10	0.2	0.2	0.2	-0.2	0.1	0.3	-0.2	0.2	100%
12	-0.5	0.7	-0.2	0.1	0.0	0.3	-0.3	0.2	100%
14	**2.6**	0.8	**2.2**	**2.3**	**2.7**	.	**2.1**	**2.3**	14%
15	0.2	0.7	0.5	0.7	0.9	**1.2**	0.8	0.7	88%
16	0.0	0.0	0.3	0.3	-0.1	0.5	0.3	0.6	100%

Table 6.3: Difference between operators' measured values of water bucket and the reference

ID	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	% within criteria
2	0.3	-0.1	-0.5	0.6	-0.7	0.0	-0.2	-0.7	100%
3	0.5	0.4	0.2	0.5	0.4	0.5	0.0	0.5	100%
5	0.0	0.2	-0.3	0.0	-0.1	0.0	-0.2	0.0	100%
8	0.3	0.3	-0.2	0.0	0.1	0.0	**-1.1**	0.0	88%
9	0.4	0.5	0.5	0.2	**-1.5**	0.4	0.0	0.2	88%
10	0.2	0.1	0.0	0.2	-0.1	-0.2	-0.4	-0.1	100%
12	0.1	0.4	-0.2	-0.3	-0.3	-0.1	-0.2	-0.3	100%
14	**1.5**	0.5	0.7	**1.3**	0.9	.	**2.0**	**1.2**	43%
15	0.5	0.6	0.3	0.3	0.3	0.4	0.4	**-3.0**	88%
16	0.1	0.4	-0.1	-0.1	-0.1	-0.2	-0.4	0.0	100%

Table 6.4: Summary of operators' at depth/water bucket performance

ID	% within criteria: Station 1	% within criteria: Station 2	% within criteria: Water bucket	Overall % within criteria	Performance band
2	88%	75%	100%	88%	High
3	100%	75%	100%	92%	High
5	100%	100%	100%	100%	High
8	100%	100%	88%	96%	High
9	100%	100%	88%	96%	High
10	100%	100%	100%	100%	High
12	100%	100%	100%	100%	High
14	0%	14%	43%	20%	Low
15	100%	88%	88%	92%	High
16	100%	100%	100%	100%	High

Therefore, for the direct measurement of pavement temperature, nine machines achieved a high performance and one a low.

6.2.3 Surface and Air temperatures, recorded by operators

Methodologies for estimating pavement temperature from measurements of surface and air temperatures have been developed for use with deflection surveys. These are included in CS 229 (DMRB CS 229, 2020) which permits Deflectograph survey contractors to use surface and air temperature measurements to estimate 40mm pavement temperatures.

At the trial, surface and air temperature data was supplied from five machines. Data was collected from the same two locations as the 40mm temperature holes (before and after the test sections) and next to the water bucket (after the distance measurement lengths). The surface temperatures from the logger and the data supplied from the operators are shown in Figure 6.8, Figure 6.9 and Figure 6.10.

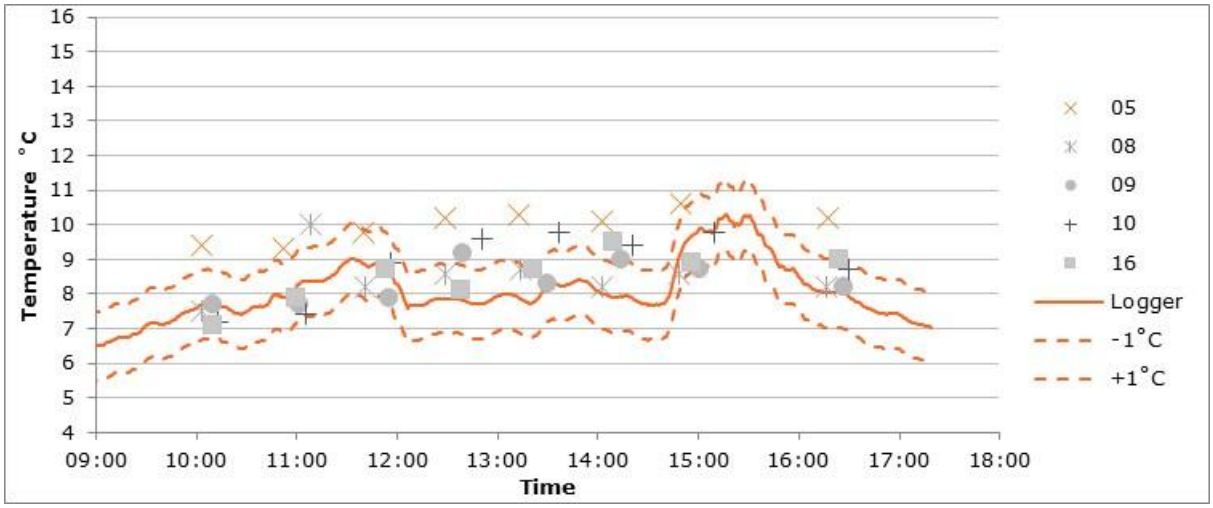

Figure 6.8: Comparison of Deflectograph recorded surface temperatures against reference – Temperature test station 1, day 2

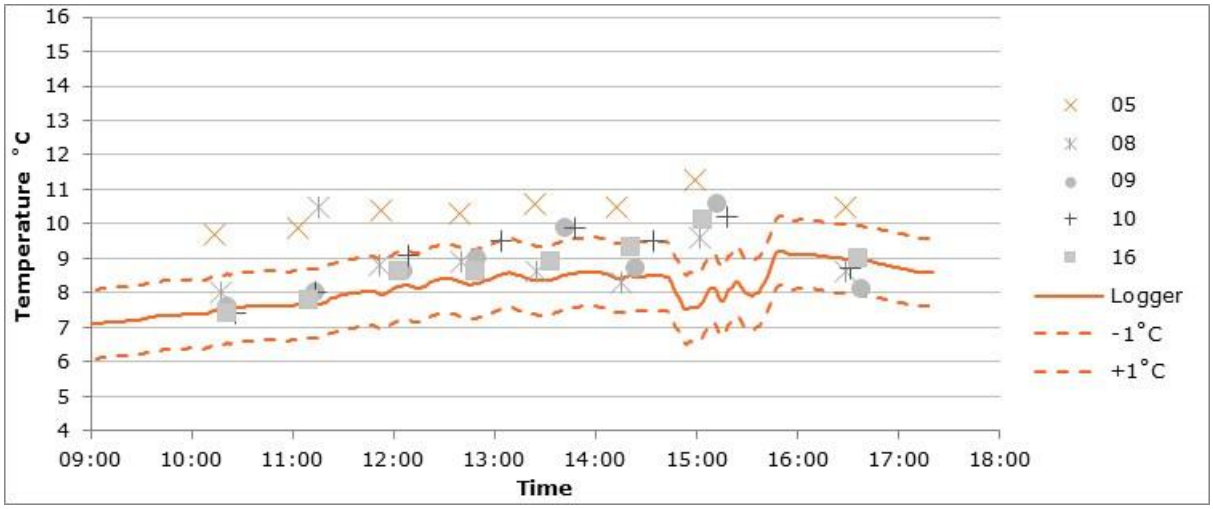

Figure 6.9: Comparison of Deflectograph recorded surface temperatures against reference – Temperature test station 2, day 2

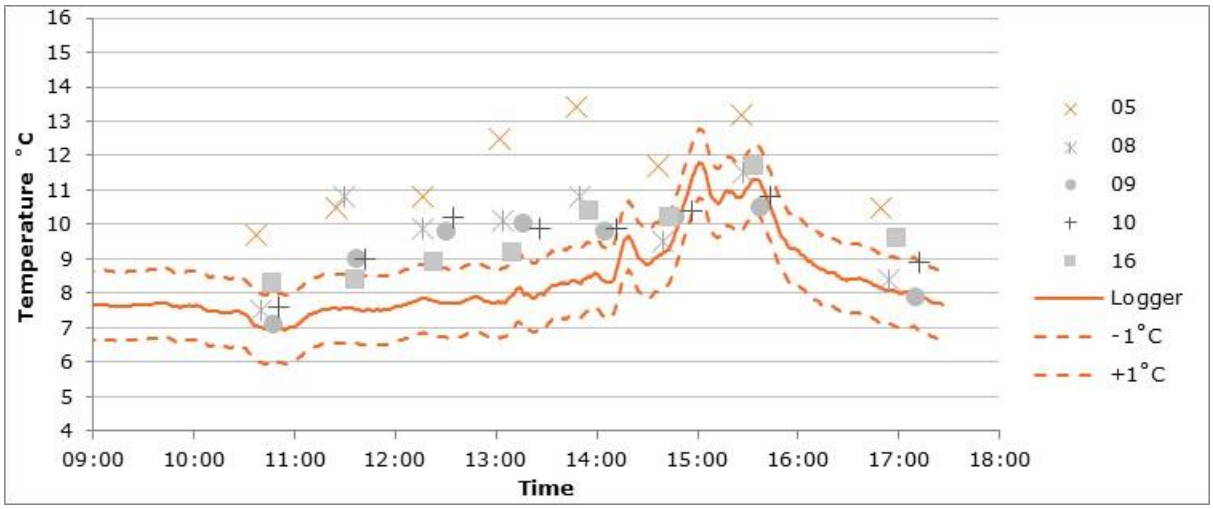

Figure 6.10: Comparison of Deflectograph recorded surface temperatures against reference – Temperature test station 3, day 2

On examination of the surface temperature data from station 3 (Figure 6.10) it can be seen that there is a larger spread in the operators' measurements and also a bigger difference between the operators' measurements and the logger. This is believed to be due to the fact that the logger being paced on a concrete layby next to the track, and some operators staying on the track for the measurements and others pulling into the layby. Therefore, the surface temperature measurements from station 3 have not been used in the assessment of performance. The use of station 3 was introduced for this trial, and the test instructions will be reviewed and better defined in future year's to avoid ambiguity in vehicle position during measurement.

The differences between the operators' measured surface temperatures and the reference values recorded by the loggers are shown in Table 6.5 for station 1 and Table 6.6 for station 2. Any measurements outside of the criterion are highlighted in red bold text. The overall summary performance for these measurements and performance band awarded to the operator is presented in Table 6.7.

Table 6.5: Difference between operators' surface temperature values and the reference: station 1

ID	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	% within criteria
5	**1.7**	**1.4**	0.9	**2.3**	**2.4**	**2.1**	**1.5**	**2.2**	13%
8	-0.2	**1.6**	-0.6	0.7	0.8	0.2	-0.4	0.2	88%
9	0.0	-0.6	-0.8	**1.4**	0.1	**1.1**	**-1.2**	0.2	63%
10	-0.5	**-1.0**	0.2	**1.9**	**1.6**	**1.5**	0.0	0.8	63%
16	-0.6	-0.4	-0.1	0.2	0.9	**1.6**	-0.8	1.0	88%

Table 6.6: Difference between operators' surface temperature values and the reference: station 2

ID	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	% within criteria
5	**2.2**	**2.2**	**2.4**	**2.0**	**2.2**	**2.1**	**3.7**	**1.5**	0%
8	0.5	**2.8**	0.8	0.6	0.2	-0.1	**1.9**	-0.4	75%
9	0.1	0.3	0.4	0.7	**1.4**	0.2	**2.6**	-0.8	75%
10	-0.2	0.3	0.9	1.0	**1.3**	1.0	**2.3**	-0.3	75%
16	-0.1	0.1	0.4	0.3	0.5	0.8	**2.3**	0.0	88%

Table 6.7: Summary of operators' surface temperature performance

ID	% within criteria: Station 1	% within criteria: Station 2	Overall % within criteria	Performance band
5	13%	0%	6%	Not suitable
8	88%	75%	81%	High
9	63%	75%	69%	Medium
10	63%	75%	69%	Medium
16	88%	88%	88%	High

For surface temperature measurements, two machines achieved a high performance, two a medium and the remaining was identified as not suitable.

The air temperatures from the logger and the data supplied from the operators are shown in Figure 6.11, Figure 6.12 and Figure 6.13.

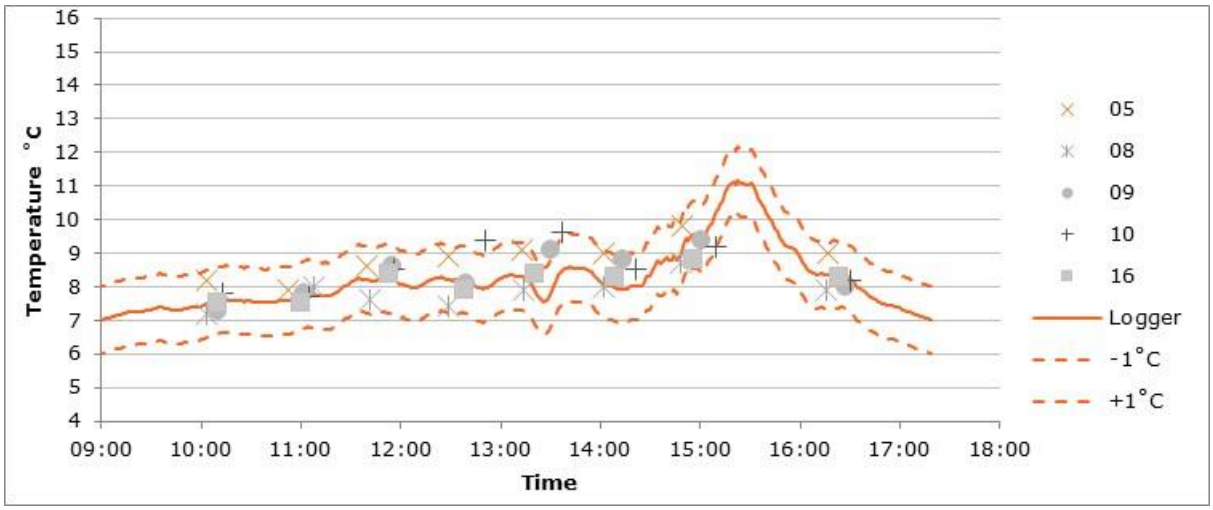

Figure 6.11: Comparison of Deflectograph recorded air temperatures against reference – Temperature test station 1, day 2

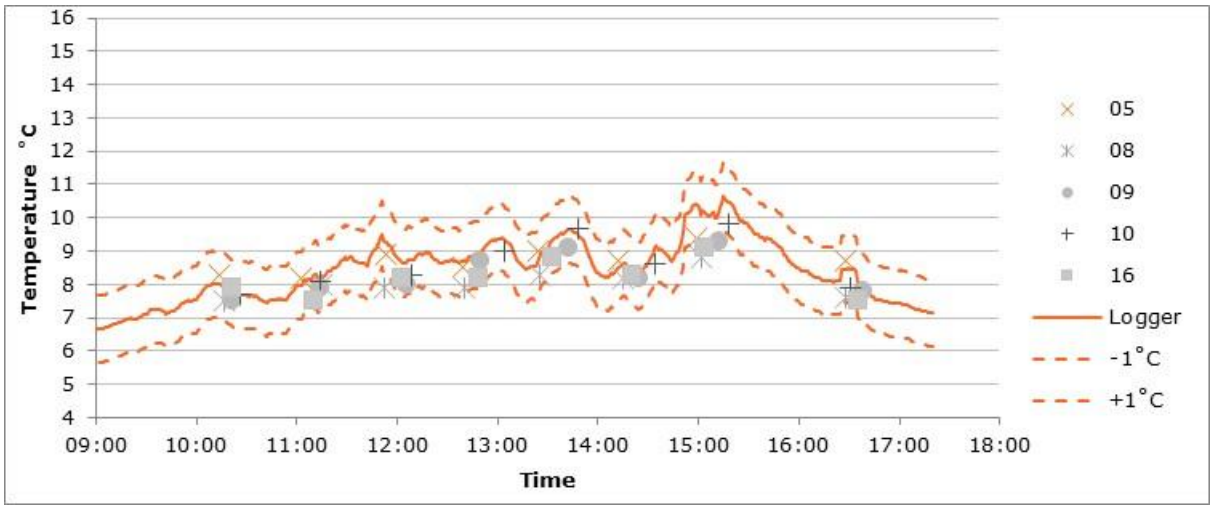

Figure 6.12: Comparison of Deflectograph recorded air temperatures against reference – Temperature test station 2, day 2

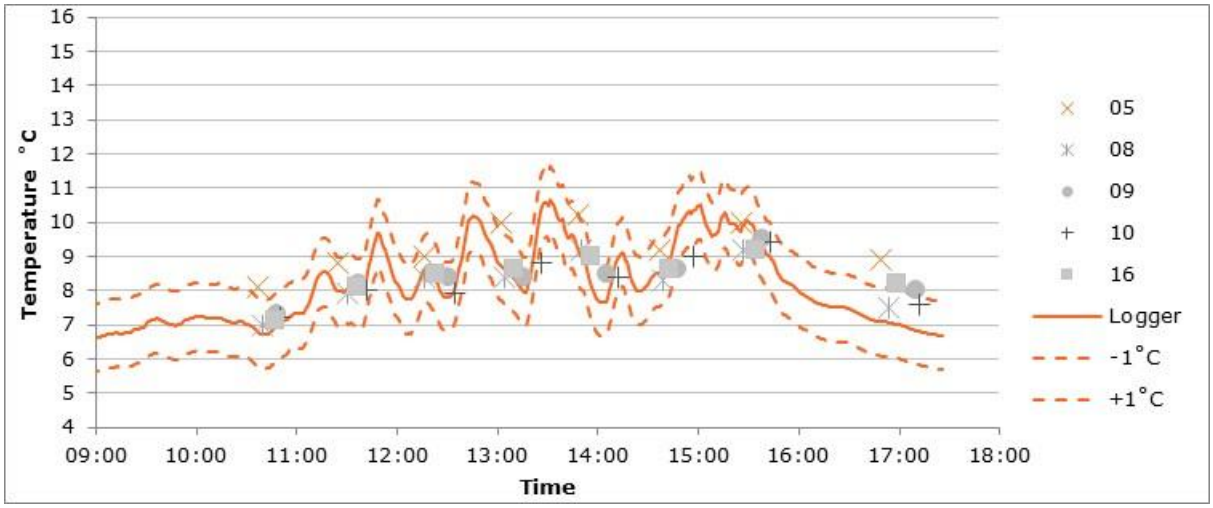

Figure 6.13: Comparison of Deflectograph recorded air temperatures against reference – Temperature test station 3, day 2

The differences between the operators' measured air temperatures and the reference values recorded by the loggers are shown in Table 6.8 for station 1, Table 6.9 for station 2 and Table 6.10 for station 3. Any measurements outside of the criterion are highlighted in red bold text. The overall summary performance for these measurements and performance band awarded to the operator is presented in Table 6.11.

Table 6.8: Difference between operators' air temperature values and the reference: station 1

ID	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	% within criteria
5	0.7	0.3	0.4	0.7	0.8	0.9	0.8	0.7	100%
8	-0.3	0.2	-0.6	-0.8	-0.4	-0.1	-0.2	-0.4	100%
9	-0.3	0.0	0.4	-0.1	**1.3**	0.9	0.0	-0.3	88%
10	0.2	-0.1	0.3	**1.4**	**1.1**	0.5	-1.0	0.0	75%
16	-0.1	-0.2	0.2	-0.3	0.6	0.3	-0.8	-0.1	100%

Table 6.9: Difference between operators' air temperature values and the reference: station 2

ID	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	% within criteria
5	0.3	0.2	-0.4	-0.2	0.4	0.2	-1.0	0.3	100%
8	-0.4	-0.2	**-1.4**	-0.8	-0.5	-0.5	**-1.4**	-0.8	75%
9	-0.2	-0.3	-0.8	-0.3	-0.5	-0.1	-0.8	-0.1	100%
10	0.0	-0.1	-0.5	-0.4	0.2	-0.5	-0.7	-0.5	100%
16	0.2	-0.7	-0.4	-0.7	-0.6	-0.1	**-1.0**	-0.5	88%

Table 6.10: Difference between operators' air temperature values and the reference: station 3

ID	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	% within criteria
5	**1.3**	0.8	0.4	**1.3**	0.9	0.6	0.1	**1.8**	63%
8	0.3	-0.1	-0.2	-0.2	0.2	-0.3	-0.7	0.4	100%
9	0.4	0.3	0.6	0.4	0.8	**-1.1**	0.2	**1.1**	75%
10	0.2	-0.5	-0.1	**-1.5**	-0.5	**-1.3**	0.5	0.8	75%
16	0.2	0.2	0.2	0.3	0.9	-0.3	-0.5	**1.2**	88%

Table 6.11: Summary of operators' air temperature performance

ID	% within criteria: Station 1	% within criteria: Station 2	% within criteria: Station 3	Overall % within criteria	Performance band
5	100%	100%	63%	88%	High
8	100%	75%	100%	92%	High
9	88%	100%	75%	88%	High
10	75%	100%	75%	83%	High
16	100%	88%	88%	92%	High

All five machines that provided air temperatures achieved a high performance.

6.3 Deflection readings

To allow the machines to "warm up", the first lap on this day (lap 11) was disregarded (after initial analysis to identify any early issues). Due to the larger rates of change in temperature seen on this day (discussed in 6.2.1), additional laps were undertaken. There were also some issues reported for devices on achieving the test line on lap 12. Therefore, the tables and analysis below include the data from laps 13 to 18 carried out on this day.

6.3.1 Between-run standard deviation for deflection values

The between-run standard deviation (BRSD) for each machine, are shown in Table 6.12. Values (where present) which are more than two times the fleet average for the section and wheel path are highlighted in bold red text.

Table 6.12: Between-run standard deviation for day 2 (laps 13 to 18)

Machine number	NHCP_01 NS	NHCP_01 OS	NHCP_02 NS	NHCP_02 OS	NHCP_03 NS	NHCP_03 OS
2	4.2	4.7	4.5	5.9	10.1	11.8
3	2.3	2.6	21.0	9.0	11.7	8.8
5	8.6	3.5	10.3	2.7	3.3	4.1
8	**14.7**	**15.1**	15.8	8.3	7.9	6.0
9	2.3	4.8	6.2	7.4	4.6	7.2
10	2.5	5.3	8.2	8.9	8.0	5.2
12	5.1	4.3	3.7	4.7	5.5	5.3
14	2.5	1.3	4.5	6.0	7.9	7.1
15	3.5	9.3	12.3	14.8	6.7	12.7
16	2.9	2.7	7.2	2.5	7.8	6.0

It can be seen from Table 6.12 that there was increased variability in Machine 8 on NHCP_01, however this variability was not seen on the other sections. Other than this observation, and despite some variation in the values, no machine was obviously more variable on average than the others.

6.3.2 Mean deflection values

The mean deflections recorded on each section, together with the summary statistics for the testing on day 2 (laps 13-18) can be seen in Table 6.13. As with the analysis for the data on day 1, instances where the between-equipment standard deviation (BESD) is within the criterion are highlighted in green and instances where the criterion is not met are in red. Table 6.14 shows the deviations from the overall mean and these are highlighted if they are more than 2 or 3 times the BESD criteria (in orange and red, respectively).

Table 6.13: Mean deflection (µm) by section: day 2 (laps 13-18)

Machine number	NHCP_01 NS	NHCP_02 OS	NHCP_02 NS	NHCP_02 OS	NHCP_03 NS	NHCP_03 OS	Average NS	Average OS
2	47	46	249	206	118	113	138	121
3	40	40	270	223	134	122	148	128
5	61	42	301	210	154	119	172	124
8	55	51	273	221	131	125	153	132
9	43	51	269	229	127	127	146	136
10	49	53	278	236	150	156	159	148
12	31	26	254	196	107	99	131	107
14	73	49	297	228	161	133	177	137
15	49	59	256	239	125	142	143	147
16	52	46	275	233	143	134	157	138
Mean	50	46	272	222	135	127	152	132
BESD	11.6	9.1	17.1	14.1	16.9	15.8	14.4	12.4
BESD criterion	11.2	11.1	16.9	15.6	13.4	13.1	13.8	13.3
CoV	23.1%	19.8%	6.3%	6.4%	12.5%	12.5%	9.5%	9.4%

Table 6.14: Deviation (µm) from overall mean deflection by section: day 2 (laps 13-18)

Machine number	NHCP_01 NS	NHCP_02 OS	NHCP_02 NS	NHCP_02 OS	NHCP_03 NS	NHCP_03 OS	Average NS	Average OS
2	-3.3	-0.7	-23.0	-16.1	-16.9	-14.2	-14.4	-10.3
3	-9.8	-6.5	-2.1	1.3	-1.3	-5.4	-4.4	-3.5
5	11.3	-3.9	28.6	-12.0	19.1	-7.9	19.7	-7.9
8	5.1	4.9	0.4	-1.2	-4.1	-2.1	0.5	0.5
9	-7.3	4.8	-2.9	6.7	-8.3	0.1	-6.1	3.9
10	-0.7	6.6	5.9	14.3	14.7	28.9	6.7	16.6
12	-18.9	-20.5	-18.6	-26.5	-27.7	-28.3	-21.8	-25.1
14	23.1	2.6	24.9	5.8	26.0	6.4	24.7	4.9
15	-1.2	13.3	-16.2	16.8	-9.8	15.1	-9.1	15.1
16	1.7	-0.6	3.0	11.0	8.3	7.4	4.3	5.9
2x BESD criterion	22.3	22.1	33.7	31.2	26.7	26.3	27.6	26.5
3x BESD criterion	33.5	33.2	50.6	46.8	40.1	39.4	41.4	39.8

From Table 6.13 it can be seen that the BESD criteria is met for the average of the site in the OS wheel path but not the NS wheel path. This would normally lead to the identification and removal of outliers. However, on examination of Table 6.14, it can be seen that no machine is more than 3 times the BESD criterion away from the fleet mean and no machine is consistently more than 2 times the BESD criterion away from the fleet mean. It can also be seen that the machine which is producing the highest value on the NS (Machine 14) is approximately the same distance away from the mean as the one producing the lowest value (Machine 12). This suggests that although the BESD criterion has not been met for the NS measurements the overall spread of the machines is suitable. Therefore, all of the machines are considered as meeting the trial criteria for deflection measurement.

6.4 Distance measurement

A distance check length was set up on the track to assess the distance measurement systems on the machines. The reference length used was 522m. During the trial, the survey crews were asked to test the reference length and note down on the run log sheets the distance measured. This involves reviewing the survey file and identifying the length between the two marker points. The crews were also asked to provide these survey files.

The difference between the measured length from each machine and the reference length, along with the overall performance, are given in Table 6.15. Where the difference between the machine and the reference exceeds the threshold for the criteria as set out in Section D.1, it is highlighted in red.

Table 6.15: Difference between operator's distance measurements and the reference

ID	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	% within criteria	Performance
2	1.0	-1.0	0.0	5.0	3.0	3.0	4.0	3.0	100%	Pass
3	1.0	-4.0	-5.0	-5.0	-5.0	-4.0	-5.0	**-9.0**	88%	Pass
5	-3.0	-4.0	0.0	-2.0	-1.0	-3.0	0.0	-2.0	100%	Pass
8	0.0	-4.0	-1.0	-1.0	-2.0	-2.0	-2.0	-1.0	100%	Pass
9	-3.0	-2.0	-1.0	-1.0	1.0	0.0	0.0	-1.0	100%	Pass
10	-3.0	-1.0	0.0	1.0	0.0	-2.0	-2.0	-1.0	100%	Pass
12	-3.0	-2.0	0.0	-2.0	-2.0	-3.0	-4.0	-5.0	100%	Pass
14	-4.0	-3.0	0.0	-3.0	1.0	-3.0	-4.0	-1.0	100%	Pass
15	-1.0	-3.0	-3.0	1.0	0.0	0.0	-4.0	-1.0	100%	Pass
16	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	100%	Pass

From Table 6.15 it can be seen that all ten machines passed the distance measurement criteria.

7 Conclusions

The 2023 National Deflectograph accreditation trials were held on the Horiba-MIRA proving grounds by TRL on behalf of National Highways in the week beginning the 20th February 2023. Ten machines, which is thought to constitute the whole of the current UK fleet of Deflectographs, attended the trial.

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

(I) Wheel Weights

All ten machines that participated in the trial were within the wheel and axle limits.

(II) Deflection measurement

All ten machines that participated in the trial met the criteria for deflection measurement.

(III) Distance measurement

All ten machines that participated in the trial met the criteria for distance measurement.

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

(IV) Temperature measurement – measurement at depth

Nine of the ten operators achieved a high performance with regards to the measurement of temperature at depth. One machine achieved a low.

(V) Temperature measurement – surface temperature

Surface temperature data from five machines was supplied at this trial. Two machines achieved a high performance, two a medium and one was identified as not suitable.

(VI) Temperature measurement – air temperature

Air temperature data from five machines was supplied at this trial. All five machines achieved a high performance.

A summary of the machines that attended the 2023 accreditation trial and the criteria that they met/performance achieved can be found in Appendix A.

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Appendix A Machine identification

Table A.1: Machine identification

ID	Operator at trial date	Registration number	Deflection	Distance	Temperature at 40mm	Surface temperature	Air temperature
2	PTS Ltd	L697 BKR	Pass	Pass	High	No data	No data
3	TRL Ltd	B180 FBL	Pass	Pass	High	No data	No data
5	WDM Ltd	D962 JRU	Pass	Pass	High	Not Suitable	High
8	WDM Ltd	BYW 80V	Pass	Pass	High	High	High
9	WDM Ltd	VGV 182X	Pass	Pass	High	Medium	High
10	WDM Ltd	F569 JBB	Pass	Pass	High	Medium	High
12	WDM Ltd	EOU 230W	Pass	Pass	High	No data	No data
14	Lincolnshire County Council	B195 CFW	Pass	Pass	Low	No data	No data
15	DFI Roads	ACZ 3268	Pass	Pass	High	No data	No data
16	WDM Ltd	B880 XOU	Pass	Pass	High	High	High

Appendix B Layout of test sections at Horiba-MIRA

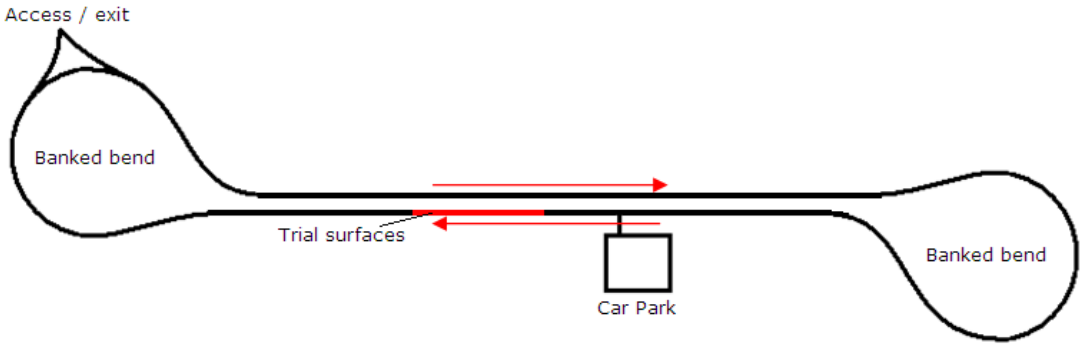

Figure B.1: Test route on the Horiba-MIRA twin straights

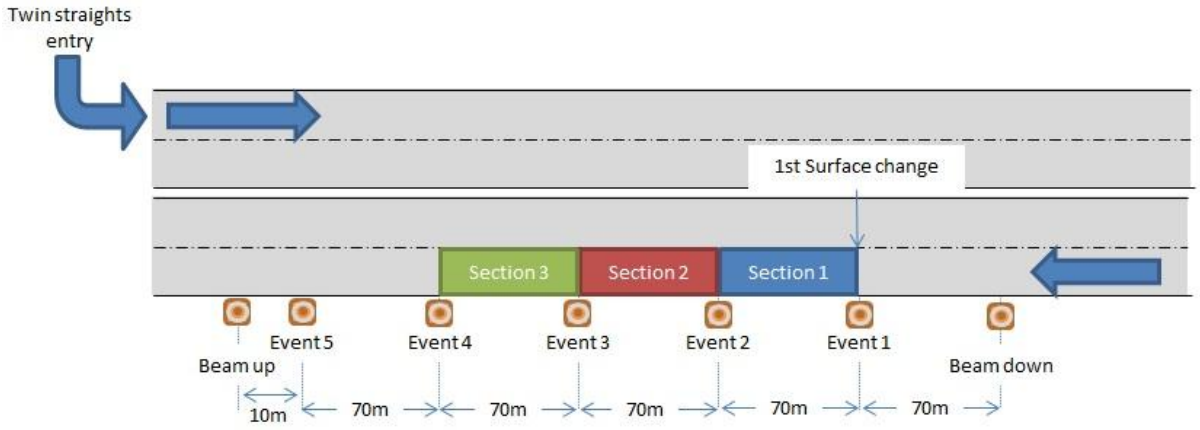

Figure B.2: Location of marker cones and test sections on Horiba-MIRA twin straights

Appendix C Construction details for Horiba-MIRA test sections

Table C.1: Nominal construction details for design construction of Horiba-MIRA site

Section	Surface course (mm)	Binder course (mm)	Total asphalt thickness (mm)	Sub-base (mm)
NHCP_01	30 TSC	235 EME2	270	200mm C8/10 HBM
NHCP_02	35 TSC	170 DBM	200	250mm 6F1 granular capping material
NHCP_03	30 TSC	170 EME2	200	200 Type 1 granular material

Notes: TSC = Cl 942 Thin Surface Course EME2 = Enrobé à Module Élevé, DBM = Dense Bitumen Macadam, HBM = Hydraulically Bound Material, 6F1 = Selected granular capping.

Table C.2: Post construction details for Horiba-MIRA site from cores

Section	Surface course (mm)	Binder/ Binder+ base courses (mm)	Total asphalt thickness (mm)	Base (mm)
NHCP_01	42 TSC	228	270	217 (HBM)
NHCP_02	37 TSC	158	192	-
NHCP_03	35 TSC	191	226	-

Notes: TSC = Cl 942 Thin Surface Course EME2 = Enrobé à Module Élevé, DBM = Dense Bitumen Macadam, HBM = Hydraulically Bound Material

Table C.3: Construction details for Horiba-MIRA site from GPR (mm)

Section	Minimum	Average	Maximum	Material
NHCP_01 (Asphalt)	192	242	272	Asphalt
NHCP_01 (HBM)	166	188	215	HBM
NHCP_01 (Total bound thickness)	388	431	468	Total bound thickness
NHCP_02	167	192	240	Asphalt
NHCP_03	167	199	240	Asphalt

Notes: HBM = Hydraulically Bound Material

Appendix D Criteria for acceptability

The accreditation trial criteria are specified in "Accreditation and Quality Assurance of Deflectograph Survey Devices" (TRL, 2020). This document is a live document (i.e. is subject to change) and the most recent (June 2020) version of the document was used for the trial. The relevant section of the document is reproduced verbatim below in Section D.1. 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 NS deflection measurement system, temperature 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 the Equipment belongs and to whom Accreditation Certificates are awarded. Note that the copied text refers to other parts of the accreditation document which are not reproduced in this report.

D.1 Trial criteria from the Accreditation and QA document

E3. Equipment inspection

E3.1 Contractors should be provided with an inspection check sheet which they shall complete and provide to the Auditor *in advance* of the Trial. The Contractors should also be asked to supply evidence that the required Calibrations have been performed (see section C.4).

E3.2 Equipment should also be inspected at the trial to ensure that they are in a suitable condition to conduct the tests. This should include verifying that the Equipment appears to be in good general mechanical order.

E3.3 Equipment shall be weighed so that Load normalisation of the survey data can be carried out. The Equipment shall be within the limits given in Table 1.

Table 1 – Criteria for wheel weights

Parameter	Acceptability Limit
Front Axle	4500 kg ±5%[1]
Twin rear wheel	3175 kg±10%

[1] It has been the experience in the Accreditation Trials that Equipment falling within 15% above the target limit for the front axle has performed acceptably with regards to deflection measurements. This matter has been investigated by TRL and Highways England. It has been concluded that, while consideration may be given to revising the specification limits at an appropriate point in the future, for the time being Equipment falling within this expanded front axle range would continue to be regarded as acceptable provided that they performed satisfactorily in the dynamic tests.

E3.4 A simple assessment of the temperature probe used for the direct measurement method should be carried out to make sure that it is producing consistent results.

E3.5 Equipment which has infra-red temperature sensors for determining surface temperature fitted should be checked to confirm that the emissivity settings have been set to the manufacturer's recommended setting for asphalt.

E.4 Running Trials

E4.1 Overview

E4.1.1 As detailed in 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 Deflection testing – Mandatory Requirement

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

E4.2.2 The Equipment shall undertake laps so that the following criteria are met:

- At least 5 laps are undertaken that comply with the requirements for Reference Data (see Appendix B, App B.3)
- Survey data shall be collected at a test speed of 2.4±0.1 km/h. Equipment shall be checked by measuring the time taken to travel a known length. If the Equipment is found to be surveying outside the test speed range, the survey operator shall be asked to adjust their speed accordingly. Laps for Equipment where the survey speed requirements are not met shall be excluded from the assessment.
- Instances where the rate of change in temperature measured at 40mm is greater than 2.5˚C per hour measured over a period of 15 minutes shall be investigated. If the variation of deflection data is seen to be to large then the lap should be disregarded and an additional lap undertaken.

E4.2.3 The Contractor shall supply the deflection measurements for their Equipment from each test lap in the file formats specified by the Auditor.

E4.2.4 The Auditor shall calculate:

- The load corrected mean for the Equipment for each wheel path and test section.
- 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 deflection values between laps for the Equipment for each wheel path and test section. 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.

E4.2.5 The BRSD shall be used in the initial assessment of each Equipment. During the Tests, the BRSD values will be affected by the variability of pavement temperatures during the course of the testing. Therefore the performance shall be assessed by comparison against the performance of the other Equipment undertaking the Re-accreditation/Accreditation Tests.

E4.2.6 Where the BRSD values of the Equipment are significantly higher than the BRSD values of other individual Fleet Equipment, the data from the Equipment shall undergo further investigation by the Auditor to determine if the Equipment is suitable for Accreditation.

E4.2.7 The Trial BESD is acceptable if it is below the criterion given in Table 2. If the trial BESD exceeds this criterion then the data shall be further examined to identify outlying Equipment. This shall 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 fail Accreditation. Any Equipment that is between two and three times the BESD criterion from the Fleet mean shall undergo further investigation by the Auditor to determine if the Equipment is suitable for Accreditation.

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

Table 2 – Criterion for Deflection measurements

Parameter	Acceptability Limit
Between Equipment standard deviation (BESD)	≤0.0257 * Reference Data+9.88 (µm)

E4.2.10 The performance shall be assessed for both wheel paths separately. To achieve Accreditation the Equipment shall meet the requirements for both the NS wheel path and the OS wheel path.

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 Location Referencing (Distance) – Mandatory Requirement

E4.3.1 Accreditation of an Equipment's ability to measure distance is carried out by comparing its measurements of a test length with the Reference Data (App B.3.2), repeated at least five times. The criteria applied to the test measurements are given in Table 3. Note: the tolerance allows for the basic method by which events are recorded in Deflectograph Survey Data.

Table 3 – Criteria for Measurement of Distance travelled

Parameter	Acceptability Limit
Distance measured	≥80% within 5m

E.5 Additional Tests

E5.1 Overview

E5.1.1 The criteria in this sub-section are specified as High, Medium and Low levels of performance. This reflects the lower level of maturity of this test. In future revisions to this document these 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 Temperature measurement – direct measurement method

E5.2.1 If undertaking this test, the Contractor should be required to make measurements from holes supplied by the Auditor (40mm depth) so that at least eight measurements are taken during the course of the test laps. These probes are required to provide results to a resolution equal to or better than 0.1˚C. Therefore if the probe does not then it shall be identified as "Not Suitable" regardless of the performance seen for the measurements (with a note identifying the reason for the performance given). The criteria for the assessment of the direct measurement method are given in Table 4.

Table 4– Criteria for direct measurement method

Performance level	Measurement of temperature
High	≥80% of the measurements are within 1.0ºC of the reference
Medium	≥50% of the measurements are within 1.0ºC of the reference
Low	≥15% of the measurements are within 1.0ºC of the reference
Not Suitable	Otherwise

E5.3 Temperature measurement –Contactless measurement

E5.3.1 If undertaking this test, the Contractor shall be required to make measurements of the air and surface temperature (at locations specified by the Auditor) so that at least eight pairs of measurements are taken during the course of the test laps. These sensors are required to provide results to a resolution equal to or better than 0.1˚C. Therefore if the sensor does not then it shall be identified as "Not Suitable" regardless of the performance seen for the measurements (with a note identifying the reason for the performance given). The criteria for the assessment of surface temperature measurement are given in Table 5 and the assessment of air temperature measurement are given in Table 6.

Table 5– Criteria for surface temperature measurement

Performance level	Measurement of temperature
High	≥80% of the measurements are within 1.0ºC of the reference
Medium	≥50% of the measurements are within 1.0ºC of the reference
Low	≥15% of the measurements are within 1.0ºC of the reference
Not Suitable	Otherwise

Table 6– Criteria for air temperature measurement

Performance level	Measurement of temperature
High	≥80% of the measurements are within 1.0ºC of the reference
Medium	≥50% of the measurements are within 1.0ºC of the reference
Low	≥15% of the measurements are within 1.0ºC of the reference
Not Suitable	Otherwise

E5.3.2 In addition to providing the air and surface temperatures the Survey Contractor shall provide the predicted temperature at 40mm depth using this data. The Auditor may allow Survey Contractors to provide these predicted temperatures after the trial to allow for processing time. The Auditor shall confirm on the Accreditation Certificate whether the calculations have been accurately calculated.

National Highways 2023 Deflectograph Accreditation Trial

A key element for the successful maintenance of a road network is accurate, reliable and consistent survey data. To this aim, National Highways commissions annual accreditation trials for the Deflectograph devices 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 2023 accreditation trial run by TRL and held on the HORIBA-MIRA proving ground between 21st and 23rd of February 2023.

Other titles from this subject area

PPR2039 National Highways 2022 Deflectograph Accreditation Trial. S Brittain. 2026

PPR1019 Highways England 2021 National Deflectograph Accreditation Trial. S Brittain. 2022

PPR977 Highways England 2020 National Deflectograph Accreditation Trial. S Brittain. 2022

PPR1018 Highways England 2019 National Deflectograph Accreditation Trial. S Brittain. 2022

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