

## **PUBLISHED PROJECT REPORT PPR2073**

Trial of laser-based compliance  
requirements for ride quality and texture  
depth of newly laid asphalt surfaces

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## Report details

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## Executive summary

TRL was commissioned by National Highways to carry out a project to explore ways of achieving smoother pavements on the Strategic Road Network (SRN) through improved standards, which will lead to cost-effective changes in construction and maintenance practice. The intention is that the work will bring about an improvement in pavement smoothness, contributing to improving customer experience, reduced carbon emissions and other benefits.

A suitable QA/QC approach for smoothness of new surfaces was developed that could be deployed using non-contact measurement methods, and which would optimise the ability to achieve a smooth road that is both durable and delivers a high level of ride comfort for users. Requirements for non-contact measures of texture depth had previously been developed as part of SPATS 1-731 (Collaborative research programme 2019) and 1-912 (Materials performance and texture depth policy).

The requirements developed for non-contact compliance measurements of ride quality and texture depth were based on existing data available within P-AMS and limited site-based measurements along with the outcomes from user perception trials of ride quality (Browne et al, 2023).

To further test the appropriateness of the proposed compliance process and the associated thresholds, a wider trial was undertaken as part of the project. This report provides:

- details of the trial,
- summary results for the sites included in the trial
- observations from the analysis of the measurements
- feedback from asphalt installers
- recommendations for the implementation of the new compliance requirements.

The results from the trial showed that, in general, high levels of compliance were achieved for texture depth but that the results for ride quality were much more variable although all the sites showed an improvement in overall ride quality (average RI value reduced across the site) following the works. Nonetheless, the results did not suggest that the thresholds set for MPD and RI compliance required amendment as they were met, or nearly met, on several of the sites. The main issues that can contribute to poor ride quality were identified through a combination of in-depth analysis of the data from the trial sites and discussions with installers and include:

- Poor joints/transitions at the start and end of each site
- Periodic features along a site
- The influence of some features such as bridge deck joints and/or bridge decks, that may need to be excluded from the compliance assessment
- Previous (before resurfacing) roughness may not be fully remedied by the new surface
- Deeper treatment (i.e. beyond just the surface course) causing roughness at the surface

- Lengths that were rougher than the previous surface as a result of poor workmanship or the introduction of new joints

In addition to these observations, the trials also highlighted practical areas that require further consideration as part of the implementation of the new laser-based compliance requirements and, importantly, enabled installers to better understand the requirements and how working practices and processes can influence the results.

In light of the findings from the trial, the following recommendations are made:

- 1. Staged implementation:** the new laser-based measurements should be allowed through the Departure Approval System (DAS); alternative laser-based measures other than MPD and RI should not be permitted through DAS at this point. Full implementation will follow once the SHW has been updated to include laser-based compliance measurements.
- 2. Restricted initial application:** implementation of the new compliance requirements should initially be restricted to mainline lengths of Thin Surface Course Systems (TSCS) as these represented most of the sites included in the trial. The opportunity should be taken prior to the full implementation of the new specifications to gain a better understanding of how the requirements could be applied to non-mainline lengths of carriageway and to a wider range of surfacing types.
- 3. Stakeholder engagement:** this should continue until the new requirements are fully implemented as it will enable:
  - a. additional sites to be identified and measurements undertaken
  - b. installers to be updated on developments and progress towards implementation, and to continue to provide feedback, particularly on any impacts that the new requirements may have on, for example, ways of working, costs, etc.
  - c. measurement providers to gear up so that there is sufficient measurement capacity when the new requirements are fully implemented. This process will be aided by allowing the new requirements to be used through Departures from mid-2025 and enable providers to work towards certification of their devices prior to 2027.
- 4. Develop data flow processes and analysis tools:** further work is required to produce automated data analysis and compliance tools to enable efficient delivery of the process. Concerns raised by installers relating to the flow of data and where responsibility lies at each stage in the process will need to be addressed and clear guidance produced.

# 1 Introduction

TRL was commissioned by National Highways to carry out a project to explore ways of achieving smoother pavements on the Strategic Road Network (SRN) through improved standards, which will lead to cost-effective changes in construction and maintenance practice. The intention is that the work will bring about an improvement in pavement smoothness, contributing to improving customer experience, reduced carbon emissions and other benefits.

To deliver these objectives, the project included four sub-tasks that focussed on different elements of knowledge:

- Sub-task 1: Assessing potential to improve pavement smoothness through enhanced processes
- Sub-task 2: Developing an improved approach to Quality Assurance/Quality Control (QA/QC) methods
- Sub-task 3: Carrying out exploratory research to better understand the benefits of smoother roads
- Sub-task 4: Update of the Manual of Contract Documents for Highway Works (MCHW) with a more robust test of compliance and more stringent requirements for surface regularity

To deliver smooth roads on the SRN National Highways specify requirements for the smoothness of both the newly laid surface and for the smoothness of in-service roads. New pavements are subject to QA/QC compliance regime prescribed in the MCHW 700 series. The regime for longitudinal smoothness involves the use of the (slow speed) Rolling Straight Edge (RSE) to measure deviations in the shape of the road surface. However, in-service pavement smoothness is measured using non-contact measurement methods at traffic-speed (i.e. a laser profilometer as used in the TRACS survey).

The QA/QC regime for new pavements therefore has several limitations. The RSE requires that technicians must work on the highway to measure the smoothness (exposing them to risk), and the measurements provided by the RSE are not considered to be robust in terms of the repeatability of the data and its ability to reflect the likely experience of users (Benbow, 2009). Because the RSE differs from the TRACS method, it is not possible to carry forward the ride quality assessment achieved during the construction of the pavement through to the on-going assessments carried out after trafficking has begun.

In the light of these limitations, road administrations in many countries are moving away from the RSE method of compliance, instead opting for longitudinal profile metrics derived from profilometer data. These metrics can improve the robustness of the compliance process and support the achievement of improved smoothness for new roads. They also allow the same method to be used to assess new and in-service pavements.

A similar situation exists for measurements of texture depth where newly laid surfaces are assessed using Volumetric Patch Texture (VPT) (BS EN 13036-1) while in service texture is measured as part of TRACS using laser profilometers.

Task 2 identified a suitable QA/QC approach for smoothness of new surfaces that could be deployed using non-contact measurement methods (Dhillon and Wright, 2024), and which would optimise the ability to achieve a smooth road that is both durable and delivers a high level of ride comfort for users. Requirements for non-contact measures of texture depth had previously been developed as part of SPATS 1-731 (Collaborative research programme 2019) and 1-912 (Materials performance and texture depth policy).

The requirements developed for non-contact compliance measurements of ride quality and texture depth were based on existing data available within P-AMS and limited site-based measurements along with the outcomes from user perception trials of ride quality (Browne et al., 2023).

To further test the appropriateness of the proposed compliance process and the associated thresholds, a wider trial was undertaken as part of the project. This report provides:

- details of the trial,
- summary results for the sites included in the trial
- observations from the analysis of the measurements
- feedback from asphalt installers
- recommendations for the implementation of the new compliance requirements.

## 2 Details of the trial

To prepare for the change, and to help asphalt suppliers understand how surfaces they are currently laying will perform under the new requirements, TRL has undertaken a trial of the new compliance approach for National Highways. As part of the wider project engagement with industry, asphalt installers were asked to identify sites for inclusion in the trial and to provide scheme details (e.g. location, start/end point, laying dates, material, etc) to TRL. In addition to the sites identified by installers, measurements at a small number of sites were also requested by National Highways. A total of twelve sites were identified and included in the trial.

Measurements of the pavement surface before and after the works had taken place were completed with National Highways HARRIS3 vehicle, the reference device for TRACS. HARRIS3 was set up to comply with the draft specification for the measurements of MPD and RI, but with raw profile being measured in five lines across a lane width rather than the four lines required by the draft specification. However, only four of the measurement lines were utilised in the calculation of compliance results for the sites. At least three runs were completed in each lane to enable the consistency of the data being collected to be assessed. Forward-facing and downward images of the site were also collected to aid in accurately locating the start and end points of the new surfacing and to enable any features identified in the data to be related to physical features on the site.

Summary details of the sites included in the trial are provided in Table 1.

**Table 1 Summary details of the sites included in the trial**

| Site ID | Carriageway type | Lane Length (m) | Surface material |
|---------|------------------|-----------------|------------------|
| A       | Dual             | 9070            | TSCS (10mm)      |
| B       | Dual             | 9940            | TSCS (10mm)      |
| C       | Dual             | 7860            | TSCS (10mm)      |
| D       | Dual             | 4500            | TSCS             |
| E       | Dual             | 11400           | TSCS (14mm)      |
| F       | Dual             | 12680           | TSCS (14mm)      |
| G       | Motorway         | 24020           | TSCS (14mm)      |
| H       | Dual             | 2180            | TSCS             |
| I       | Motorway         | 13120           | TSCS (14mm)      |
| J       | Dual             | 12640           | TSCS (10mm)      |
| K       | Dual             | 4520            | TSCS (14mm)      |
| L       | Dual             | 1600            | TSCS (14mm)      |

The data from the HARRIS3 surveys were processed and the compliance test requirements applied to each site. In depth investigations of the profiles were also undertaken to understand the performance of each site and to investigate any particular features that



were identified. The results were shared (anonymously) with all stakeholders and discussed in a series of stakeholder workshops. This engagement created an increasing level of interest from the asphalt industry, as they began to understand the implications of the new standards and the work that will be required across the industry to meet the new requirements. Installers were also engaged at an individual level to discuss the results of particular sites to enable a better understanding to be gained of site-specific activities/processes that may have influenced the results.

## 2.1 Assessment criteria

The draft specification for the assessment of texture depth and ride quality of new asphalt surfaces were published on the UK Road Leadership Group (UKRLG) website (<https://ukrlg.ciht.org.uk/ukrlg-home/guidance/road-condition-information/>) and these have been used in the compliance assessment of the trial sites. For completeness, a summary of the requirements is provided in Table 2 and Table 3.

Continuous measurements of MPD and RI are required for the full length of the new surfacing material in each carriageway lane, plus 100 m before and after, with the measurements being made between 3 and 28 days of completion of the surfacing.

For MPD, the average and standard deviation of all valid 10 m results within each carriageway lane are calculated for 100 m lengths, beginning at the start of the new surfacing and continuing until the end of the new surfacing. The requirements for RI differ slightly, with all valid 10 m within each lane being assessed for 300 m lengths, beginning 10 m before the start of the new surfacing and continuing until 10 m after the end of the new surfacing; this is to ensure that the start and end joints of the surfacing are included in the assessment.

For both MPD and RI, a minimum of 80 % of the 10 m values for each assessment length need to be valid in order for the length to be assessed against the compliance requirements.

**Table 2 Requirements for initial surface macrotexture depth using the laser method, for trunk roads including motorways**

| Material type                                          | Surfacing type / application                                                 | Average MPD per 100 m length, mm |         | Standard deviation per 100 m length, mm |
|--------------------------------------------------------|------------------------------------------------------------------------------|----------------------------------|---------|-----------------------------------------|
|                                                        |                                                                              | Minimum                          | Maximum | Maximum                                 |
| Thin surface course systems (Clause 942)               | Upper (D) aggregate size of 14 mm                                            | 1.0                              | 1.6     | 0.2                                     |
|                                                        | Upper (D) aggregate size of 10 mm                                            | 1.0                              | 1.5     | 0.2                                     |
|                                                        | Upper (D) aggregate size of 6 mm                                             | 1.0                              | 1.4     | 0.2                                     |
| Chipped hot rolled asphalt surface course (Clause 943) | High speed roads<br>Posted speed limit ≥50 miles/h (80 km/h)                 | 1.3                              | 1.8     | 0.25                                    |
|                                                        | Lower speed roads<br>Posted speed limit <50 miles/h (80 km/h)                | 1.0                              | 1.5     | 0.25                                    |
|                                                        | Roundabouts on high speed roads<br>Posted speed limit ≥50 miles/h (80 km/h)  | 1.0                              | 1.5     | 0.25                                    |
|                                                        | Roundabouts on lower speed roads<br>Posted speed limit <50 miles/h (80 km/h) | 0.9                              | 1.3     | 0.25                                    |

**Table 3 Requirements for initial ride quality using the laser method, for trunk roads including motorways**

| Surface type               | Road type                        |                                  |
|----------------------------|----------------------------------|----------------------------------|
|                            | Carriageway with one-way traffic | Carriageway with two-way traffic |
| Thin surface course system | 100% of 10m values < 5.0         | 100% of 10m values < 6.5         |
|                            | 80% of 10m values < 2.0          | 80% of 10m values < 2.6          |
| Hot rolled asphalt         | 100% of 10m values < 6.0         | 100% of 10m values < 6.0         |
|                            | 80% of 10m values < 2.4          | 80% of 10m values < 2.4          |

### 3 Summary results from the trial

The results from the trial sites are presented in Table 4 showing the percentage of assessment lengths within each site that met the compliance requirements. Sites where more than 90% of the assessment lengths met the requirements are highlighted in green while those where compliance was less than 50% are highlighted in orange.

The results show that, in general, high levels of compliance were achieved for texture depth but that the results for ride quality were much more variable. Nonetheless, all the sites where before and after measurements had been undertaken showed a reduction in RI (improved ride quality) following the works.

To better understand the results, additional in-depth analysis of the data was undertaken and discussions were held with installers to gain their views on what may have influenced the compliance results. The outcomes of those investigations are discussed in Section 4.

**Table 4 Results for the trial sites showing the percentage of evaluation lengths that meet the compliance requirements**

| Site ID | Texture depth (MPD)        |                       |                               | Ride Quality (RI)                      |                                       |                               |                   |                  |
|---------|----------------------------|-----------------------|-------------------------------|----------------------------------------|---------------------------------------|-------------------------------|-------------------|------------------|
|         | Percentage passing av. MPD | Percentage passing SD | Percentage passing compliance | Percentage passing Criteria 1 (100%<5) | Percentage passing Criteria 2 (80%<2) | Percentage passing compliance | Average RI before | Average RI after |
| A       | 99.6                       | 100.0                 | 99.6                          | 87.9                                   | 87.7                                  | 82.4                          | 2.2               | 1.4              |
| B       | 73.7                       | 92.8                  | 66.5                          | 32.3                                   | 21.9                                  | 19.8                          | 2.6               | 1.9              |
| C       | 72.8                       | 100.0                 | 72.8                          | 41.7                                   | 41.7                                  | 31.9                          | 2.4               | 2.0              |
| D       | 100.0                      | 100.0                 | 100.0                         | 35.4                                   | 0.0                                   | 0.0                           | 3.2               | 2.0              |
| E       | 91.9                       | 97.8                  | 90.8                          | 61.9                                   | 62.8                                  | 52.1                          | 2.0               | 1.5              |
| F       | 68.4                       | 94.9                  | 64.5                          | 52.4                                   | 25.4                                  | 21.4                          | 2.4               | 1.9              |
| G       | 99.8                       | 99.3                  | 99.3                          | 92.0                                   | 97.4                                  | 91.7                          | 1.8               | 1.2              |
| H       | 5.3                        | 98.7                  | 4.5                           | 83.1                                   | 85.5                                  | 76.1                          | n/a               | 1.3              |
| I       | 100.0                      | 100.0                 | 100.0                         | 98.0                                   | 98.0                                  | 95.0                          | n/a               | 1.2              |
| J       | 100.0                      | 99.0                  | 99.0                          | 90.0                                   | 65.0                                  | 57.0                          | n/a               | 1.5              |
| K       | 64.0                       | 100.0                 | 64.0                          | 55.0                                   | 64.0                                  | 45.0                          | 1.7               | 1.6              |
| L       | 100.0                      | 100.0                 | 100.0                         | 100.0                                  | 100.0                                 | 100.0                         | 1.6               | 1.2              |

## 4 Observations and industry feedback

### 4.1 Insights from the data analysis

By careful review of plots of both the MPD and RI data variations and “spikes” in the measurements could be observed. These features were analysed in more depth and the images collected at each site examined to investigate whether the features observed in the data could be linked physical features on the pavement.

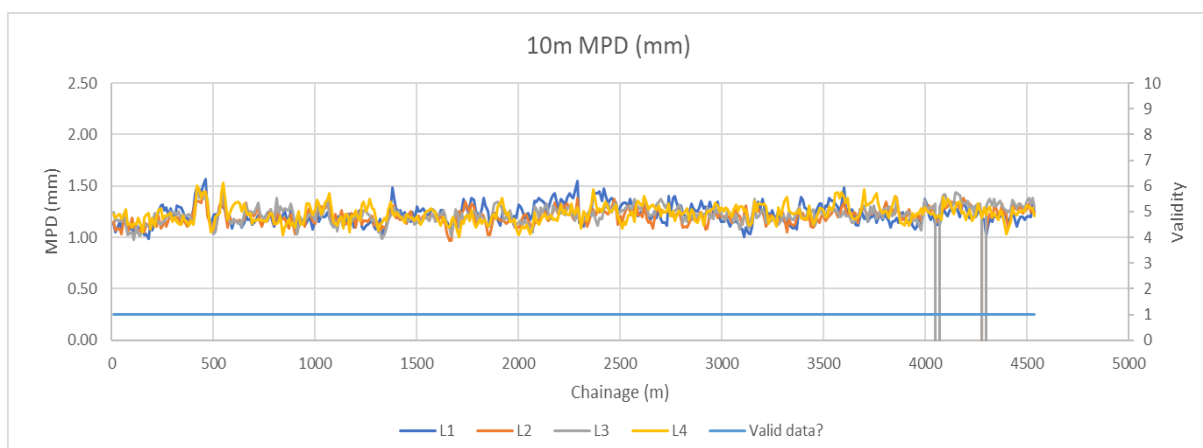
#### 4.1.1 Texture depth

The following observations were made from the in-depth review of the texture data:

- The MPD measurements provide a high level of detail in the texture, reflecting actual variations along and across the lane.
- The measurements are highly repeatable, as demonstrated by the low levels of variation between measurements runs.

These observations can be seen, for example, in Figure 1; the figure also shows a very limited number of “dropouts” from Laser 3, but these were not sufficient to make the compliance assessment invalid.

*Note: the light blue line showing whether the data are valid will have a value of 1 for valid data and 0 for invalid data; at least 50% of the data in each assessment length needs to be valid for a compliance result to be returned.*



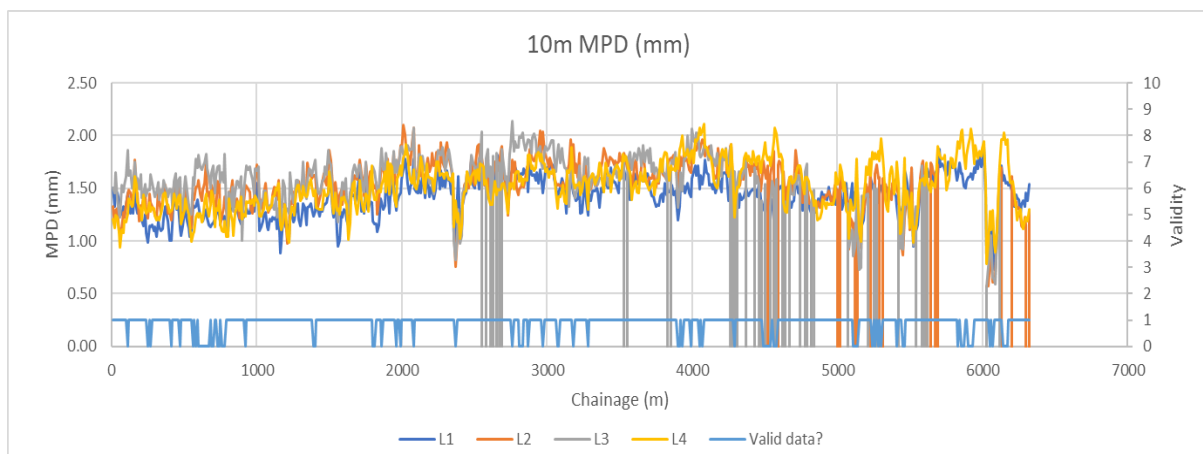
**Figure 1 Variation in MPD along a site measured in four laser lines**

Whilst the compliance results for texture depth were generally good, some observations were made that may challenge industry to make improvements in the future. It was noted that:

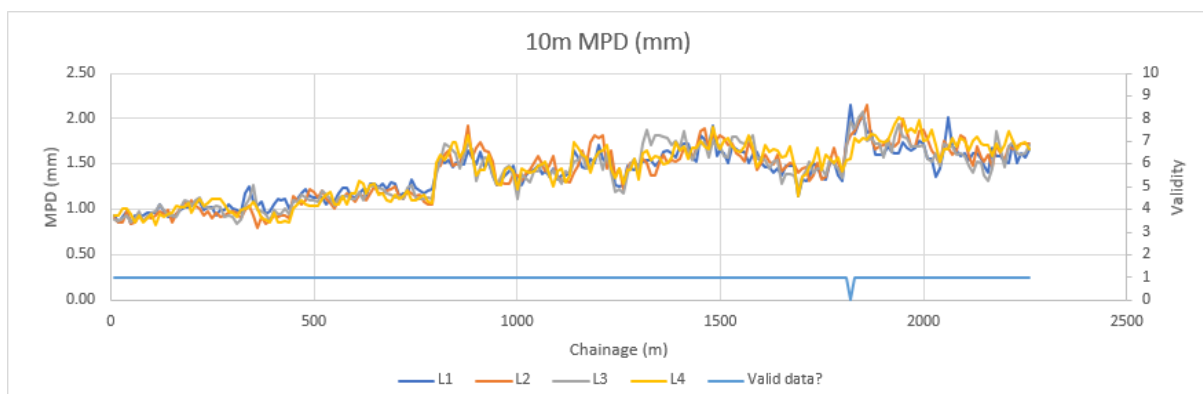
- There could be unevenness in the texture along a site.

- Texture could be too high/too low compared to the compliance thresholds, although the extent to which the limits were missed could be very small.
- Texture depth could vary along a site while being consistent along a given length. This could be linked to slight variations in the mix design during the works.
- Texture depth could vary transversally which may be indicative of uneven compaction across the lane width.

A number of these observations can be seen, for example, in Figure 2. This shows a marked difference between laser line 1 and 3 over significant lengths of the site and an increase in average texture depth between chainages 2000-4000m compared to chainage 0-2000m. Similarly, Figure 3 shows a notable increase in MPD from about chainage 750m. It can be seen that the MPD values over the initial 750m were close to or below the lower threshold of 1mm; potentially a change to the mix to address this issue may have overcompensated and resulted in values above the upper MPD threshold of 1.6mm for the site.



**Figure 2 Variation in MPD along a site measured in four laser lines**



**Figure 3 Notable change in texture depth along a site**

As with the texture depth data, the RI data were found to be consistent between individual measurement runs and also highly detailed. For example, Figure 4 shows that what might at

first be considered as “noise” in the data is often repeated in all four measurement lines and this consistency indicates genuine variations in surface roughness.



**Figure 4 Variations in RI replicated across all four laser lines**

However, few of the trial sites fully met the performance requirements and the factors contributing to this appear to include:

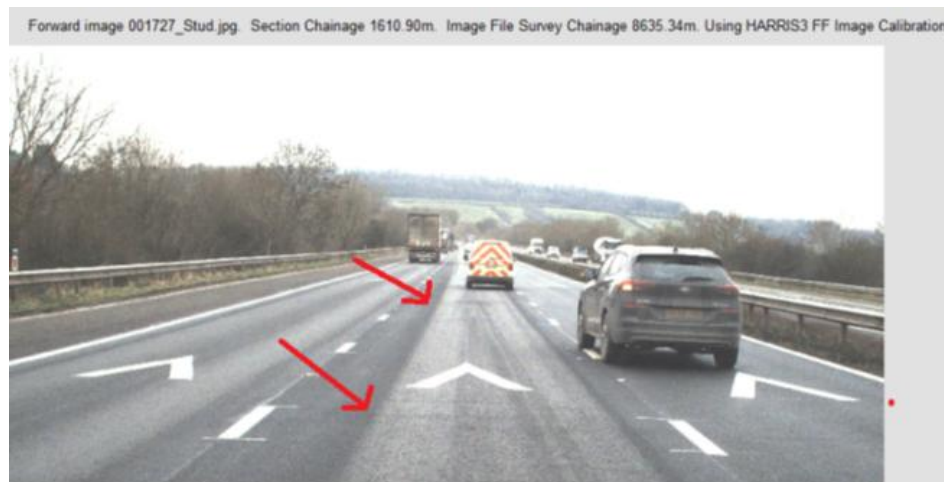
- Poor joints/transitions at the start and end of each site
- Periodic features along a site
- The influence of some features such as bridge deck joints and/or bridge decks, that may need to be excluded from the compliance assessment
- Previous (before resurfacing) roughness may not be fully remedied by the new surface
- Deeper treatment (i.e. beyond just the surface course) causing roughness at the surface
- Lengths that were rougher than the previous surface for unexplained reasons

Figure 5 shows the transition joint at the start of a site and the associated step in the raw profile measurement at that point. Such “bump” like features were frequently seen and were highlighted to be of particular concern in the road user perception study (Browne et al., 2023).



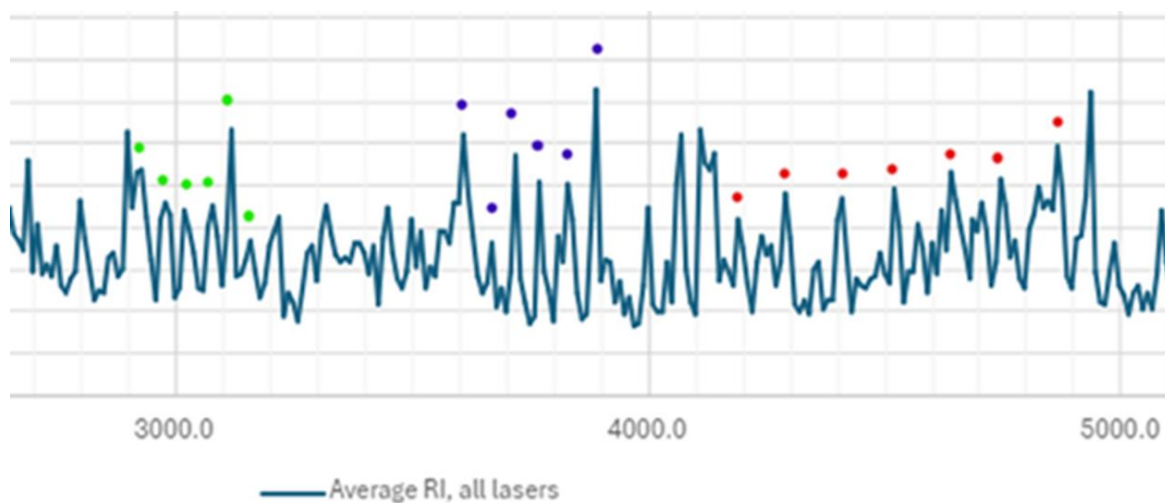
**Figure 5 Unevenness at the transition joint at the start of a site**

In addition to poor profile at joints, some sites also showed clear unevenness in the new surface that was sufficient to be seen in the response of the survey vehicle as well as in the RI values (see Figure 6).



**Figure 6 General unevenness along a site**

Regular 'spikes' were seen in the RI values on several sites with the spacing of the spikes varying, but often found to be between 45 – 60 m. Such features become more apparent when the RI values from each of the four lasers are averaged across the lane width, as seen in Figure 7. Discussions with installers have suggested that such features may develop as a result of the paver being nudged by a delivery lorry during loading of new material, which could be mitigated by the use of material transfer vehicles ("shuttle buggies"). The features may also arise, when using conventional delivery lorries, as a result of the cooler material at the top of the trailer coming out initially and resulting in uneven compaction; the use of trailers with hydraulic rams may help to mitigate this.



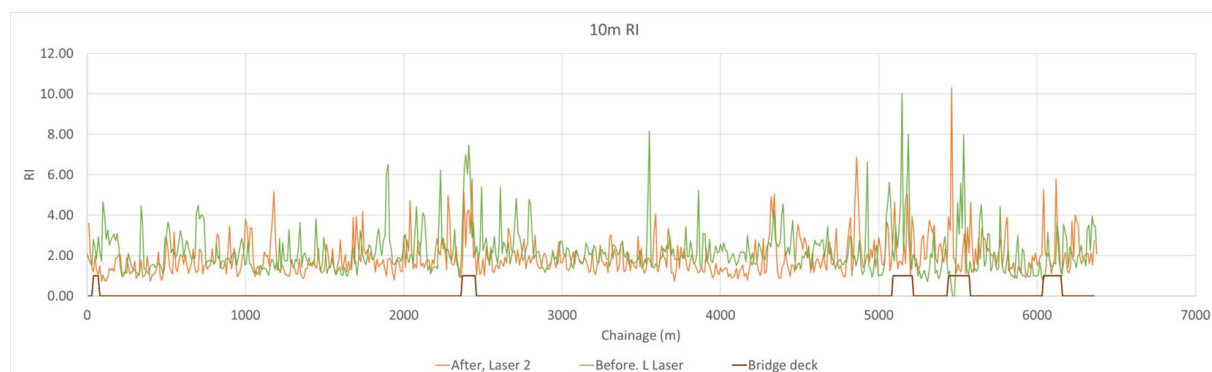
**Figure 7 Regular spikes observed in the RI data**

A number of the trial sites included bridge decks and it was observed that the presence of the joint at the bridge deck resulted in a high value of RI and, in some cases, the profile of the bridge deck itself produced high RI values. The presence of bridges within the trial sites was identified manually from the survey images and this also enabled an assessment to be made of whether the bridge deck had been included in the re-surfacing work.

Figure 8 shows that where bridge decks were present, spikes in the RI values were seen both before and after the resurfacing works; this could be expected as work related to the joints was not included in any of the schemes.

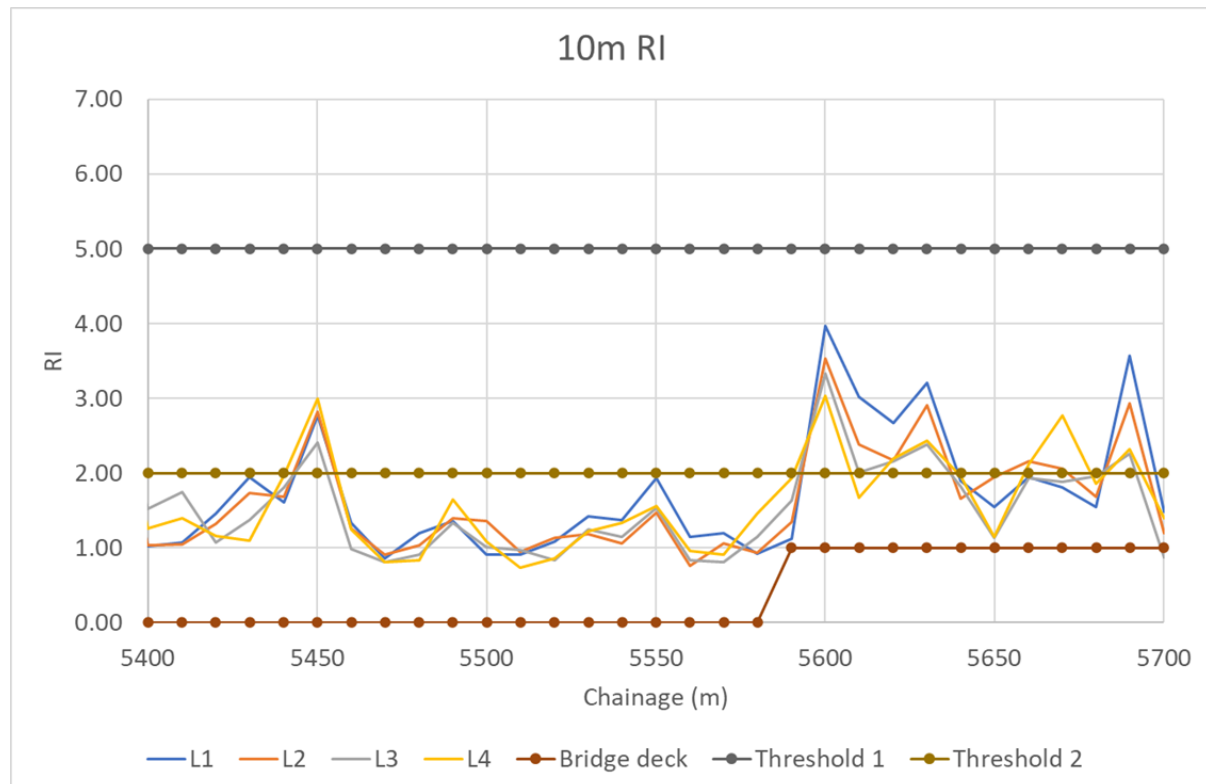
A more detailed examination of the fourth bridge deck in Figure 8 (approx. chainage 5600m) clearly shows the increase in roughness across the bridge deck (Figure 9). The figure highlights a single 300m assessment length (Ch. 5400-5700m) with the bridge deck running from Ch 5590m to 5700m. If the deck length was included in the analysis, then that 300m assessment length does not meet the compliance requirements for RI. However, excluding the bridge deck results in the revised assessment length meeting the requirements. It is also worth noting that bridge decks can often be resurfaced using different materials to the mainline to limit water ingress to the underlying structure; therefore different compliance criteria may apply.

This issue may also apply to other features present in the pavement, such as ironwork, where the asphalt installer has little control over improving the profile during resurfacing. This analysis suggests that a process will need to be developed to enable certain features to be identified in the measurement data and to be excluded from the compliance checks.



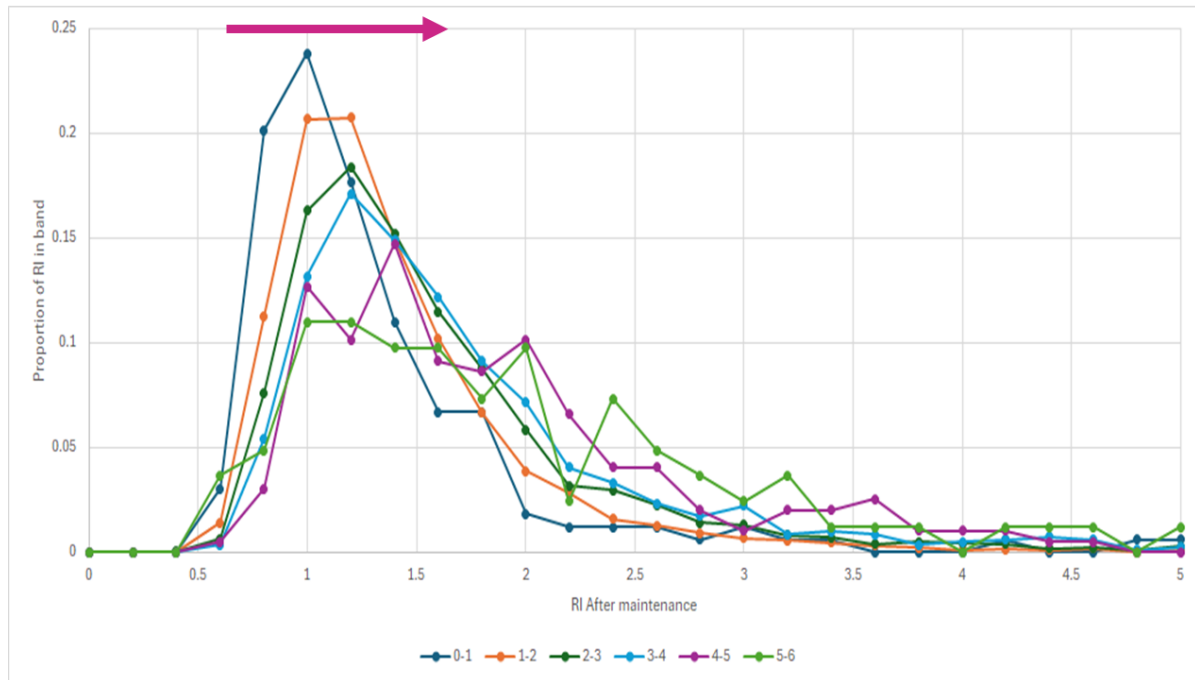
**Figure 8 Spikes in RI values occurring at bridge decks**



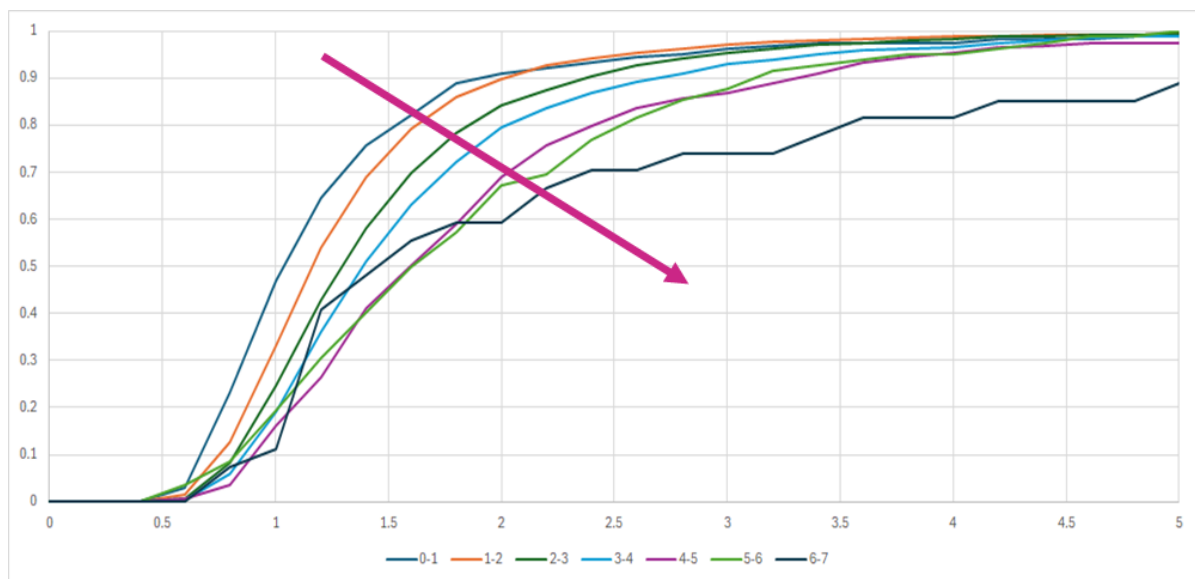


**Figure 9 Detailed view of the profile for a 300m assessment length that included a bridge deck**

From discussions with installers, queries were raised regarding the extent to which the existing profile of the pavement influenced the ride quality achieved following resurfacing. To assess this, the “pre-works” 10m RI values over the sites were assigned to bands of RI (0-1, 1-2, 2-3 etc.). The distribution of RI values obtained after surfacing, for the lengths falling into these bands, were then plotted (see Figure 10). The plot appears to show a trend of the distributions moving to higher values as the pre-works RI value increases. The trend can be seen more clearly in Figure 11 where the cumulative distributions of RI following resurfacing indicate that there is a greater risk of higher RI levels remaining after maintenance where there was higher RI before. These results suggest that the existing ride quality of a site should be considered both at the design stage and in planning delivery of the works so that any lengths of poor profile can be addressed during the works.



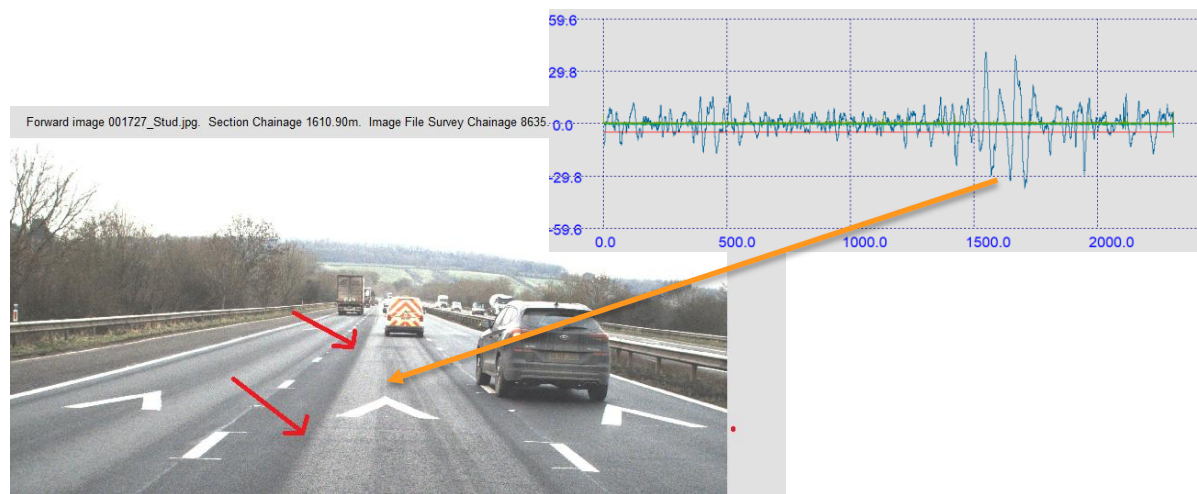
**Figure 10 Proportion of RI values after resurfacing for lengths within defined bands prior to resurfacing**



**Figure 11 Cumulative distribution of RI values after resurfacing for lengths within defined bands prior to resurfacing**

Some of the sites reviewed in more detail also indicated potentially that where short lengths of deeper treatments were included in a scheme, the underlying joints from those treatments could affect the ride quality once the surfacing had been applied. Figure 12 provides an example of this where roughness is evident in the raw profile measurements and is visible at the surface at a location where deeper treatments had been applied. This

suggests that construction practices or sequencing may need to be reviewed for these types of works if improved ride quality is to be achieved.



**Figure 12 Roughness that may be a result of features below the surfacing**

The final observation from the in-depth analysis was that in some cases the roughness of a length of pavement either remained high or even increased following resurfacing. Figure 13 shows the 10m RI values along Lane 2 of a site both before (green) and following resurfacing (red). It can be seen clearly that, in general, the RI values have reduced as a result of the works. However, at some locations, high RI values remain after resurfacing (highlighted by the ellipses in the figure) while at others the RI values have increased (highlighted by the rectangles).



**Figure 13 Example of where spikes in RI either remained after resurfacing or were introduced as a result of the works**

Visual assessment of the surface at the location of poor profile that was present both before and after maintenance showed that these resulted primarily from construction joints; it may just have been a coincidence that the before and after joints occurred in the same place.

Where poor profile is present that was not present before the maintenance, the visual assessment indicated that this could be a result of poor workmanship or the introduction of construction joints that had not been present previously. For example, Figure 14 shows the roughness of the surface at the location of poor profile around chainage 2800m of the site (first rectangle in Figure 13).



**Figure 14 Area of roughness that was not present before resurfacing**

## **4.2 Insights from engagement with installers**

Meetings were arranged with the asphalt installers, that had identified sites for the trial, where the results for individual sites were presented and discussed. The main topics of the discussions and the insights that these brought are summarised below.

1. Where repeated spikes were seen in the data (see Figure 7) it was felt that at least some of them would have been a result of the loading lorry “bumping” the paver as asphalt was being transferred. This could have resulted in the screed moving which would have influenced the pavement profile at that point.
2. While the aim during laying was for the paver never to stop, this was not always possible due to timing of deliveries, issues at the asphalt plant, etc. and could, therefore, result in additional joints that are more likely to influence the finished profile.
3. The installers believed that the use of material transfer vehicles (“shuttle buggies”) would help to overcome issues related to bumping of the paver and disruption to deliveries, but that their use is not always possible and there are additional costs associated with their deployment, although these were considered small compared to overall scheme costs. Shuttle buggies generally require closure of an adjacent lane but can enable continuous paving for 1-1.5 km per night.

4. It was felt that the current approach to traffic management for pavement works, i.e. generally overnight lane closures with sites being available for trafficking by 6am, limits the ways of working that installers can adopt that may provide benefits in the finished profile of the surface. Wider use of contraflow working would help to enable alternative ways of working to be introduced, but would require additional traffic management, potentially the construction of crossovers, CCTV and vehicle recovery services. These would have cost implications for delivery of the scheme. Full closures/24hr working would be preferred from a delivery viewpoint and could potentially result in cost savings. An example was given of a scheme that was delivered using a full, long-weekend closure where the works were completed in 7no. 8-hour shifts; using standard overnight closures, the work would have required 14no. 8-hour shifts.
5. The installers confirmed that the need for localised deeper treatments on some schemes could impact the ride quality that was achieved. The time taken to install the deeper treatments and the need to have the road re-opened to traffic by the morning, results in reduced lengths of work being achievable. As a consequence, more joints are required in the surface course which can have a negative impact on the profile. To address this issue, one of the installers was proposing on an upcoming scheme to make the surfacing sacrificial where deeper treatments were installed and then to resurface the full length once the deeper treatments had been completed. It was stated that such an approach would reduce substantially the number of joints in the surface course which should improve the overall profile.
6. The installers stated that they are generally just given the scheme designs and have little if any input into those. It was felt that the existing profile of the pavement was not given a great deal of consideration in designing a scheme. Profile milling is only specified occasionally, and very little levelling (lasers/pins) is specified due to the additional costs. Installers believed that designers should have access to the existing profile and the desired outcome as part of the design process. It was felt that better communication/collaboration between installers and designers would be beneficial in obtaining the desired outcome of smoother pavements.
7. It was noted that where works were not in all lanes there was a need to tie-in with levels in adjacent lanes/hardstrips that could impact the ability to make substantial improvements to profile. This situation had occurred on one of the trial sites but did not appear to have a significant influence on the results achieved (which were very good).
8. The measurement of non-mainline lengths of resurfacing was discussed as it was noted that for most of the trial sites works had been on the mainline. An example was given of how measurements over the full length of a slip road could be achieved in live traffic given the need to merge safely onto the mainline. It was also noted that where a lane tapers it would not be possible to measure in all four laser lines towards the end of the taper. It was accepted that such aspects would require further consideration.
9. Queries were raised related to the practical implementation of the new requirements, where responsibility would sit at each stage and how data would flow between stakeholders (National Highways, Designers, Installers and Measurement providers). It was explained that the final goal was to incorporate the process into existing National

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Highways systems, e.g. P-AMS, but it was recognised that this would take time and that interim arrangements would need to be put in place.

10. The issue of investing in new equipment, e.g. for installers to make their own profile and texture measurements, was also discussed. At present, industry do not have the level of insight or confidence to make investment decisions given the timeline needed for CapEx expenditure. It was noted that the current National Highways pavement framework ends in 2027 and there is no guarantee that all the existing suppliers will be on the next framework. As such, investments aimed at delivering National Highways ride quality objective are difficult to make.



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## 5 Conclusions and recommendations

The results from the trial showed that, in general, high levels of compliance were achieved for texture depth but that the results for ride quality were much more variable although all the sites showed an improvement in overall ride quality (average RI value reduced across the site) following the works. Nonetheless, the results did not suggest that the thresholds set for MPD and RI compliance required amendment as they were met, or nearly met, on several of the sites. The main issues that can contribute to poor ride quality were identified through a combination of in-depth analysis of the data from the trial sites and discussions with installers and include:

- Poor joints/transitions at the start and end of each site
- Periodic features along a site
- The influence of some features such as bridge deck joints and/or bridge decks, that may need to be excluded from the compliance assessment
- Previous (before resurfacing) roughness may not be fully remedied by the new surface
- Intermittent deeper treatment (i.e. beyond just the surface course) causing roughness at the surface
- Lengths that were rougher than the previous surface as a result of poor workmanship or the introduction of new joints

In addition to these observations, the trials also highlighted practical areas that require further consideration as part of the implementation of the new laser-based compliance requirements and, importantly, enabled installers to better understand the requirements and how working practices and processes can influence the results.

In light of the findings from the trial, the following recommendations are made:

- 1. Staged implementation:** The new Specification for Highway Works (SHW) is due to be published in summer 2025 but will still base the compliance requirements for new asphalt surfaces on the existing manual measurements of volumetric patch texture (VPT) and Rolling Straight Edge (RSE) for ride quality. Updating of the SHW to include the new laser-based compliance requirements can then proceed so full implementation of the new requirements is likely to be during 2026. However, it is recommended that the new laser-based measurements should now be permitted through the Departure Approval System (DAS); alternative laser-based measures other than MPD and RI should not be permitted through DAS at this point.
- 2. Restricted initial application:** The sites assessed as part of the trial all utilised Thin Surface Course Systems (TSCS) and, as such, it is recommended that when introduced the new requirements should apply only to these types of surfacing. Furthermore, most of the measurements made during the trial were on mainline carriageway lengths and it was recognised that further consideration and experience were needed related to measurements and thresholds on other road function types, such as slip roads and roundabouts. The opportunity should be taken prior to the full implementation of the new specifications in 2027 to gain a better understanding of how the requirements could be applied to non-mainline lengths of carriageway and to a wider range of

surfacing types. This could be achieved through a combination of additional site measurements with HARRIS3, data collected through Departures and a review of TRACS data collected on recently resurfaced lengths of the network.

3. **Stakeholder engagement:** this should continue until the new requirements are fully implemented as it will enable:
  - a. additional sites to be identified and measurements undertaken
  - b. installers to be updated on developments and progress towards implementation, and to continue to provide feedback, particularly on any impacts that the new requirements may have on, for example, ways of working, costs, etc.
  - c. measurement providers to gear up so that there is sufficient measurement capacity when the new requirements are fully implemented. This process will be aided by allowing the new requirements to be used through Departures from mid-2025 and enable providers to work towards certification of their devices prior to 2027.
4. **Develop data flow processes and analysis tools:** the data analysis during the trial was undertaken by the TRL team, but it was recognised that the process was somewhat resource intensive as location information for the precise start and end of sites had to be obtained by reviewing the images collected by HARRIS3 at the time that measurements were made. It was also identified that if the compliance process is to be integrated into National Highways systems, e.g. P-AMS, in the future, then measurements need to be linked to the network section and chainage referencing system. Work, outside of this project, is progressing so that the data collected can be fitted to the network using route files and processed using National Highways Machine Survey Pre-processor (MSP) software. However, there is also a need to further develop the tools used to undertake the compliance checks once the data have been processed. The concerns raised by installers relating to the flow of data and where responsibility lies at each stage in the process will need to be addressed and clear guidance produced.



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# Trial of laser-based compliance requirements for ride quality and texture depth of newly laid asphalt surfaces



TRL was commissioned by National Highways to carry out a project to explore ways of achieving smoother pavements on the Strategic Road Network (SRN) through improved standards, which will lead to cost-effective changes in construction and maintenance practice. A suitable compliance approach for smoothness of new surfaces was developed that could be deployed using non-contact measurement methods. To test the appropriateness of the proposed compliance process and the associated thresholds, a trial was undertaken, and this report presents the details and outcomes of that trial.

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