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TII Publications

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Approval of Specific Products (Including Amendment No. 1, dated January 2016)

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June 2015

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NRA DMRB and MCDRW References

For all documents that existed within the NRA DMRB or the NRA MCDRW prior to the launch of TII Publications, the NRA document reference used previously is listed above under 'historical reference'. The TII Publication Number also shown above now supersedes this historical reference. All historical references within this document are deemed to be replaced by the TII Publication Number. For the equivalent TII Publication Number for all other historical references contained within this document, please refer to the TII Publications website.

**Approval of Specific Products
(Including Amendment No. 1, dated January 2016)**

June 2015

Summary:

This Standard sets out requirements and advice for the approval of specific products/systems detailed in the NRA Manual of Contract Documents for Road Works, Volume 1, NRA Specification for Road Works, Series 900, Road Pavements – Bituminous Materials.

The requirements set out in this Standard, together with associated requirements, advice and guidance on both specification and design of bituminous materials, will replace the current requirements in the NRA DMRB and NRA MCDRW.

**VOLUME 7 Pavement Design and
Maintenance**

SECTION 6 Product Approval

PART 1

NRA HD 301/15

**Approval of Specific Products
(Including Amendment No. 1, dated January
2016)**

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Amendment No 1

1. INTRODUCTION

1.1 General

This Standard sets out requirements and advice for the approval of specific products not covered by a harmonised technical specification which are detailed in the NRA Manual of Contract Documents for Road Works, Volume 1, NRA Specification for Road Works, Series 900, Road Pavements – Bituminous Materials (NRA Series 900).

IMPLEMENTATION

This Standard shall be used forthwith on all schemes on national roads, except where the scheme has received, prior to publication of this Standard, its statutory approvals to allow it to proceed

2. HIGH FRICTION SURFACING

GENERAL

- 2.1 This Chapter of NRA HD 301 specifies the performance requirements and control procedures for the installation of high friction surfacing works on National Roads.
- 2.2 As high friction surfacing is not covered by a harmonised European Standard, the layout of this Chapter (and in particular its Annexes) is intended to be compatible with Standards such as IS EN 12271, 12272-2, 12273 and 12274-8.
- 2.3 This Standard is not applicable to high friction surfacing carried out in tunnels and where fire regulations apply. This Standard does not apply to small areas of high friction surfacing on roads that are less than 5m² which are not contiguous (for example patch repairs).

NORMATIVE REFERENCES

- 2.4 The following referenced documents are indispensable for the application of this Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IS EN 12272-1, *Surface dressing — Test methods — Part 1: Rate of spread and accuracy of spread of binder and chippings*

IS EN 12272-2, *Surface dressing — Test methods — Part 2: Visual assessment of defects*

IS EN 12274-8 *Slurry Surfacing — Test Methods — Part 8: Visual Assessment of defects*

IS EN 12697-38, *Bituminous mixtures — Test methods for hot mix asphalt — Part 38: Common equipment and calibration*

prCEN/TS 12697-51, *Bituminous mixtures - Test methods - Part 51: Surface shear strength test*

IS EN 13036-1, *Road and airfield surface characteristics — Test methods — Part 1: Measurement of pavement surface macrotexture depth using a volumetric technique*

IS EN 13043, *Aggregates for bituminous mixtures and surface treatments for roads, airfields and other trafficked areas*

IS EN ISO 9001¹, *Quality management systems — Requirements*

TERMS AND DEFINITIONS

- 2.5 This Clause includes terms and definitions not included in NRA Series 900. For other terms and definitions refer to NRA Series 900 Clause 1.7.

Aggregate

Coarse aggregate practically free of fines with a narrow grading range.

Binder

Resin component of high friction surfacing.

¹ Amended as per Amendment No. 1, Item 1

Bond

Strength of attachment of high friction surfacing to the substrate, measured by surface shear strength test in accordance with prCEN/TS 12697-51, refer to Table 2.1.

Calcined bauxite

Defined as refractory grade and detailed in NRA Series 900 Table 23b.

Defect

State of the high friction surfacing in the case of fatting up (P_1); or disruption as in the case of delamination (P_2), loss of chippings (P_3) or grinning (P_4).

NOTE 1: For further clarification refer to IS EN 12272-2, IS EN 12274-8 and Clause 2.6 below.

NOTE 2: A defect can occur due to poor construction techniques.

Durability of a product

Ability of a product to maintain its required performance, under the influence of foreseeable actions, for at least it's 'Design Working Life' and for a reasonable economic working life.

Embedment

Process whereby chippings are forced into high friction surfacing resin by the action of traffic.

NOTE 1: Factors affecting embedment

- Traffic density of heavy vehicles and high road surface temperatures can affect hot thermoplastic screeded materials
- Traffic speed; slow moving traffic, experienced on hills and at junctions, increases embedment.

NOTE 2: Embedment results in fatting up and a reduction of macrotexture with time.

Perceptible properties check

Evaluation made with the senses: sight, touch, smell, hearing, etc. It is a broader concept than the more commonly used term 'visual inspection' and includes photographic evidence.

NOTE 1: For example, a check on binder delivery might involve visual (colour, fuming, consistency and homogeneity), smell (odour) and touch (estimate of viscosity by stirring and tackiness when cured and at ambient temperature). This would detect whether the binder conformed to the expectations of the tester and would be the quickest way to detect a defective load. Similar principles apply to aggregates, particularly with stockpile inspection where handling soon reveals cleanliness, grading or flakiness problems.

NOTE 2: In all cases perceptible property checks should extend only as far as health and safety regulations permit.

Provisional Type Approval Installation Trial (prTAIT)

Demonstrates that the characteristics of the high friction surfacing comply with the declared characteristics according to this Standard. The prTAIT consists of a defined section where high friction surfacing has been installed using Factory Production Control (FPC) and which has been subjected to in service performance over a period of one year. After this period, detailed information is recorded to clearly identify the product, its performance and the intended uses (refer to Annex 2C).

NOTE: A prTAIT is used by the Contractor to provide confidence in his product and his capability to design and install it.

prTAIT Family

Represents a declared sub-group of associated road parameters to classify products by their intended uses (refer to Annex 2C).

Works Proposal

Works proposed to provide the performance requirements specified including: constituent materials (binder and aggregate type), preparation and application details.

SYMBOLS AND ABBREVIATIONS

2.6 For the purposes of this Standard, the following symbols and abbreviations apply:

- S is the area treated by high friction surfacing for the prTAIT, in square metres (m^2);
- P_1 is the visual assessment of fattening up using IS EN 12272-2 expressed as the percentage (%) of the area of the section, S ;
- P_2 is the visual assessment of delamination using IS EN 12274-8, expressed as the percentage (%) of the area of the section, S ;
- P_3 is the visual assessment of fretting using IS EN 12272-2, expressed as the percentage (%) of chipping loss;
- P_4 is the visual assessment of groups of small repetitive defects except that the minimum defect size shall be 10mm, and not $10D$, this is defined as grinning (substrate positive texture showing through, for example high friction surfacing worn off polished pre-coated chippings in hot rolled asphalt substrate), expressed as the percentage (%) of area of the section, S ;

NOTE: The above are determined by test procedures from IS EN 12272-2 and IS EN 12274-8.

- FPC Factory Production Control;
- τ_{sss} Surface Shear Strength;
- prTAIT Provisional type approval installation trial;
- PSV Polished Stone Value.

REQUIREMENTS

Type of High Friction Surfacing

2.7 The type of high friction surfacing shall be described as part of the product description and relates to the prTAIT family, grade of calcined bauxite or aggregate, type of binder used, and method of application.

NOTE: The design proposal can include for different treatments depending on the substrate type/condition, time of year, etc.

Existing Conditions

- 2.8 The macrotexture of the existing surface prior to application of the high friction surfacing shall be between 0,50 mm to 2,0 mm unless otherwise verified by a successful prTAIT.
- 2.9 High friction surfacing shall only be installed when the surface temperature of the substrate is between 5°C and 35°C unless otherwise verified by a successful prTAIT.

- 2.10 High friction surfacing shall not be installed on concrete substrate unless otherwise verified by a successful prTAIT.

Application of Binder

- 2.11 The tolerance for the rate of spread to be applied to the declared target rate of binder for cold broadcast systems is taken from Table 2.1.
- 2.12 The tolerance for the target application rate and binder content for hot and cold mixed screeded materials are taken from Table 2.1.

Defects as determined by Visual Assessment

- 2.13 Defects can be repaired at any time after the installation of high friction surfacing to maintain its performance; however, a prTAIT shall not include within its length any sections of repaired material.
- 2.14 Categories for visual assessment of defects shall be declared from Table 2.1, within a month either side of one year of trafficking. Visual assessments beyond one year shall be carried out to enable the Contractor to declare the period for which the performance characteristics have been retained.

NOTE 1: In general, most defects occur during the first year of the life of a high friction surfacing.

NOTE 2: Measurement of defects by visual assessment after a year gives an indication of the durability.

- 2.15 Prior to the commencement of a visual assessment, the Contractor shall consult with the National Roads Authority in order to agree an approach to undertaking the assessment. The Contractor's approach shall propose the use of competent personnel to undertake the assessment(s) and the methodology for conducting the assessment(s) e.g., Laser Crack Measurement System, High Definition video, site walk, etc.

Macrotexture

- 2.16 Macrotexture in accordance with IS EN 13036-1 shall be declared from the categories shown in Table 2.1.
- 2.17 The definitive test is the volumetric patch technique measured in accordance with IS EN 13036-1. Measurements shall be made on 50m lane lengths evenly spaced along the section and covering not less than one third of the section tested. On each 50m lane length, 10 individual measurements of the texture depth shall be taken at approximately 5m spacings along a diagonal line across the carriageway lane width. Measurements shall not be taken within 300mm of the longitudinal edge of the carriageway.
- 2.18 To reduce the variability, base the determination of the average texture depth of a test section on not less than six sets of ten individual measurements. For small schemes it may be practicable to carry out measurements over the entire surface course or over alternate 50m lengths covering 50% of the work. Where this cannot reasonably be done test measurements shall be made over regularly spaced 50m lengths of carriageway lane, covering not less than one third of the surfacing laid in one lane. On larger schemes, exceeding a kilometre in length, select test sections of carriageway 1000m long in the same way.
- 2.19 Other test methods may be used (for example laser texture meters – see IS EN ISO 13473-1) provided that they are correlated with the patch test as the reference test.

Bond to Substrate

- 2.20 Performance in terms of bond to substrate is critical and depends on the cleanliness and nature of the existing road surface. If there is poor bond then the high friction surfacing will delaminate (detach in sheets) when moisture enters at the interface.

The works proposal will contain substrate preparation details to ensure bond; these may include treatment of the existing surface e.g., shot blasting or use of a special primer.

- 2.21 The performance measurement is given by a pull-off test as detailed in Table 2.1. This test shall be carried out on site.

Site Works Approval

- 2.22 The transport, delivery and installation of bituminous mixtures to site, should be monitored by the Employer's Representative to ensure compliance with the requirements of the specification Series 900. In doing so the Employer's Representative should be aware that the Polished Stone Value test cannot be carried out on material supplied to site.

Performance

- 2.23 It is important for the Purchaser to ensure that the correct performance levels of the high friction surfacing are specified and obtained, and in particular any parameters specified are measured to demonstrate compliance.
- 2.24 The Contractor shall continue to monitor the prTAIT site and declare the period for which the performance characteristics have been retained. This will aid the Purchaser in satisfying themselves that there is minimum risk of failure during the 'Design Working Life', which may be much longer than the performance term.
- 2.25 In applying previously successful prTAITs to other sites, the following shall apply (based on Table 2C.1):
- (i) prTAIT family 2 may be proposed for use on site categories Q, G1 and S1 with traffic category ≤ 1000 .
 - (ii) prTAIT family 4 may be proposed for use on site categories G2 and S2 with traffic category ≤ 750 .
 - (iii) prTAIT family 6 may be proposed for use on site category K with traffic category ≤ 500 .

Characteristics required				
Technical requirement	Reference	Unit	Defects in HFS	
Visual assessment of defects			² Defects within the wheel tracks ¹	³ Defects outside the wheel tracks ¹
P_1 – fatting up at 1 year	IS EN 12272-2	%	≤ 0.5	≤ 2
P_2 – delamination at 1 year	IS EN 12274-8 ²	%	≤ 0.5	≤ 2
P_3 – fretting at 1 year	IS EN 12272-2	%	≤ 3	≤ 6
P_4 – grinning at 1 year	IS EN 12274-8 ²	%	≤ 3	≤ 6
Notes				
¹ Where the location of the wheel track is indeterminate, the whole area shall meet the wheel track criteria.				
² The assessment is carried out using two separate standards, surface dressing and microsurfacing, because the failure mechanisms for high friction surfacing include delamination and wear.				
³ The maximum width of crack(s) shall be ≤ 0.5 mm as confirmed using a pin gauge. Where cracking is a defect then it is necessary to consider untreated substrate condition and photographic records are useful.				
Surface characteristics				
Minimum macrotexture at one year for cold applied broadcast systems	IS EN 13036-1 (or IS EN ISO 13473-1)	mm	≥ 0.7 for individual measurement and ≥ 1.0 mean	
Minimum macrotexture at one year for hot screeded systems			≥ 0.5 for individual measurement and ≥ 0.8 mean	
Notes				
Cold applied thermosetting broadcast systems provide greater macrotexture				
Hot thermoplastic screeded systems may have lower initial macrotexture				
Bond to substrate				
In situ test at target temperature of $20 \pm 2^\circ\text{C}$	⁴ ASTM C1583 ^{3,4}		$\geq 0.5 \text{ N/mm}^2$	
Notes				
³ For cold applied broadcast systems, test prior to application of the aggregate. In situ test need not use coring.				
⁴ For screeded systems, test on the system. In situ test may need coring if high friction surfacing thicker than 15mm.				
Other Characteristics				
High Friction Surfacing System	Choose system: cold applied thermosetting broadcast system; hot thermoplastic screeded system; or cold thermosetting mixed screeded system.			
Target rate of spread of binder for cold applied broadcast systems	IS EN 12272-1	kg/m ²	$\geq 1,35$	
Tolerance on rate of spread of binder – for cold applied broadcast systems	IS EN 12272-1	%	± 10	
Target rate of spread of aggregate - for cold applied broadcast systems	IS EN 12272-1	kg/m ²	As declared	
Tolerance on rate of spread of aggregate – for cold applied broadcast systems	IS EN 12272-1	%	± 10	

² Amended as per Amendment No. 1, Item 2

³ Amended as per Amendment No. 1, Item 3

⁴ Amended as per Amendment No. 1, Item 4

Target application rate for screeded systems hot and cold	IS EN 12274-6	kg/m ²	As declared
Tolerance on application rate for screeded systems hot and cold	IS EN 12274-6	%	± 15
Tolerance on target binder content	IS EN 12697-39	%	± 10
Other characteristics			
Binders – other characteristics of binders may be declared.			
Aggregates – other characteristics of aggregates may apply according to IS EN 13043 as appropriate.			
System – Claims made by the Contractor regarding installation restrictions (installation temperature, substrate texture depth, use on concrete substrates) to be verified by prTAIT.			

Table 2.1 — Performance categories

PERFORMANCE

General

2.26 High friction surfacing produced in accordance with this Standard is deemed to be durable for a reasonable economic working life.

Frictional Capacity

2.27 Durability of frictional capacity shall be demonstrated by means of measurement of PSV of the aggregate in accordance with IS EN 13043 together with a measurement of macrotexture, after 11 months and before 13 months after trafficking. The prTAIT may be tested for frictional capacity during normal monitoring. This information may be useful to support the data in the prTAIT certificate.

NOTE: Different categories can be used for different intended uses.

Polished Stone Value (PSV)

2.28 Polished Stone Value of the aggregate shall be declared in accordance with IS EN 13043 and certified in accordance with NRA HD 36.

NOTE: Different categories can be used for different intended uses.

Macrotexture

2.29 Macrotexture shall be declared in accordance with Table 2.1.

EVALUATION OF PERFORMANCE

2.30 Evaluation of performance shall be demonstrated by:

- (i) Provisional Type Approval Installation Trial (prTAIT) in accordance with Annex 2C;
- (ii) Factory Production Control in accordance with Annex 2A.

Annex 2A

Factory Production Control

2A.1 GENERAL

The Contractor shall establish, document and maintain a Factory Production Control (FPC) system to ensure that the high friction surfacing placed on the market conforms to the stated performance characteristics. The FPC system shall consist of procedures, regular inspections and tests and/or assessments and the use of the results to control incoming materials, equipment, the production process and the product. Alternative tests to those referred to in this Standard may be used for FPC, provided they have been approved by the Purchaser and correlation has been demonstrated.

Where the Contractor purchases constituent materials or has the high friction surfacing designed, or parts of the production or testing carried out by subcontracting, the FPC of the supplier or subcontractor may be taken into account. However, where this occurs, the Contractor shall retain the overall control of the high friction surfacing and ensure receipt of all the information that is necessary to fulfil the responsibilities according to this Standard. The Contractor who sub-contracts all of his activities may in no circumstances discharge his responsibilities to a sub-Contractor.

All the elements, requirements and provisions adopted by the Contractor shall be documented in a systematic manner in the form of written policies and procedures as a quality plan. This production control system documentation shall ensure a common understanding of conformity evaluation and enable the achievement of the required component characteristics and the effective operation of the production control system to be checked.

FPC brings together operational techniques and all measures allowing maintenance and control of the conformity of the high friction surfacing with its technical requirements. Its implementation may be achieved by controls and tests on measuring equipment, constituents, processes, machines and manufacturing equipment and finished components, including material properties of components, and by making use of the results thus obtained.

As part of the FPC, the prTAIT procedure should be repeated at intervals not greater than 5 years to confirm continuing validity of the product composition.

A Contractor who has a FPC which complies with IS EN ISO 9001 and made specific to this Standard shall be deemed to satisfy the requirements of this Annex.

2A.2 GENERAL REQUIREMENTS

The FPC system shall at least fulfil the requirements as described in the Clauses of IS EN ISO 9001 specified in Table 2A.1, where applicable:

Column	1	2	3
Line	Subclauses of IS EN ISO 9001:2000	Subject	Sub-clause in this Standard for additional requirements or information
1	7.5	Documented information	2A.3.2
2	5.1.1 e)	Leadership and commitment – general	2A.3.3
3	5.3	Organizational roles, responsibilities and authorities	2A.3.4
4	5.3	Organizational roles, responsibilities and authorities	
5	7	Support for FPC system including resources, competence, awareness and communication	
6	8.1 except 8.1a)	Operational planning and control	
7	8.2.1 c)	Purchaser feedback	
8	8.3	Design and development of products and services	2A.3.5
9	8.4	Control of externally provided processes, products and services	
10	8.5	Production and service provision	2A.3.6
11	7.1.5	Monitoring and measuring resources	2A.3.7
12	8.6	Release of products and services	2A.3.8
13	8.7 10.2	Control of nonconforming outputs Nonconformity and corrective action	2A.3.9
14	10.2	Nonconformity and corrective action	2A.3.10

⁵Table 2A.1 — Clauses of IS EN ISO 9001 to be addressed in the FPC

The FPC system may be part of a Quality Management system, e.g. in accordance with IS EN ISO 9001.

2A.3 PRODUCT SPECIFIC REQUIREMENTS

2A.3.1 General

The requirements set out in this sub-clause provide product specific details.

2A.3.2 Records

Records shall be stored in such a way that they are retrievable and maintained for a minimum period of 5 years from the date of production.

2A.3.3 FPC System

The FPC system shall:

- Ensure consistency with the requirements of this Standard;
- Ensure that high friction surfacing products placed on the market conform with the stated performance characteristics;
- Comply with the Clauses of IS EN ISO 9001 listed in Table 2A.1.
- Document and demonstrate the testing frequencies regime (see Annex 2B).

⁵ Amended as per Amendment No. 1, Item 5

2A.3.4 Responsibility and Authority

The responsibility and authority of personnel shall be defined for personnel who have authority to:

- Modify the design locally to adjust to road and environmental conditions;
- Identify and record any product quality problems.

NOTE An individual may exercise such supervision over a number of sites.

2A.3.5 Design Process

The design procedure used shall be documented.

Reference to a European standard procedure, if used, shall be sufficient.

Information on the traffic category and properties of the existing road can be supplied by the Purchaser.

2A.3.6 Process Control

High friction surfacing is a site performed manufacturing process and the performance of high friction surfacing is greatly dependent upon the condition of the substrate, application, mixing and other external factors. The process control therefore shall include controlling and monitoring criteria normally associated with the Works.

The Contractor shall produce a works proposal for each site or group of sites for the production and installation of high friction surfacing. The Contractor's management shall have a working knowledge of, and access to, all relevant documentation including the Contract and relevant NRA Standards.

Before site work commences the Contractor shall ensure that the following are documented and issued to the appropriate personnel:

- The design of high friction surfacing for the site;
- Any special instructions to the site staff relating to the programme of work;
- The equipment required for the work and the method of working to meet the design proposal and the requirements of the Contract;
- Any additional instructions including application requirements.

Actions to be controlled:

- Cleanliness of substrate;
- Preparatory work based on weather conditions;
- Conformity of materials purchased to Specification;
- Materials identification;
- Operation and maintenance of application equipment within documented tolerances;
- The use of competent personnel during the production of the high friction surfacing;
- A system for handling and taking account of any changes made;
- Record of the road surface condition prior to production of the high friction surfacing and any local variations to the works proposal;
- Procedure and time scale for notifying the Purchaser of any problems which may affect the work (issues which may require deviation from the original specification);
- Activities to maintain the product until the work is handed to the Employer.

NOTE Records should be kept of the operation on site that could affect the performance of the high friction surfacing, covering the period shortly before operations commence until the opening of the site to unrestricted normal traffic. These records should contain the following:

- Variations from the original design proposal including those necessitated by site conditions;
- Unforeseen problems (weather conditions, emergency vehicle damage, etc.);

-
- Weather information;
 - Any other information considered relevant to the performance of the product.
 - Traffic control measures;
 - Notes on perceptible properties checks;
 - Complaints from the public.

2A.3.7 Control of Equipment, Monitoring and Measuring Devices

Procedures shall be documented for ensuring that test, monitoring and measuring equipment continues to function properly within the tolerances stated in the Contractor's documented procedures.

All equipment used in the manufacturing process shall be regularly inspected and maintained to ensure use, wear or failure does not cause inconsistency in the manufacturing process.

Rapid checks on the functionality of test equipment may be used e.g., checking a balance with a standard mass. Useful information on calibration and accuracy of test equipment can be found in IS EN 12697-38.

2A.3.8 Monitoring and Measurement of Product

The Contractor shall establish procedures to ensure that the production tolerances allow for the product performances to be in conformity with the values derived from the prTAIT.

The characteristics and the means of verification are given in Table 2A.2.

2A.3.9 Non-Conforming Products

The Contractor shall have written procedures which specify how to deal with non-conforming products. Any such events shall be recorded as they occur and these records shall be kept for the period defined in the Contractor's written procedures.

2A.3.10 Corrective and Remedial Action

In the event that a non-conformities is identified, investigations shall be initiated to determine the reasons for non-conformity. The Contractor shall have documented procedures that instigate action to eliminate the cause of non-conformities in order to prevent recurrence in accordance with procedures documented in the quality plan. Non-conformity of the high friction surfacing shall involve one or more of the following:

- Repair and/or remedial action to bring the product up to the required performance;
- Written acceptance of the product following agreement by the purchaser to accept the non-conforming product;
- Rejection and removal of the product.

Column	1	2	3
Line	Characteristics	Inspection procedure and minimum frequency	Notes
1	Adhesion of binder to aggregate	Table 2B.3 Table 2B.6	Perceptible properties check Rate of spread of binder for cold applied and binder content for hot screeded
2	Resistance to flow/deformation	Table 2B.4	Perceptible properties check and Supplier document inspection
3	Hardening or setting ability	Table 2B.4	Perceptible properties check plus weather
4	Cohesion	Table 2B.4	Supplier document inspection
5	Frictional Capacity	Table 2B.3	Supplier document inspection
6	Resistance to abrasion	Table 2B.3	Supplier document inspection
7	Bond to substrate	Table 2B.1	Visual inspection of road cleanliness
8	Dangerous substances	Incoming materials	

Table 2A.2 — Assessment of performance characteristics

Annex 2B

(normative)

Minimum inspection/test frequencies for FPC

Column	1	2	3	4
Line	Control Area	Inspection/Test	Purpose	Minimum frequency
1	Aggregate stocks	Visual	To check for contamination and moisture content	Prior to first use
2a	Binder stocks	Visual and temperature for cold applied binders	To check storage conditions	Every production day
2b		Softening Point for thermoplastic binders	To check for binder property changes	One week after most recent delivery
3a	Equipment	Visual	Check for contamination and cleanliness	Before starting application
3b		Temperature for hot screeded systems	To check that mixing is at the correct temperature	At start of production
4	Road cleanliness	Visual inspection	To ensure the existing surface is in a fit state to be surface dressed	Continual
5	Applicator	Visual	To ensure equipment provides an even application	Continual
6	Mixing of hot and cold screeded materials	As set out in the FPC	To check manufacture	Each batch
7	Defects	Visual	To check for application problems	Continual
8	Aggregate application for cold applied systems	Visual	To prevent adhesion problems if applied after gel time	Continual
9	Binder application for cold applied systems	Visual and rate estimate from area and volume	To check application	Continual

Table 2B.1 — Process control inspection schedule

Column	1	2	3	4
Line	Item of plant/equipment	Inspection/test	Purpose	Minimum frequency
1a	Temperature measurement and recording equipment	Visual inspection	To ascertain the equipment is functioning correctly	Every production day
1b		Test of accuracy	To ensure correct temperatures are measured and/or recorded	1) On installation 2) After significant repair 3) Annually 4) When apparatus does not appear to be functioning correctly
2a	Mixing systems for hot and cold screeded systems	Visual inspection	To ascertain the equipment is functioning correctly	Every production day
2b		Test of accuracy	To ensure correct temperatures and times are measured and/or recorded and mixing protocol is maintained	1) On installation 2) After significant repair 3) Annually 4) When apparatus does not appear to be functioning correctly
3a	Application of binder or screed	Rate of spread of binder	To ensure the quantity of binder delivered is within the specification tolerance	1) On installation 2) After significant repair 3) Annually before the first installation 4) When apparatus does not appear to be functioning correctly
3b		Screeded application rate	To ensure the screed is within the specification tolerance	
4	Device for indication of volume or mass of binder and mixture components	Comparison of actual quantity of each component with the planned amount	To enable total amount laid on a site and components to be measured within limits set out in the FPC	1) On installation 2) After significant repair 3) Annually 4) When apparatus does not appear to be functioning correctly
5a	Weighing or volume measuring equipment	Visual inspection	To ascertain the equipment is functioning correctly	Every production day
5b		Test of accuracy	To ensure correct masses/volumes are measured and/or recorded	1) On installation 2) After significant repair 3) Annually 4) When apparatus does not appear to be functioning correctly
6	Sweeper	Brush, water sprinklers and suction inspection	Maintain efficiency of sweeping process	Once per production day
Notes				
Not all high friction surfacing equipment will have all the above equipment installed and methods of calibration can vary according to the plant types and facilities available.				

Table 2B.2 — Plant and equipment calibration requirements

Column	1	2	3
Line	Inspection/test	Purpose	Minimum frequency
1	Tests for intrinsic properties of aggregate (strength, PSV adhesivity, etc.) IS EN 13043	To check properties against the design proposal	Source approval before initial use
2	Sieve analysis and flakiness index	To assess compliance with standard or other agreed grading (e.g. material passing a 0,5 mm sieve)	In accordance with IS EN 13043 In case of doubt following perceptible properties check
3	Inspection of delivery ticket	To check consignment is as ordered and from correct source	Each delivery
4	Perceptible properties check of stockpile	For comparison with normal appearance with respect to source, grading, shape and impurities	Each day deliveries are made
Notes			
Results of tests and inspections by the aggregate supplier, as part of his Factory Production Control (when included in Contractor's FPC), may be used to satisfy the requirements of this table.			

Table 2B.3 – Minimum inspection and test frequencies for aggregates

Column	1	2	3
Line	Inspection/test	Purpose	Minimum frequency
1	Tests for intrinsic properties of binder	To check properties against the design proposal	Source approval before initial use Updated in accordance with FPC
2	Grade properties	To assess compliance agreed Contractor requirements	And annually and in case of doubt following perceptible properties check
3	Inspection of delivery ticket	To check consignment is as ordered and from correct source	Each delivery
5	Perceptible properties check (by sample inspection)	For comparison with normal appearance, smell, tackiness etc.	Each delivery or every production day
6	Sampling	To enable properties to be checked in the event of defective high friction surfacing	Each delivery or load
Notes			
Results of tests and inspections by the supplier, as part of his Factory Production Control, may be used to satisfy the requirements of this table. Any samples shall be stored in such a manner that deterioration is kept to a minimum.			

Table 2B.4 — Minimum inspection and test frequencies for binders

Column	1	2	3
Line	Inspection/test	Purpose	Minimum frequency
1	Tests for intrinsic properties of other constituents or additives	To check against design proposal	Source approval before initial use. Updated in accordance with FPC
2	Inspection of delivery ticket	To check consignment is as ordered and from correct source	Each delivery
3	Grade/category properties appropriate to the material	To assess compliance with standard or other agreed specification	1) First delivery from new source 2) In case of doubt following perceptible properties check
4	Perceptible properties check of consignment	For comparison with normal appearance etc.	Each delivery
Notes			
Results of tests and inspections by the supplier, as part of his factory production control, may be used to satisfy the requirements of this table.			

Table 2B.5 — Minimum inspection and test frequencies for other constituents and additives

Column	1	2	3
Line	Inspection/test	Purpose	Minimum frequency F
1	Rate of spread of binder for cold applied (IS EN 12272-1 or reconciliation of binder to area of high friction surfacing)	To ensure the quantity of binder on the road is within the design requirements	Category F ₁ : Reconciliation of binder used to area of high friction surfacing for each job site Category F ₀ : As set out in the quality plan
2	Rate of spread of screeded materials	To ensure the quantity of material on the road is within the design requirements	Category F ₁ : Reconciliation of binder used to area of high friction surfacing for each job site Category F ₀ : As set out in the quality plan
3	Mixing for hot and cold screeded materials	To ensure the quantity of components mixed is within the design requirements	Category F ₀ : As set out in the quality plan

Table 2B.6 — Minimum inspection and test frequencies during production

Annex 2C

Provisional Type Approval Installation Trial (prTAIT)

2C.1 GENERAL

The Contractor shall carry out one provisional Type Approval Installation Trial (prTAIT) to cover each high friction surfacing product/system to be placed on the market.

A prTAIT demonstrates that the characteristics of the high friction surfacing complies with the declared characteristics. The prTAIT consists of a defined section where high friction surfacing has been installed using Factory Production Control (FPC) and which has been subjected to in service performance after a period of one year. After this period, detailed information is recorded to clearly identify the product, its performance and the intended uses.

A prTAIT shall be carried out on a site with site characteristics consistent with the prTAIT family intended to be used by the proposed system. The site characteristics are defined in Table 2C.1.

The prTAIT process shall be repeated if:

- a) The constituents of proposed product/system change;
- b) An installation is proposed on a higher road category to that already installed; or
- c) There is a change to the documented FPC system.

2C.2 REQUIREMENTS

A prTAIT shall comprise a full set of tests as detailed in Table 2.1 of this Standard demonstrating the performance characteristics of a defined section of high friction surfacing constructed in accordance with the requirements of Chapter 2.

The minimum length of a prTAIT section shall be 50m, to a maximum of 100m. The width of a prTAIT section shall be one lane width of road on single carriageways or extend across all lane widths on dual carriageways or motorways.

The prTAIT shall be carried out within a representative high friction surfacing contract, or, alternatively, it may be carried out in a special section of work that shall be representative of the road parameters for the targeted high friction surfacing prTAIT family.

The prTAIT is completed by carrying out visual assessments and performance tests on the high friction surfacing, on site, after one year of completion of the installation. This shall include visual assessment of defects and macrotexture and shall meet the requirements of Table 2.1.

The prTAIT shall verify the performance of the high friction surfacing where the requirements for the macrotexture of the existing surface, application to concrete substrate, and/or surface temperature of substrate during installation, as specified in NRA Series 900 Clauses 10.2.4.2 and 10.2.4.4, are amended.

The Contractor shall submit a works proposal detailing the design and installation of the high friction surfacing, of which the prTAIT is a representative section, in accordance with the documented FPC system described in Annex 2A. The Contractor shall record all the data required by the FPC and any additional data required by this Standard. In addition, and in advance of the Works, the works proposal should also contain any other relevant information, including the following:

- a) Storage, handling and transport procedures and requirements suitable for installing the high friction surfacing system.

- b) Weather conditions (dry/wet, temperature, etc.) suitable for installing the high friction surfacing system.
- c) Trafficking requirements for the high friction surfacing to include the duration between completion of installation to opening to restricted and unrestricted traffic, noting any restrictions.

The Contractor may alter the design for a product system to take into account local conditions provided that the prTAIT used is still representative of the high friction surfacing under intended use conditions.

2C.3 PRTAIT ASSESSMENT

Where the prTAIT satisfies the requirements of Table 2.1 after 1 year in service, the performance of the high friction surfacing shall be deemed as suitable for further use. The location and extent of any defects shall be noted. The high friction surfacing shall be deemed unsuitable if the maximum permitted value of defects in any category of Table 2.1 is exceeded and shall not be permitted for further use on roads within that prTAIT family, or any roads with higher traffic volumes.

If subsequently proposed for use on a traffic category which is lower than where the defect occurred, the high friction surfacing will be required to fully comply with the requirements of this Standard.

Prior to the commencement of a visual assessment, the Contractor shall consult with the National Roads Authority in order to agree an approach to undertaking the assessment. The Contractor's approach shall propose the use of competent personnel to undertake the assessment(s) and the methodology for conducting the assessment(s) e.g., Laser Crack Measurement System, High Definition video, site walk, etc.

2C.4 DATA RECORDED

The data recorded for a prTAIT shall include the following information:

- a) Company Name and Address;
- b) QA reference number and certifying body;
- c) prTAIT reference number;
- d) Location of prTAIT (road number, start and end points);
- e) prTAIT family;
- f) Date of prTAIT;
- g) Name of Notified Body which has certified the high friction surfacing product/system;
- h) Proprietary Name (if applicable);
- i) Description of product/system (refer to Clause 2.7);
- j) Design procedure or method;
- k) Design office (name, address, phone number etc. (where different from the 'Contractor'));
- l) Storage and transportation requirements;
- m) Colour retention (if applicable);
- n) Relevant test results of materials used. Typical tests include;
 - a. Softening point of binder for thermoplastic systems [IS EN 1427]

-
- b. Aggregate PSV, AAV and grading if not in accordance with NRA Series 900
 - c. Binder content for screeded systems [IS EN 12697-39]
 - d. Duration of workability (pot life) for thermosetting systems [IS EN 14022]

NOTE: This list is not exhaustive and the final test programme shall include all tests required in the NRA Specification for Road Works Series 900.

- o) FPC documentation for the section used for the prTAIT;
- p) The rate and tolerance of spread of both binder and aggregate (for broadcast systems) or rate of application (for screeded systems) used for the prTAIT;

NOTE: It is preferable that the tests are actually carried during the production of the prTAIT;

- q) Time of year, temperature and weather conditions during installation;
- r) The time duration between completion of installation and opening to restricted and unrestricted traffic noting any restrictions;
- s) Claims made by the applicant verified by the prTAIT that the high friction surfacing can be installed under conditions that do not comply with the requirements specified in NRA Series 900;
- t) After one year, visual assessment as described in Table 2.1 and macrotexture to IS EN 13036-1 (or to IS EN ISO 13473-1);
- u) Period for which the performance characteristics have been retained;
- v) Name of Contractor's representative responsible for prTAIT.

2C.5 INFORMATION AVAILABILITY

The information from a prTAIT shall be kept and stored securely. If the data is lost the prTAIT shall no longer be valid.

2C.6 HIGH FRICTION SURFACING FAMILIES

This Annex identifies parameters by which a prTAIT family of high friction surfacing is defined (refer to Clauses 2.7 – 2.25 and Table 2C.1). The prTAIT families specify the intended use which may have set frequencies of testing and/or set categories of performance.

The site characteristics are defined in Table 2C.1. This table groups site categories and traffic volumes (in terms of cv/lane/day) according to the expected frictional demand and breaking stresses caused by traffic as a means of limiting the number of prTAITs and defining families.

Column	1	2	3	4	5	6	7
Line	Parameters that limit the application of a prTAIT	Site Categories ¹					
1		G1, S1		G2, S2		K	
2	Traffic Category (cv/lane/day)	≤ 1000	> 1000	≤ 750	> 750	≤ 500	> 500
3	Type of High Friction Surfacing	Cold Broadcast / Cold Screeded / Hot Screeded					
4	Types of Aggregate	Natural / Manufactured					
5	prTAIT family	1	2 ²	3	4 ²	5	6 ²
Notes							
¹ Site categories as defined in NRA HD 28.							
² Previously successful prTAITs may be applied to other site in accordance with Clause 2.25.							

Table 2C.1 – Limiting number of prTAITs and defining families for High Friction Surfacing

3. LOW ENERGY BOUND MIXTURES

GENERAL

- 3.1 This Chapter of NRA HD 301 specifies the product approval requirements for the use of Low Energy Bound Mixtures (LEBM) products on National Roads.

TYPE TESTING

General

- 3.2 A Type Test is the complete set of tests or other procedures to determine compliance of the LEBM samples with the requirements of NRA Series 900.
- 3.3 Type Testing shall be performed to show conformity with the requirements of NRA Series 900 on first use for LEBM on the National Roads Network.
- 3.4 For each mix formulation to be used in the Works the Type Testing procedure shall be carried out to provide proof that the formulation meets the relevant requirements of NRA Series 900. Products CE marked in accordance with appropriate harmonised European Standards may be presumed to have the performances stated with the CE marking, although this does not replace the responsibility of the Producer to ensure that the LEBM complies with the requirements of NRA Series 900.
- 3.5 Where raw materials are used, whose characteristics have already been determined, these characteristics need not be reassessed provided that the raw material's performance remain the same throughout the design process.
- 3.6 NRA Series 900 contains a number of requirements for physical and mechanical properties for LEBM. Some of these are expressed as direct measurements of mechanical properties such as stiffness, whilst other requirements are in the form of surrogate properties such as bitumen content or voids content. The Producer, when carrying out the Type Testing procedure, should provide evidence for each relevant requirement in NRA Series 900 for which conformity is being demonstrated.
- 3.7 The results of Type Testing shall be presented in a Type Test report containing all of the information required.
- 3.8 The Type Testing procedure is also required to be carried out at a frequency of at least once every five years as part of the procedure to demonstrate ongoing conformity.

Validity

Period of Validity

- 3.9 A Type Testing report is valid for a single mix formulation and remains valid for the purposes of Type Testing. A new Type Test shall be required under the following circumstances:
- (i) If there is a change in the type of coarse aggregate constituting:
 - a. change in the category of coarse aggregate for one of the following properties: shape, percentage of crushed gravel, resistance to fragmentation, resistance to freezing and thawing, fines content;
 - b. change in petrographic type;
 - c. change in particle density (weighted mean) greater than 0,05 Mg/m³;
 - (ii) If there is a change in the source, the type, or the grading category of fine aggregate;
 - (iii) If there is a change in the mineralogical type of filler;
 - (iv) A change in bitumen grade, cement class, or other characteristic change regarding the binder such as composition or binder content by percentage weight shall result in a new Type Test.

Constituent Materials

- 3.10 The Type Testing procedure shall include tests to demonstrate that all constituent materials conform to the appropriate requirements. The requirements are detailed in NRA Series 900 Clause 8.1.1.
- 3.11 The tests for geometrical properties of the aggregate constituents, penetration and softening point of the binder and grading shall be carried out on the constituents actually used in Type Testing.
- 3.12 For other constituent properties, tests carried out as part of the Evaluation of Conformity procedures used to demonstrate conformity of the aggregates, bitumen, cement, etc. with the appropriate European Standard shall be acceptable.

Mixed Material

General

- 3.13 The Type Testing shall include tests on the mixed material to determine compliance with the requirements with which conformity is to be demonstrated. The requirements are detailed in Table 3.1.
- 3.14 Test methods requiring the testing of multiple test specimens to produce a single result include the whole procedure as a single test.

Application

- 3.15 The Type Testing validation of mix properties shall comply with one of the three models below:
- (i) All properties demonstrated by laboratory validation;
 - (ii) All properties demonstrated by production validation;
 - (iii) Some properties demonstrated by laboratory validation, some properties demonstrated by production validation.
- 3.16 Tests for the same property made on laboratory-prepared and compacted specimens will often give results which are different from those on plant-mixed and site-compacted specimens. The Producer should take this into account and care should be taken to compare results with the appropriate limits.

Sampling and Testing

- 3.17 All testing and sampling shall be carried out in accordance with the appropriate European Standard, as specified in NRA Series 900, such that the samples will be representative of the normal constituents and mixed materials.

Mixed LEBM Composition

- 3.18 All tests on mixed LEBM shall be conducted on specimens manufactured at the declared mix formulation determined by the mixture design evaluation process described in NRA HD 300.

Mixed LEBM Sample Preparation

General

- 3.19 Mixed material and test specimens shall be prepared in accordance with the model selected above. The Type Testing shall clearly identify which of the procedures (laboratory or production) has been used in the validation of the mixture.

Laboratory Validation

- 3.20 When executing laboratory validation, tests shall be carried out on material mixed in a laboratory from constituent materials blended to the input target composition consistent with the procedures to be utilised in live production of the product. Specimens required for physical and mechanical testing shall be prepared and compacted using vibratory compaction.

Production Validation

- 3.21 When executing production validation, the LEBM shall be mixed in a full-scale LEBM production plant under standard operating conditions set to produce the declared mix formulation. Test specimens of the LEBM shall be prepared using one of the following procedures:
- (i) Representative sample of the mixed LEBM shall be taken and test specimens shall be compacted in the laboratory in accordance with vibratory compaction method in accordance with IS EN 12697-32; or
 - (ii) Mixed material shall be laid in a full-scale trial pavement using full scale paving equipment and procedures. Representative test specimens shall then be cut from the pavement by sawing or coring.
- 3.22 When using production validation, the Type Testing procedure shall include tests on the specimens used in validation of mix properties to confirm that the binder content and grading is within the close tolerance limits given in Table 3.2 about the output target composition.

Type Test Report

- 3.23 The Type Test report shall form part of the Producer's declaration of performance. This shall include the information listed in required information below and shall be accompanied by all appropriate test certificates. The information detailed in Clauses 3.24 – 3.27 below shall be supplied by the Producer:
- 3.24 The Producer shall supply general details including:
- (i) Name and address of Producer making declaration;
 - (ii) Date of issue;
 - (iii) Identification of mixing plant;
 - (iv) Material classification which performance is being declared (cement treated material, bitumen stabilised material, cement bitumen treated material, cold asphalt mixture);
 - (v) Statement of methods used in mix validation (laboratory or production).
- 3.25 The Producer shall supply details regarding properties of the constituents and mix formulation.
- (i) Properties of constituents including:
 - a. Each aggregate size: source and type;
 - b. Binder: type and grade;
 - c. Filler: source and type;
 - d. Additives: source and type;
 - e. Test certificates demonstrating compliance with the requirements of NRA Series 900 for all constituent properties as appropriate.
 - f. Mix formulation.
 - (ii) Mix formulation expressed as:
 - a. Proportion of all aggregate constituents;
 - b. Combined target grading, including fillers, adhesion agents and tolerances;
 - c. Proportion of all binders by percentage weight;
 - d. Optimum moisture content.

3.26 The Producer shall supply details regarding temperatures including:

- (i) Maximum and minimum mix temperatures for mixtures with modified binders or additives where these are different from the default values in the product standards.

3.27 The Producer shall supply test results including:

- (i) Relative in-situ density relative to refusal density;
- (ii) Moisture content;
- (iii) Indirect tensile stiffness modulus (dry);
- (iv) Percentage air voids contents.

Results shall meet the requirements of NRA Series 900 Table 24g.

Property	Test Method	Number of tests
Binder content (prescriptive)	IS EN 12697-1 or -39	1 for production validation 0 for laboratory validation
Grading (prescriptive)	IS EN 12697-2	1 for production validation 0 for laboratory validation
Moisture content (performance related)	IS EN ISO 17892-1	1
Refusal density (performance related)	IS EN 12697-6	1
Stiffness (performance based)	IS EN 12697-26 using IT-CY method, specimens conditioned in accordance with NRA HD 300, Clause 6.47	1
Air voids content including VFB and VMA (performance related)	IS EN 12697-8 Using bulk density to IS EN 12697-6, procedure B, in a saturated surface dry condition. Using maximum density to IS EN 12697-5 using Procedure A in water.	1

Table 3.1 – Type and number of tests for Low Energy Bound Mixtures

Column	1	2
Line	Percentage Passing ¹	Individual samples Tolerance about target composition
1	D	-9 +5
2	D/2 or Characteristic coarse sieve	± 9
3	2mm	± 7
4	Characteristic fine sieve ²	± 5
5	0,063 mm	± 3
6	Soluble binder content	± 0,6
Notes		
¹ A tolerance of -2% shall apply to the requirement of 100% passing 1,4D		
² The D/2 sieve is not appropriate for all mixes. Alternatively, for each product a sieve size may be indicated in the project standard which is of particular importance in characterising the material.		

Table 3.2 – Tolerances in absolute percentage for the assessment of conformity of production

4. RETEXTURING

GENERAL

- 4.1 For each retexturing treatment system to be incorporated into the Works, the provisional Type Approval Installation Trial (prTAIT) shall be supplied to the Purchaser for review prior to commencement of the Works.
- 4.2 The prTAIT requirements include consistency in accordance with NRA Series 900 Clause 8.2.1.
- 4.3 If a proposed retexturing treatment system has received an approved prTAIT, it shall have been carried out on a site with the same characteristics as specified in the Contract. The site characteristics are detailed in Table 4.1. The characteristics are defined in terms of site categories, traffic volumes (in terms of cv/lane/day) and retexturing treatment types as a means of limiting the number of prTAITs and defining families.
- 4.4 The prTAIT shall have been installed in accordance with the Contractor's instructions.

Column	1	2	3	4	5	6
Line	Parameters that limit the application of a prTAIT	Site Categories ¹				
1		B, C, G1/G2, K, Q, R and S1/S2				
2	Traffic Category (cv/lane/day)	All traffic levels				
3	Type of Retexturing treatment	Bush Hammering	Shot Blasting	Grooving/ Grinding	Longitudinal Scabbling	Water Jetting
4	prTAIT family	1	2	3	4	5

Table 4.1 – Limiting number of prTAITs and defining families for Retexturing treatments

prTAIT REQUIREMENTS

General

- 4.5 The Contractor shall carry out one provisional Type Approval Installation Trial (prTAIT) to cover each retexturing system to be placed on the market.

Requirements

- 4.6 A minimum length of a prTAIT section shall be 15m. The width of a prTAIT section shall be one lane width on all types of road.
- 4.7 The procedure shall demonstrate the ability to retexture the surface course type for which it is proposed to be utilised.
- 4.8 The Contractor may alter the design for a retexturing system to take into account local conditions provided that the prTAIT used is still representative of the retexturing system under intended use conditions.

Data Recorded

4.9 The data recorded for a prTAIT shall include the following information:

- a) Contractor (name, address, phone number etc.);
- b) Date of prTAIT;
- c) Location of prTAIT (road number, start and end points);
- d) Intended use;
- e) Description of type of retexturing system;
- f) The surface macrotexture prior and after treatment works.

Information availability

4.10 The information from a prTAIT shall be kept and stored securely. If data is lost the prTAIT shall no longer be valid.

5. PERMANENT REPAIR MATERIAL SYSTEMS AND LOCALISED SURFACE REPAIR SYSTEMS

GENERAL

- 5.1 This Chapter of NRA HD 301 specifies the performance requirements and control procedures for the installation of Permanent Repair Material Systems (PRMS) and Localised Surface Repair Systems (LSRS) for repair works on National Roads.
- 5.2 As PRMS and LSRS are not covered by a harmonised European Standard, the layout of this Chapter (and in particular its Annexes) is intended to be compatible with the layout of European Standards.

NORMATIVE REFERENCES

- 5.3 The following referenced documents are indispensable for the application of this Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IS EN 1097-5, *Tests for Mechanical and Physical Properties of Aggregates — Part 5: Determination of the Water Content by Drying in a Ventilated Oven*

⁶IS EN ISO 9001, *Quality management systems — requirements*

IS EN 12591, *Bitumen and Bituminous Binders — Specifications for Paving Grade Bitumens*

IS EN 13036-1, *Road and airfield surface characteristics — Test methods — Part 1: Measurement of pavement surface macrotexture depth using a volumetric patch technique*

IS EN 13043, *Aggregates for bituminous mixtures and surface treatments for roads, airfields and other trafficked areas*

TERMS AND DEFINITIONS

- 5.4 This Clause includes terms and definitions not included in NRA Series 900. For other terms and definitions refer to NRA Series 900 Clause 1.7.

Defect

State of the PRMS/LSRS in the case of delamination, loss of material, wearing, lane joint gaps and rutting (P₁) or corrugation, bumps and ridges (P₂).

NOTE 1: A defect can occur due to poor construction techniques.

Durability

Ability of a product to maintain its required performance, under the influence of foreseeable actions, for a reasonable economic working life.

Localised Surface Repair Systems

LSRS utilise an infra-red process that reconstitutes the surfacing material in-situ to provide a permanent repair, which conforms to the requirements of NRA Series 900.

⁶ Amended as per Amendment No. 1, Item 6

Permanent Repair Material Systems

PRMS utilise a cold-lay bituminous material which shall be used for the permanent repair of surface defects, filling of road stud cavities and core holes, filling around ironworks, and utility cuttings/openings conforming to the requirements of NRA Series 900.

Provisional Type Approval Installation Trial (prTAIT)

Demonstrates that the characteristics of the PRMS/LSRS comply with the declared characteristics according to this Standard. The prTAIT consists of a defined section where PRMS/LSRS has been installed using Factory Production Control (FPC) and which has been subjected to in service performance over a period of one year. After this period, detailed information is recorded to clearly identify the product, its performance and the intended uses (refer to Annex 5C).

NOTE 1: A prTAIT is used by the producer to provide confidence in his product and his capability to design and install it.

SYMBOLS AND ABBREVIATIONS

5.5 For the purposes of this Standard, the following symbols apply.

AAV Aggregate Abrasion Value;

NPD No performance determined;

FPC Factory Product Control;

P₁ is the visual assessment of delamination, loss of material, wearing, lane joint gaps and rutting in the PRMS/LSRS section, expressed as a percentage (%) of the area of the section, S;

P₂ is the visual assessment of corrugation and bumps in the PRMS/LSRS section, expressed as a percentage (%) of the area of the section, S;

S is the area of the road that has been repaired using the PRMS/LSRS, in square metres (m²);

prTAIT Provisional Type Approval Installation Trial;

PSV Polished Stone Value.

REQUIREMENTS

Defects as determined by Visual Assessment

5.6 Categories for visual assessment of defects shall be declared from Table 5.1 for each inspection at 1, 6 and 12 months after installation.

Characteristics required			
Technical requirement	Reference	Unit	Defects in PRMS/LSRS
Visual assessment of defects			
<i>P</i> ₁ – Delamination, loss of material, wearing, lane joint gaps and rutting	NRA HD 301	%	0
<i>P</i> ₂ – Corrugation, bumps and ridges	NRA HD 301	%	0

Table 5.1 — Performance categories

5.7 Prior to the commencement of a visual assessment, the Contractor shall consult with the National Roads Authority in order to agree an approach to undertaking the assessment. The Contractor's approach shall propose the use of competent personnel to undertake the assessment(s) and the methodology for conducting the assessment(s) e.g., Laser Crack Measurement System, High Definition video, site walk, etc.

PERFORMANCE

General

5.8 Performance of PRMS/LSRS is demonstrated by the provisional Type Approval Installation Trial (prTAIT).

Evaluation of Performance

5.9 Evaluation of performance shall be demonstrated by:

- (i) Provisional Type Approval Installation Trial (prTAIT) in accordance with Annex 5C.
- (ii) Factory Production Control (FPC) in accordance with Annex 5A.

Annex 5A

(normative)

Factory Production Control

5A.1 GENERAL

The product manufacturer/Contractor shall establish, document and maintain a Factory Production Control (FPC) system to ensure that the PRMS/LSRS placed on the market conforms to the stated performance characteristics. The FPC system shall consist of procedures, regular inspections and tests and/or assessments and the use of the results to control incoming materials, equipment, the production process and the product. Alternative tests to those referred to in this Standard may be used for Factory Production Control, provided they have been shown to correlate.

Where the product manufacturer/Contractor purchases constituent materials or has the PRMS/LSRS designed, or parts of the production or testing carried out by subcontracting, the FPC of the supplier or subcontractor may be taken into account. However, where this occurs, the product manufacturer/Contractor shall retain the overall control of the PRMS/LSRS and ensure that he receives all the information that is necessary to fulfil his responsibilities according to this Standard. The Contractor who sub-contracts all of his activities may in no circumstances discharge his responsibilities to a sub-Contractor.

All the elements, requirements and provisions adopted by the product manufacturer/Contractor shall be documented in a systematic manner in the form of written policies and procedures. This production control system documentation shall ensure a common understanding of conformity evaluation and enable the achievement of the required component characteristics and the effective operation of the production control system to be checked.

Factory Production Control therefore brings together operational techniques and all measures allowing maintenance and control of the conformity and performance of the PRMS/LSRS with its technical requirements. Its implementation may be achieved by controls and tests on measuring equipment, constituents, processes, machines and manufacturing equipment and finished components, including material properties of components, and by making use of the results thus obtained.

A product manufacturer/Contractor who has a Factory Production Control which complies with IS EN ISO 9001 and made specific to this Standard shall be deemed to satisfy the requirements of this Annex.

5A.2 GENERAL REQUIREMENTS

The FPC system shall at least fulfil the requirements as described in the Clauses of IS EN ISO 9001 specified in Table 5A.1, where applicable:

Column	1	2	3
Line	Sub-clauses of IS EN ISO 9001:2000	Subject	Sub-clause in this Standard for additional requirements or information
1	7.5	Documented information	5A.3.2
2	5.1.1 e)	Leadership and commitment – general	5A.3.3
3	5.3	Organizational roles, responsibilities and authorities	5A.3.4
4	5.3	Organizational roles, responsibilities and authorities	
5	7	Support for FPC system including resources, competence, awareness and communication	
6	8.1 except 8.1a)	Operational planning and control	
7	8.2.1 c)	Purchaser feedback	
8	8.3	Design and development of products and services	5A.3.5
9	8.4	Control of externally provided processes, products and services	
10	8.5	Production and service provision	5A.3.6
11	7.1.5	Monitoring and measuring resources	5A.3.7
12	8.6	Release of products and services	5A.3.8
13	8.7 10.2	Control of nonconforming outputs Nonconformity and corrective action	5A.3.9
14	10.2	Nonconformity and corrective action	5A.3.10

⁷Table 5A.1 – Clauses of IS EN ISO 9001 to be addressed in the FPC

The FPC system may be part of a Quality Management system, e.g. in accordance with IS EN ISO 9001.

5A.3 PRODUCT SPECIFIC REQUIREMENTS

5A.3.1 General

The requirements set out in this sub-clause provide product specific details.

5A.3.2 Records

Records shall be stored in such a way that they are retrievable and maintained for a minimum period of 5 years from the date of production.

5A.3.3 FPC System

The FPC system shall:

- Ensure consistency with the requirements of this Standard;
- Ensure that the PRMS/LSRS placed on the market conform with the stated performance characteristics;
- Comply with the Clauses of IS EN ISO 9001 listed in Table 5A.1.
- Document and demonstrate the testing frequencies regime (see Annex 5B).

⁷ Amended as per Amendment No. 1, Item 7

5A.3.4 Responsibility and Authority

The responsibility and authority of personnel shall be defined for personnel who have authority to:

- Determine that the PRMS/LSRS complies with the requirements of this Standard.

NOTE 1: An individual may exercise such supervision over a number of sites.

5A.3.5 Design Process

The design procedure used shall be documented.

Reference to a standard procedure, if used, shall be sufficient.

Information on the traffic category and properties of the existing road can be supplied by the Employer.

5A.3.6 Process Control

The Contractor shall produce a works proposal for each site or group of sites for the production and installation of PRMS/LSRS. The Contractor's management shall have a working knowledge of, and access to, all relevant documentation including the Contract and relevant NRA Standards.

Before site work commences the Contractor shall ensure that the following are documented and issued to the appropriate production personnel:

- Any special instructions to the site staff relating to the programme of work;
- The equipment required for the work and the method of working to meet the requirements of the contract;
- Any additional instructions including application requirements.

Actions to be controlled:

- Cleanliness of substrate;
- Preparatory work based on weather conditions;
- Conformity of materials purchased to Specification requirements;
- Materials identification;
- Operation and maintenance of application equipment within documented tolerances;
- The use of competent personnel during the production of the PRMS/LSRS;
- A system for handling and taking account of any changes made;
- Record of the road surface condition prior to installation of the PRMS/LSRS and any local variations to the works proposal;
- Procedure and time scale for notifying the Employer of any problems which may affect the work (issues which may require deviation from the original specification);
- Activities to maintain the product until the work is handed to the purchaser.

NOTE: Records should be kept of the operation on site that could affect the performance of the PRMS/LSRS, covering the period shortly before operations commence until the opening of the site to unrestricted normal traffic. These records should contain the following:

- Variations from the original works proposal including those necessitated by site conditions;
- Unforeseen problems (weather conditions, emergency vehicle damage, etc.);
- Weather information;
- Any other information considered relevant to the performance of the product;
- Traffic control measures;
- Complaints from the public.

5A.3.7 Control of Equipment, Monitoring and Measuring Devices

Procedures shall be documented for ensuring that test, monitoring and measuring equipment continues to function properly within the tolerances stated in the Contractor's documented procedures.

All equipment used in the manufacturing process shall be regularly inspected and maintained to ensure use, wear or failure does not cause inconsistency in the manufacturing process.

Rapid checks on the functionality of test equipment may be used e.g., checking a balance with a standard mass.

5A.3.8 Monitoring and Measurement of product

The Contractor shall establish procedures to ensure that the production tolerances allow for the product performances to be in conformity with the values derived from the prTAIT process.

The characteristics and the means of verification are given in Table 5A.2.

5A.3.9 Non-Conforming products

The Contractor shall have written procedures which specify how to deal with non-conforming products. Any such events shall be recorded as they occur and these records shall be kept for the period defined in the Contractor's written procedures.

5A.3.10 Corrective and Remedial action

The Contractor shall have documented procedures that instigate action to eliminate the cause of non-conformities in order to prevent recurrence. Non-conformity of the PRMS/LSRS shall involve one or more of the following:

- Repair and/or remedial action to bring the product up to the required performance;
- Written acceptance of the product following agreement by the purchaser to accept the non-conforming product;
- Rejection and removal of the product.

Column	1	2	3
Line	Characteristics	Inspection procedure and minimum frequency	Notes
1	Void Content	Table 5B.7	Supplier document inspection
2	Water Sensitivity	Table 5B.7	Supplier document inspection
3	Resistance to permanent deformation	Table 5B.7	Supplier document inspection
4	Water sensitivity	Table 5B.7	Supplier document inspection
5	Frictional capacity	Table 5B.3	Supplier document inspection
6	Resistance to abrasion	Table 5B.3	Supplier document inspection
7	Dangerous substances ¹	Incoming materials	
Notes			
¹ An informative database of European and national provisions on dangerous substances is available at the Construction web site on EUROPA (accessed through http://europa.eu.int/comm/enterprise/construction/internal/dangsub/dangmain.html).			

Table 5A.2 – Assessment of performance characteristics

Annex 5B

(normative)

Minimum inspection/test frequencies for FPC

Column	1	2	3	4
Line	Control Area	Inspection/Test	Purpose	Minimum frequency
1	Chipping stocks	Visual	To check for contamination and moisture content	Prior to first use
2	Cold feed bins	As set out in quality plan	To ensure correct feeding of plant	a) On installation b) As set out in quality plan
3	Binder stocks	Visual and temperature for binders	To check storage conditions	Every production day
4	Binder	Tank temperature penetration or softening point	To check storage temperature To check for binder hardening ¹	a) Daily b) In case of doubt
5	Mixed asphalt	Temperature	To ensure temperature conforms	Every batch or continuously
6	Equipment	Visual	Check for contamination and cleanliness	Before starting application
Notes				
¹ Binder can harden during storage, particularly when circulated. The quality plan shall state the 'safe' storage period for binder in its tank configuration and require testing if that period is exceeded without fresh deliveries. In the absence of other information, a period of two weeks shall be adopted.				

Table 5B.1 — Process control minimum inspection schedule

Column	1	2	3	4
Line	Item of plant/equipment	Inspection/test	Purpose	Minimum frequency
1	Weighing equipment	Visual inspection as described in procedures	To ascertain that weighing equipment is functioning correctly	Daily
		Testing of weighing accuracy — (recalibration)	To ensure accuracy within quality plan requirements	a) On installation ¹ b) Every year c) In case of doubt
2	Admixture dispensers	Organoleptic inspection	To ascertain that dispenser is functioning correctly	First batch of the day containing admixture
		Test for accuracy as described in procedures.	To ensure accuracy within quality plan requirements	a) On installation ¹ b) Every year c) In case of doubt
3	Flow meters	Comparison of the actual amount with the metered amount by reconciliation	To ensure accuracy within quality plan requirements	a) On installation ¹ b) Every year c) In case of doubt
4	Batching system (on batch plants)	Comparison of actual mass of constituents in the batch with the intended mass using the method prescribed in the quality plan	To ascertain the batching accuracy in accordance with the quality plan	a) On installation ¹ b) Every year c) In case of doubt
5	Proportioning system (on continuous plants)	Comparison of actual mass in a measured period of time with the intended mass using the method prescribed in the quality plan	To ascertain the accuracy in accordance with the quality plan	a) On installation ¹ b) Every year c) In case of doubt
6	Temperature, monitoring equipment	Visual as described in procedures	To ascertain the equipment is functioning correctly	Daily
		Test of accuracy as described in procedures.	To ensure correct temperatures are recorded	a) On installation ¹ b) Every year c) In case of doubt
Notes				
'In case of doubt' refers to the reasonable judgement of an experienced plant operator				
¹ Or after comprehensive repair.				

Table 5B.2 — Plant and equipment calibration requirements

Column	1	2	3	4
Line	Inspection/test	Purpose	Normative references	Minimum frequency
1	Tests for intrinsic properties of aggregate (strength, PSV, etc.)	To check suitability for intended use	IS EN 13043	Source approval before initial use ¹
2	Sieve analysis and flakiness index	To assess compliance with standard or other agreed grading (e.g. material passing a 0,5 mm sieve)	IS EN 13043	a) First delivery from new source b) In case of doubt following stockpile check c) 1 per 2000t
3	Inspection of delivery ticket ²	To check consignment is as ordered and from correct source	As described in the quality plan	Each delivery
4	Organoleptic check of stockpile ³	For comparison with normal appearance with respect to source, grading, shape and impurities	As described in the quality plan	Each day deliveries are made
5	Shape, crushed particle index, etc.	To assess compliance with standard or other agreed specification	IS EN 13043	a) First delivery from new source. b) In case of doubt c) As indicated in quality plan
6	Moisture content	Process control	IS EN 1097-5	As indicated in the quality plan

Notes

¹ Results of tests and inspections by the aggregate supplier, as part of his Factory Production Control (when included in producer's FPC), may be used to satisfy the requirements of this table.

² These requirements will not apply in the case of direct supplies from an aggregate production unit to an asphalt plant on the same site.

³ This table may include the results of tests and inspections by the supplier as part of his Factory Production Control.

Table 5B.3 — Minimum inspection and test frequencies for aggregates

Column	1	2	3	4
Line	Inspection/test	Purpose	Normative references	Minimum frequency
1	Tests for intrinsic properties of filler (bulk density, stiffening properties etc.)	To check suitability for intended use	IS EN 13043	Source approval before initial use
2	Inspection of delivery ticket	To check consignment is as ordered and from correct source	As described in the quality plan	Each delivery
3	Sieve analysis	To check compliance with standard or other agreed grading	IS EN 13043	a) First delivery from new source b) As indicated in the quality plan

Notes

¹ This table may include the results of tests and inspections by the supplier as part of his Factory Production Control.

Table 5B.4 — Minimum inspection and test frequencies for filler¹

Column	1	2	3	4
Line	Inspection/test	Purpose	Normative references	Minimum frequency
1	Tests for intrinsic properties of binder	To confirm the characteristics of the product and the conformity to the appropriate specification	IS EN 12591	Source approval before initial use ²
2	Grade properties (penetration, softening point or viscosity)	To assess compliance agreed Contractor requirements	As described in the quality plan	1 per 300t
3	Inspection of delivery ticket	To check consignment is as ordered and from correct source	As described in the quality plan	Each delivery
4	Temperature	To check that binder is with permitted temperature limits	As described in the quality plan	Each delivery
5	Organoleptic check (by sample or tank inspection)	For comparison with normal perceptible properties	As described in the quality plan	Each delivery or daily in tanks
Notes				
¹ This table may include the results of tests and inspections by the supplier as part of his Factory Production Control.				
² Results of tests and inspections by the supplier, as part of his Factory Production Control, may be used to satisfy the requirements of this table. Any samples shall be stored in such a manner that deterioration is kept to a minimum.				

Table 5B.5 — Minimum inspection and test frequencies for binders¹

Column	1	2	3	4
Line	Inspection/test	Purpose	Normative references	Minimum frequency
1	Tests for intrinsic properties of other constituents or additives	To confirm characteristics of product or check compliance with specification	As described in the quality plan	a) Source approval prior to initial use b) As stated in the quality plan Updated in accordance with FPC ²
2	Inspection of delivery ticket	To check consignment is as ordered and from correct source	As described in the quality plan	Each delivery
3	Organoleptic check of consignment	For comparison with normal appearance etc.	As described in the quality plan	Each delivery, if practicable; otherwise in accordance with quality plan
Notes				
¹ This table may include the results of tests and inspections by the supplier as part of his Factory Production Control.				
² Results of tests and inspections by the supplier, as part of his Factory Production Control, may be used to satisfy the requirements of this table. Any samples shall be stored in such a manner that deterioration is kept to a minimum.				

Table 5B.6 — Minimum inspection and test frequencies for other constituents and additives¹

Column	1	2	3	4
Line	Inspection/test	Purpose	Normative references	Minimum frequency
1	Organoleptic check on mixed asphalt	For comparison with normal appearance with respect to grading, evenness of mixing and adequacy of coating	As described in the quality plan	Every load
2	Temperature	To ensure material conforms with specification or other requirements	As described in the quality plan	a) As required under 5.3 b) Whenever samples are taken
3	Grading and binder content	To ensure material conforms to specification	As described in the quality plan	As detailed in quality plan
4	Other characteristics included in technical specifications	To assess conformity	NRA Series 900 and as described in the quality plan	As detailed in quality plan
5	Suitability of delivery vehicles by visual assessment	To check adequacy of transportation	As described in the quality plan	Prior to first use a in case of doubt
6	Cleanliness of delivery vehicles by visual assessment	To avoid contamination	As described in the quality plan	Every load prior to loading

Table 5B.7 — Minimum inspection and test frequencies for PRMS product

Annex 5C

(normative)

Provisional Type Approval Installation Trial (prTAIT)

5C.1 GENERAL

The Contractor shall carry out one Provisional Type Approval Installation Trial (prTAIT) to cover each traffic category where he wishes to place a PRMS/LSRS on the market.

5C.2 REQUIREMENTS

The prTAIT shall be carried out for each traffic category defined in Table 5C.1. The prTAIT shall consist of a defined section where a PRMS/LSRS has been installed and which has been subjected to visual assessment over a period of one year.

A prTAIT shall comprise of visual assessments, demonstrating the performance characteristics of a defined section of PRMS/LSRS constructed in accordance with the requirements of this Standard for a particular traffic category as per Table 5C.1.

The prTAIT shall verify the performance of a PRMS/LSRS where the requirements for joints coinciding with either lane edge marking or the lane marking, as specified in NRA Series 900 Clause 10.3.3.7, are amended.

To gain approval for the PRMS/LSRS, the Contractor shall submit a works proposal detailing the site location, extent of defects, and the design and installation of the PRMS/LSRS in accordance with his documented Factory Production Control System (Annex 5A). The Contractor shall record all the data required by the FPC and any additional data required by this Standard. In addition, and in advance of the Works, the works proposal should also contain any other relevant information, including the following:

- a) Test certificates giving details of the properties of each system proposed, including the data specified in this Standard and NRA Series 900.
- b) Properties and benefits of any additives used or additional materials applied to the compacted surface (LSRS only).
- c) Storage, handling and transport procedures and requirements suitable for installing the PRMS/LSRS.
- d) Weather conditions (dry/wet, temperature, etc.) suitable for installing the PRMS/LSRS.
- e) Trafficking requirements for the PRMS/LSRS to include the duration between completion of installation and opening to traffic noting any restrictions.

Prior to opening to traffic, measurement of pavement surface macrotexture shall be carried out in accordance with NRA Series 900 Clauses 10.3.3.10/10.3.4.7 (whichever is applicable).

5C.2.1 prTAIT for PRMS/LSRS

When a PRMS/LSRS is first installed the repair area shall undergo monitoring for one year from the date of opening to traffic to determine the product/system's durability. The extent of any defects shall be determined by visual inspection in accordance with Clauses 5.18 – 5.38.

The prTAIT is completed by carrying out visual assessments on the PRMS/LSRS, on site, at intervals of 1 month, 6 months and 12 months after opening to traffic.

Prior to the commencement of a visual assessment, the Contractor shall consult with the National Roads Authority in order to agree an approach to undertaking the assessment.

The Contractor's approach shall propose the use of competent personnel to undertake the assessment(s) and the methodology for conducting the assessment(s) e.g., Laser Crack Measurement System, High Definition video, site walk, etc.

Where no defects are recorded in the repair area, the performance of the PRMS/LSRS shall be deemed as suitable. Should any defects be noted, their location and extent of shall be recorded. The repair area shall be deemed as unsuitable if the maximum permitted value of defects in any category is exceeded.

5C.2.2 Further Installation of PRMS/LSRS

Subject to the approval of the National Roads Authority Head of Standards, further use of a PRMS/LSRS that is undergoing monitoring in accordance with this Standard may be permitted in other locations. These locations shall be on a traffic category, as defined in Table 5C.1, which is the same or lower than the initial repair.

Use of PRMS/LSRS under such conditions shall only be permitted after the initial repair works has been carried out in accordance with the requirements of this Standard and monitored successfully for a one month period with the repair deemed suitable in compliance with the requirements of the prTAIT.

Until such time as the full requirements of the prTAIT are met these further installations shall be undertaken at the risk of the product/system manufacturer and/or Contractor.

5C.2.3 System Failure and Remediation

Should the performance of the PRMS/LSRS not be deemed suitable in accordance Clauses 5.18 – 5.43, the product manufacturer and/Contractor shall be obliged to replace the repair area in accordance with Clause 702.10 of the NRA MCDRW, Volume 1 Specification for Road Works, Series 700. This shall be deemed as a PRMS/LSRS failure.

In the event of the system failing, the Contractor shall notify the Employer's Representative immediately of the failure.

Should the performance of the PRMS/LSRS be deemed unsuitable in accordance with Clauses 5.18 – 5.43, the PRMS/LSRS shall not be permitted for further use on the traffic category of the National Roads network where the failure occurred or any higher categories. If subsequently proposed for use on a traffic category which is lower than where the previous failure occurred, the PRMS/LSRS will be required to fully comply with NRA Series 900 and the procedures in this Standard. Traffic categories shall be defined in accordance with Table 5C.1.

5C.2.4 prTAIT Completion

Providing previous inspections have confirmed suitability of the PRMS/LSRS, a final visual assessment shall be carried out after one year after opening to traffic. Where no defects are recorded in the repair area, the PRMS/LSRS shall be deemed suitable for further use on the same National Road traffic category upon which the assessed repair was installed. If the PRMS/LSRS is deemed to be suitable, the PRMS/LSRS will also be deemed suitable for use on lower traffic categories.

Should the PRMS/LSRS be deemed suitable 12 months after opening to traffic, any further repairs on the same or lower traffic category shall not be required to undergo the requirements of the prTAIT. However the PRMS/LSRS shall continue to comply with the testing and workmanship requirements of NRA Series 900.

Traffic categories shall be defined in accordance with Table 5C.1. If the PRMS/LSRS is deemed to be suitable at a certain traffic category, it will also be deemed suitable for use on any lower traffic categories.

Once testing has been completed the Contractor shall confirm in writing to the NRA Representative that the Works have been installed as per the manufacturer's and/or Contractor's requirements and the testing conducted complies with the requirements of this Standard.

Column	1	2	3	4	5	6	7	8	9	10	11
Line	Traffic Category ¹	Commercial Vehicles per Lane per Day									
1		0 - 25	26 – 50	51 - 125	126 - 250	251 - 500	501 - 750	751 - 1000	1001 - 2000	2001 - 3000	> 3000
Notes											
¹ Traffic Category at time of repair works											

Table 5C.1 — Traffic Categories for monitoring of PRMS and LSRS

5C.3 DATA RECORDED

The data recorded for a prTAIT shall include the following information:

- a) Company (name, address, phone number etc.);
- b) Date of prTAIT;
- c) Location of prTAIT (road number, start and end points);
- d) Intended use;
- e) Description of type of system (PRMS/LSRS), material used, layer thicknesses, compaction methods;
- f) Storage, handling and transport procedures and requirements;
- g) The properties of additives and additional materials [for LSRS only];
- h) Weather conditions at the time of installation;
- i) Locations of longitudinal and transverse joints within lane;
- j) Production office (name, address, phone number etc. (where different from ‘Contractor’));
- k) Relevant test certificates of system(s) used (including the data specified in NRA Series 900), FPC documentation for the section used for the prTAIT;
- l) The time duration between completion of installation and the installation site opening to live traffic noting any restrictions;
- m) After one, six and twelve months, visual assessment as described in Table 5.1 shall be recorded;
- n) Name of producer’s representative responsible for prTAIT.

Copies of all documentation relating to the PRMS and LSRS shall be supplied to the NRA Representative by the Contractor at the following work stages:

- Submission of the works proposal;
- Opening of repair area to traffic;
- Each inspection during the prTAIT process;
- Completion of remedial works (if required).

Upon completion of each stage, records shall be submitted to the NRA Representative within 7 days.

5C.4 INFORMATION AVAILABILITY

The information from a prTAIT shall be kept and stored securely. If the data is lost the prTAIT shall no longer be valid.

PRMS AND LSRS – VISUAL ASSESSMENT OF DEFECTS

General

- 5.10 This part of NRA HD 301 specifies qualitative and quantitative test methods of the visual assessment of defects of PRMS and LSRS.
- 5.11 As PRMS and LSRS are not covered by a harmonised European Standard, the layout of this Chapter (and in particular its Annexes) is intended to be compatible with the layout of European Standards.
- 5.12 The visual assessment reports for both methods have identical records and thus both may be used to check for visual assessment of defects.
- 5.13 Defects emanating from the substrate (existing road) must not be taken into consideration.
- 5.14 The procedures detailed in this Standard (and indicated by the sample flowchart in Annex 5D) shall be followed for a one year period after the repair area is opened to traffic. This period shall be referred to as the 'Monitoring Period'.

NOTE 1: The qualitative and quantitative tests may be used separately or sequentially. This may relate to different types of sites (for example lightly trafficked roads may not be required to be quantitatively assessed).

NOTE 2: The test may be used to evaluate the durability of the PRMS/LSRS.

Normative references

- 5.15 The following referenced documents are indispensable for the application of this Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 13043, *Aggregates for bituminous mixtures and surface treatments for roads, airfields and other trafficked areas*

Terms and Definitions

- 5.16 This Clause includes terms and definitions not included in NRA Series 900. For other terms and definitions refer to NRA Series 900 Clause 1.7.

Bump (ridge)

Transverse or longitudinal raised area.

NOTE 1: This may be caused by overlap during installation.

Corrugation

Transverse undulations at more or less regular spacing (the area encompassing the corrugation is measured).

Defect

State of the PRMS/LSRS in the case of delamination, loss of material, wearing, lane joint gaps and rutting (P₁) or corrugation, bumps and ridges (P₂).

NOTE 1: A defect can occur due to poor construction techniques.

Delamination

Detachment of the PRMS/LSRS from the underlying road or from a lower layer of a multi-layer surfacing.

Lane joint gaps

Incomplete layer of slurry surfacing between adjacent lanes.

Loss of material

Loss of material due to the action of traffic before the PRMS/LSRS has gained sufficient strength or by stripping of the binder from the aggregate.

NOTE 1: Any defects on existing material adjacent to the repair area shall not be used to influence monitoring of the PRMS/LSRS. Furthermore defects noted during monitoring of the PRMS surface arising from obvious oil spill, fire or vehicle collisions shall not be deemed as a defect with which the product manufacturer/Contractor has responsibility for rectifying.

Rutting

Permanent deformation, by flow, of the slurry surfacing layer, which occurs in the wheel tracks.

Wearing and loss of slurry surfacing

Loss of mass of material.

Symbols and Abbreviations

5.17 For the purposes of this Standard, the following symbols apply.

- | | |
|--------|--|
| A_1 | is the sum of the areas of delamination, loss of material, wearing, lane joint gaps and rutting in the PRMS/LSRS section being considered, in square metres (m^2); |
| A_2 | is the sum of the areas of corrugation, bumps and ridges in the PRMS/LSRS section being considered, in square metres (m^2); |
| D | is the upper aggregate sieve size of the PRMS/reconstituted surfacing material (as in EN 13043); |
| FPC | Factory Production Control; |
| P_1 | the proportion of area of delamination, loss of material, wearing, lane joint gaps, rutting and slippage in the PRMS/LSRS section being considered expressed as a percentage of the area of the section; |
| P_2 | the proportion of area of corrugation and bumps in the PRMS/LSRS section being considered expressed as a percentage of the area of the section; |
| S | is the area of PRMS/LSRS section, in square metres (m^2); |
| prTAIT | Provisional Type Approval Installation Trial; |
| PSV | Polished Stone Value; |
| W | is the mean width of lane, in metres (m). |

Visual Assessment of Defects

General

- 5.18 The visual assessment of defects according to this part of NRA HD 301 shall be used for the essential characteristics of the PRMS/LSRS.
- 5.19 Measurement of pavement surface macrotexture shall be carried out in accordance with NRA Series 900 Clauses 10.3.3.10/10.3.4.7 (whichever is applicable).
- 5.20 Visual assessment of defects shall be carried out at 1, 6 and 12 months after the installation, using the quantitative method outlined in this Standard.
- 5.21 The section reference shall be recorded in Annexes 5E and 5F. Sections may be located anywhere along the road except that they shall not overlap. The remainder of the site that is not chosen for testing or the area between sections is deemed to be without defects at the time the test is carried out.

Qualitative Assessment

Procedure

- 5.22 The qualitative assessment uses the visual assessment report as given in Annex 5E.
- 5.23 Determine the section where the visual assessment is to be made.
- 5.24 For the defect being considered, if there is none detected by this qualitative visual assessment then “none” should be reported according to Annex 5E.

Area defects

- 5.25 Estimate the area S of the PRMS/LSRS section.

Delamination, loss of material, wearing, lane joint gaps and rutting

- 5.26 The areas of these defects shall be estimated and recorded. A_1 is the sum of these defects. P_1 is A_1 divided by S as a percentage (see 5.41, equation (1)). P_1 shall be recorded according to Annex 5E.

Corrugation, bumps and ridges

- 5.27 Bumps and ridges can be considered as defects if their height above the surrounding material is equal to or greater than 20 mm.

NOTE: Corrugations can be considered as defects if the amplitude (peak to trough) measured by laying an approximately 1m long straightedge is greater than 5mm and the distance between the two adjacent wave peaks is between approximately 50mm and 200mm.

- 5.28 The total area encompassing the corrugation is assessed. The areas of these defects shall be estimated and recorded. A_2 is the sum of the areas of these defects. P_2 is A_2 divided by S as a percentage (see 5.42, equation (2)). P_2 shall be recorded according to Annex 5E.

All other area defects

- 5.29 The area of these may be recorded for information but shall not be included in the overall assessment of the PRMS/LSRS.

Quantitative Assessment

Procedure

- 5.30 The quantitative assessment uses the table of results as given in Annex 5F.
- 5.31 Determine the section where measurement is to be made.
- 5.32 Measure the width of the section in metres to 0,1 m at 3 positions along the section at regular intervals to obtain a mean value W for determining the area of section S .
- 5.33 Measure the length of each defect to the nearest 0,1 m and its width to the nearest 0,05 m.

Area defects

- 5.34 Area defects shall be assessed individually.
- a) Rectangular shape: Calculate the surface area of a rectangular shaped defect by multiplying the length by the width.
- b) Non-rectangular shape: Calculate the surface area of a non-rectangular shaped defect by multiplying the maximum length by 0,8 times the maximum width.

Delamination, loss of material, wearing, lane joint gaps and rutting

- 5.35 The areas of these defects shall be estimated and recorded. A_1 is the sum of these defects. P_1 is A_1 divided by S as a percentage (see 5.41, equation (1)). P_1 shall be recorded according to Annex 5F.

Corrugation, bumps and ridges

- 5.36 Bumps and ridges can be considered as defects if their height above the surrounding material is equal to or greater than 20 mm.

NOTE: Corrugations can be considered as defects if the amplitude (peak to trough) measured by laying an approximately 1m long straightedge is greater than 5mm and the distance between the two adjacent wave peaks is between approximately 50mm and 200mm.

- 5.37 The total area encompassing the corrugation is assessed. The areas of these defects shall be estimated. A_2 is the sum of the areas of these defects. P_2 is A_2 divided by S as a percentage (see 5.42, equation (2)). P_2 shall be recorded according to Annex 5F.

All other area defects

- 5.38 The area of these may be recorded for information but shall not be included in the overall assessment of the PRMS/LSRS.

Expression of Results

Values

- 5.39 The visual assessment of defects for PRMS/LSRS has two values:

- P_1 the proportion of area of delamination, loss of material, wearing, lane joint gaps, rutting and slippage in the PRMS/LSRS section being considered expressed as a percentage of the area of the section; and
- P_2 the proportion of area of corrugation and bumps in the PRMS/LSRS section being considered expressed as a percentage of the area of the section.

Assessment

5.40 The table of results is completed with measurements of P_1 and P_2 are reported (see Annex 5F).

Delamination, loss of material, wearing, lane joint gaps and rutting

5.41 Calculate the total area of delamination, loss of material, wearing, lane joint gaps and rutting in the section expressed as a percentage, from equation (1):

$$P_1 = 100 \times (A_1 / S) \quad (1)$$

Where:

P_1 is the proportion of area of delamination, loss of material, wearing, lane joint gaps and rutting in the section being considered, expressed as a percentage (%), of the area of the section;

A_1 is the sum of the areas of delamination, loss of material, wearing, lane joint gaps and rutting in the section being considered, in square metres (m^2);

S is the area of the section of PRMS/LSRS, in square metres (m^2).

Corrugation, bumps and ridges

5.42 Calculate the total area of corrugation, bumps and ridges in the section expressed as a percentage, from equation (2):

$$P_2 = 100 \times (A_2 / S) \quad (2)$$

Where:

P_2 is the proportion of area of corrugation, bumps and ridges in the section being considered, expressed as a percentage (%), of the area of the section;

A_2 is the sum of the areas of corrugation, bumps and ridges in the section being considered, in square metres (m^2);

S is the area of the section of PRMS/LSRS, in square metres (m^2).

Test report

5.43 The test report shall refer to this Standard. The qualitative test shall contain the information detailed in Annex 5E. The quantitative test when carried out shall contain the information detailed in Annex 5F.

NOTE: The report may include other useful information about the defect such as the amplitude and wavelength of any corrugations or macrotexture of fatting up areas in order to indicate the severity of the defect.

Annex 5D

(informative)

Example Approach for Monitoring Phase Procedures for PRMS and LSRS

The flowchart below is an example layout. Other items may be included. The information that is required in this Annex is the minimum information that shall be provided. The information is normative, the layout is informative.

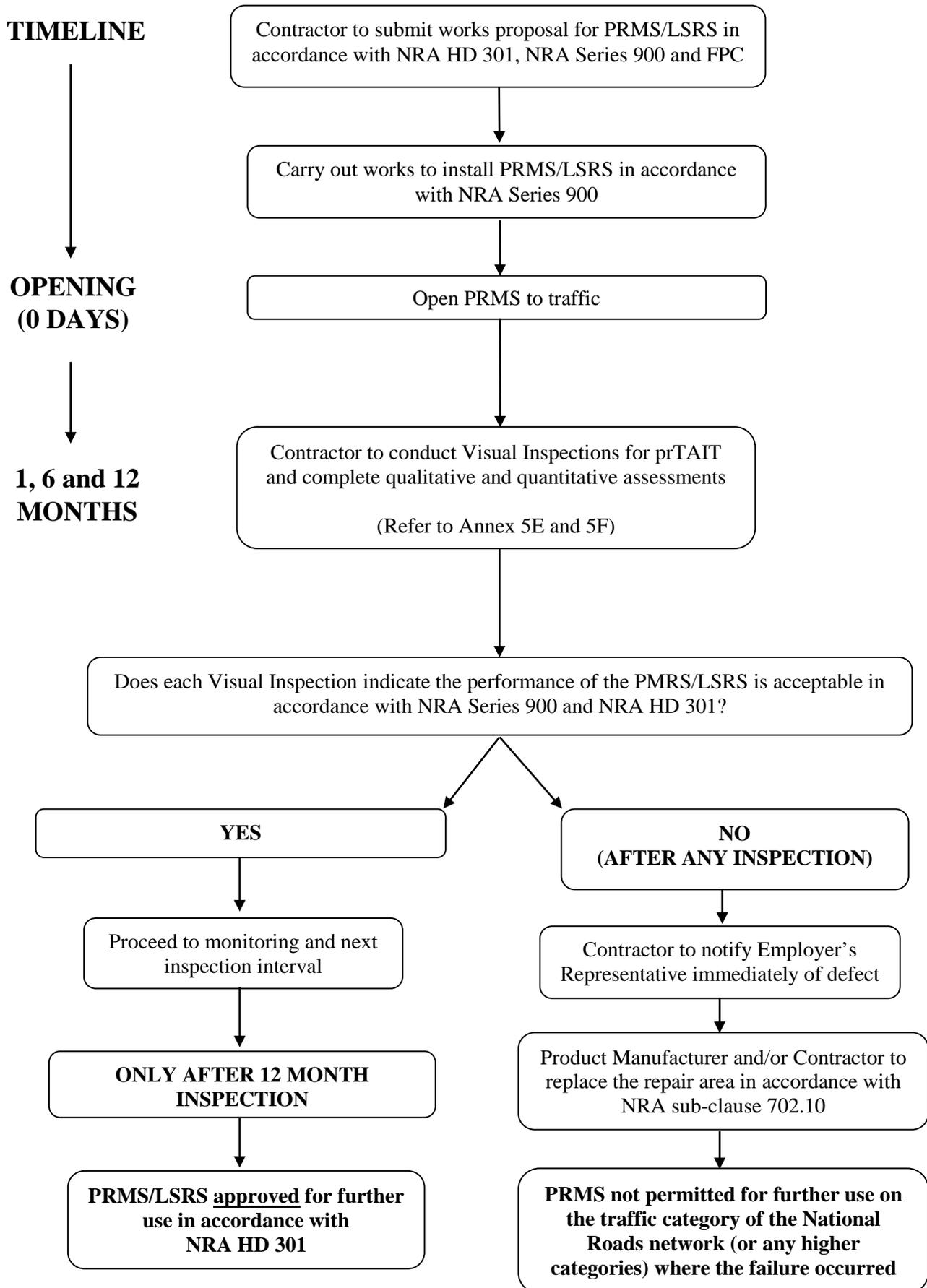


Figure 5D.1 – Flowchart for example approach for monitoring phase procedures for PRMS and LSRS

Annex 5E

(normative)

Qualitative assessment – Estimated method

The report below is an example of a suitable layout. Other data may be included. The information that is required in this Annex is the minimum information that shall be provided. The information is normative, the layout is informative.

Qualitative Visual Assessment Report (– estimated)

Client:Contractor:

Reference of the site:Total surface area of site: m²

Reference of the part where system installed and date of installation:

Type of system (PRMS/LSRS):
.....

Reference of the section and traffic category			
Lane reference			
Exact place of inspection			
Estimated mean width of section	m	W	
Estimated area of section S	m ²	S	
Defects – visual estimate of areas and lengths:			
Delamination, loss of material, wearing, lane joint gaps and rutting (Cl. 5.26)	m ²	A ₁	
$P_1 = 100 \times (A_1 / S)$	%	P ₁	
Corrugation, bumps and ridges (Cl. 5.28)	m ²	A ₂	
$P_2 = 100 \times (A_2 / S)$	%	P ₂	

Remarks:

Date of assessment:

Name of the person responsible for assessment:

Signature:

Annex 5F

(normative)

Quantitative assessment – Measured method

The report below is an example of a suitable layout. Other data may be included. The information that is required in this Annex is the minimum information that shall be provided. The information is normative, the layout is informative.

Quantitative Visual Assessment Report (– measured)

Client: Contractor:

Reference of the site: Total surface area of site: m²

Reference of the part where system installed and date of installation:

Type of system (PRMS/LSRS):
.....

Reference of the section and traffic category			
Lane reference			
Exact place of inspection			
Estimated mean width of section	m	W	
Estimated area of section S	m ²	S	
Defects – visual estimate of areas and lengths:			
Delamination, loss of material, wearing, lane joint gaps and rutting (Cl. 5.35)	m ²	A ₁	
$P_1 = 100 \times (A_1 / S)$	%	P ₁	
Corrugation, bumps and ridges (Cl. 5.37)	m ²	A ₂	
$P_2 = 100 \times (A_2 / S)$	%	P ₂	

Remarks:

Date of assessment:

Name of the person responsible for assessment:

Signature:

6. REFERENCES

6.1 NRA Design Manual for Road and Bridges (NRA DMRB):

- a) NRA HD 28 (NRA 7.3.1): Pavement Design and Maintenance, Management of Skid Resistance.
- b) NRA HD 300 (NRA 7.2.6): Pavement Design Manual.

6.2 NRA Manual for Contract Documents for Road Works (NRA MCDRW):

- a) NRA MCDRW Volume 1, NRA Specification for Road Works, Series 900: Road Pavements – Bituminous Materials.
- b) NRA MCDRW Volume 1, NRA Specification for Road Works, Series 700: Road Pavements – General.

6.3 National Standards Authority of Ireland Publications:

- a) IS EN 1097-5, *Tests for Mechanical and Physical Properties of Aggregates - Part 5: Determination of the Water Content by Drying in a Ventilated Oven*
- b) IS EN 1427, *Bitumen and Bituminous Binders - Determination of the Softening Point - Ring and Ball Method*
- c) ⁸IS EN ISO 9001, *Quality management systems - Requirements*
- d) IS EN 12271, *Surface Dressing – Requirements*
- e) IS EN 12272-1, *Surface dressing - Test methods - Part 1: Rate of spread and accuracy of spread of binder and chippings*
- f) IS EN 12272-2, *Surface dressing - Test methods - Part 2: Visual assessment of defects*
- g) IS EN 12273, *Slurry Surfacing - Requirements*
- h) IS EN 12274-6, *Slurry Surfacing - Test Methods - Part 6: Rate of Application*
- i) IS EN 12274-8, *Slurry Surfacing - Test Methods - Part 8: Visual Assessment of defects*
- j) IS EN 12591, *Bitumen and Bituminous Binders - Specifications for Paving Grade Bitumens*
- k) IS EN 12697-1, *Bituminous Mixtures - Test Methods for hot mix Asphalt - Part 1: Soluble Binder Content*
- l) IS EN 12697-2, *Bituminous Mixtures - Test Method For Hot Mix Asphalt - Part 2: Determination Of Particle Size Distribution*
- m) IS EN 12697-6, *Bituminous Mixtures - Test Methods for hot mix Asphalt - Part 6: Determination of Bulk Density of Bituminous Specimens*

⁸ Amended as per Amendment No. 1, Item 8

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- n) IS EN 12697-8, *Bituminous Mixtures - Test Methods For Hot Mix Asphalt - Part 8: Determination Of Void Characteristics Of Bituminous Specimens*
 - o) IS EN 12697-26, *Bituminous Mixtures - Test Methods for hot mix Asphalt - Part 26: Stiffness*
 - p) IS EN 12697-32, *Bituminous Mixtures - Test Methods For Hot Mix Asphalt - Part 32: Laboratory Compaction Of Bituminous Mixtures By Vibratory Compactor*
 - q) IS EN 12697-38, *Bituminous mixtures - Test methods for hot mix asphalt - Part 38: Common equipment and calibration*
 - r) IS EN 12697-39, *Bituminous Mixtures - Test Methods For Hot Mix Asphalt - Part 39: Binder Content By Ignition*
 - s) IS EN 12697-39, *Bituminous Mixtures - Test Methods for hot mix Asphalt - Part 39: Binder Content by Ignition*
 - t) prCEN/TS 12697-51, *Bituminous mixtures - Test methods - Part 51: Surface shear strength test*
 - u) IS EN 13036-1, *Road and airfield surface characteristics - Test methods - Part 1: Measurement of pavement surface macrotexure depth using a volumetric technique*
 - v) IS EN 13043, *Aggregates for bituminous mixtures and surface treatments for roads, airfields and other trafficked areas*
 - w) IS EN 13108-20, *Bituminous Mixtures - Material Specifications - Part 20: Type Testing*
 - x) IS EN 13108-21, *Bituminous Mixtures - Material Specifications - Part 21: Factory Production Control*
 - y) IS EN ISO 13473-1, *Characterization of Pavement Texture by Use of Surface Profiles - Part 1: Determination of Mean Profile Depth*
 - z) IS EN 14022, *Structural Adhesives - Determination of the pot Life (working Life) of Multi-component Adhesives*
 - aa) IS EN ISO 17892-1, *Geotechnical investigation and testing - Laboratory testing of soil - Part 1: Determination of water content*

7. ENQUIRIES

All technical enquiries or comments on this document, or any of the documents listed as forming part of the NRA DMRB, should be sent by e-mail to infoDMRB@nra.ie, addressed to the following:

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.....
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Engineering Standards & Research

National Roads Authority
Design Manual for Roads and Bridges
(NRA DMRB)

Amendment No. 1 (January 2016) to NRA Design Manual for Roads
and Bridges Volume 7, Section 6, Part 1

NRA HD 301 - Pavement Design and Maintenance - Approval of
Specific Products

Dated June 2015

The NRA Design Manual for Roads and Bridges (NRA DMRB) NRA HD 301, dated June 2015 is amended as follows:-

1. Page 2, Clause 2.4
Edit ISO 9001 reference to read “IS EN ISO 9001, Quality management systems — Requirements”
2. Page 7, Table 2.1
Revise cell that reads ‘*Defects in the inside wheel track*’ to read “*Defects within the wheel tracks*”
3. Page 7, Table 2.1
Revise cell that reads ‘*Defects in the outside wheel track*’ to read “*Defects outside the wheel tracks*”
4. Page 7, Table 2.1
Correct reference of ASTM Standard from ‘ASTM 1583’ to ‘*ASTM C1583*’
5. Page 11, Table 2A.1
Table columns 1 and 2 updated to reflect latest IS EN ISO 9001 publication.
6. Page 29, Clause 5.3
Edit ISO 9001 reference to read “IS EN ISO 9001, Quality management systems — Requirements”
7. Page 33, Table 5A.1
Table columns 1 and 2 updated to reflect latest IS EN ISO 9001 publication.
8. Page 54, Clause 6.3 c)
Edit ISO 9001 reference to read “*IS EN ISO 9001, Quality management systems — Requirements*”



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