Design Manual for Roads and Bridges

Road Layout
Inspection & Assessment

CS 126
Inspection and assessment of road markings and road studs

(formerly TD 26/17)

Revision 0

Summary
This document provides general information to support the inspection and assessment of the road marking and road stud asset. It specifically clarifies the risk based approach when considering renewal of these assets.

Application by Overseeing Organisations
Any specific requirements for Overseeing Organisations alternative or supplementary to those given in this document are given in National Application Annexes to this document.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Highways England team. The email address for all enquiries and feedback is: Standards_Enquiries@highwaysengland.co.uk

This is a controlled document.

Contents

Release notes

Version	Date	Details of amendments
0	Mar 2020	CS 126 replaces TD 26/17. This full document has been re-written to make it compliant with the new drafting rules.

Foreword

Publishing information

This document is published by Highways England.

This document supersedes TD 26/17 which is withdrawn.

Contractual and legal considerations

This document forms part of the works specification. It does not purport to include all the necessary provisions of a contract. Users are responsible for applying all appropriate documents applicable to their contract.

Introduction

Background

This document sets requirements for inspection regimes to be carried out for road markings and retroreflecting road studs, (including light emitting (active) road studs), on motorways and all-purpose trunk roads as agreed by the relevant Overseeing Organisation. These are necessary because:

1) if there is a failure in the performance of road markings and retro-reflecting road studs, this affects their legal status or that of an associated statutory provision;

2) proliferation of road markings can have a detrimental effect on the visual environment and comprehension by the road user;

3) the visual performance of road markings degrades over time, reducing conspicuity and legibility;

4) road safety can be affected by the reduction in the visibility and legibility of road markings;

Assumptions made in the preparation of this document

The assumptions made in GG 101 [Ref 3.N] apply to this document.

Mutual Recognition

Where there is a requirement in this document for compliance with any part of a "British Standard" or other technical specification, that requirement may be met by compliance with the Mutual Recognition clause in GG 101 [Ref 3.N].

Non-reflecting road studs and those incorporating active elements are not within the scope of BS EN 1463-1 [Ref 7.N] and require type approval to comply with the TSRGD 2016 [Ref 10.N]. SA 1 in the SA 1 [Ref 4.N] lists road stud products which have been type approved for use in the UK.

Abbreviations and symbols

Abbreviations

Abbreviation	Definition
EEA State	A state which is a contracting party to the European Economic Area Agreement.
NHSS	National Highway Sector Scheme, NHSS 7 [Ref 5.N].
TSM	Traffic Signs Manual, TSM Chapter 5 [Ref 11.N].
TSRGD	The Traffic Signs Regulations and General Directions, TSRGD 2016 [Ref 10.N].

Symbols

Symbol	Definition
Qd	Luminance co-efficient
β	Luminance factor - ratio of the luminance of a field of the road marking in a given direction to that of a perfect reflecting diffuser identically illuminated, BS EN 1436 [Ref 8.N].

Terms and definitions

Terms

Term	Definition
British Standard	Any standard published by the British Standards Institution including adopted European or other international standards.
Chromaticity	The colour of the line by reference to the chromaticity diagram in BS EN 1436 [Ref 8.N].
Contract	Legal document that states the formal agreement between two different groups, enforceable by law. In some forms of procurement this is termed as an "Agreement".
Critical area	Critical areas of the network refer to those areas of the network that can pose a risk to the road user if badly worn.
Critical defect	A defect that requires prompt attention because it represents an immediate or imminent hazard, or there is a breach of statutory duty, including where markings are not prescribed in regulations nor authorised by the relevant Secretary of State. NOTE: These have previously been referred to as a Category 1 (or Category I) defect. See Section 4 for required action.
Functional life	The period during which the road marking fulfils all the performance requirements initially specified. The life is influenced by thickness of the laid materials, the type of materials and the nature of location, including the traffic. This is either the number of roll overs identified on the product test certificate to BS EN 1824 [Ref 9.N] or as identified by the markings manufacturer.
Luminance	The property of the marking which describes the brightness of its colour, measured as either the luminance co-efficient (Qd) or luminance factor (β), as described in detail in BS EN 1436 [Ref 8.N].
Luminance co-efficient (Qd)	Luminance co-efficient under diffuse illumination is the quotient of the luminance of a field of the road marking in a given direction by the illuminance on the field (unit: $mcd/m^2/lx$).
Non-critical defect	A defect that requires replacement within a pre-defined period in line with agreements reached with the Overseeing Organisation. This has previously been referred to as a Category 2 (or Category II) defect. See Section 4 for required action.
Retroreflectivity	The ability of a road marking to reflect light from a vehicle's headlights back to the driving position of a vehicle.
Skid resistance	Measurement on road markings carried out using the standard British pendulum apparatus. BS EN 1436 [Ref 8.N] specifies skid resistance classes.
Targeted inspections	Inspections focused on specific locations to address specific local risks, or following extreme or unusual events.

1. Scope

Aspects covered

1.1 This document shall be used for the inspections of road marking and retroreflecting road studs (including light emitting (active) road studs but excluding non-reflective road studs).

1.2 The requirements in this document shall apply to all road markings and retroreflecting road studs in permanent use.

1.3 The requirements in this document shall apply to all road markings and retroreflecting road studs designed to be in use for more than 3 months in temporary situations and road works.

Implementation

1.4 This document shall be implemented forthwith on all schemes involving the inspection of road markings and retroreflecting road studs (including light emitting (active) studs), on the Overseeing Organisations' motorway and all-purpose trunk roads according to the implementation requirements of GG 101 [Ref 3.N] .

Use of GG 101

1.5 The requirements contained in GG 101 [Ref 3.N] shall be followed in respect of activities covered by this document.

2. Inspection frequencies

General

2.1 Inspection regimes shall follow a risk based approach where available data permits its adoption.

NOTE *For routes with available, accurate asset data, a cyclical approach to renewals can assist with reducing the cost and inconvenience of formal surveys.*

2.2 Where available data does not permit the adoption of a risk based approach, a fixed frequency for inspections shall be used in accordance with the requirements of the Overseeing Organisation.

2.3 The reasons for the selected approach shall be documented and retrievable, in accordance with the requirements of the Overseeing Organisation.

2.4 The format and content of risk assessments to support a risk based inspection approach shall be in accordance with the requirements of the Overseeing Organisation.

Frequency of inspections

2.5 Inspections of road markings and retroreflecting road studs shall be undertaken periodically so that the requirements of this document can be met.

NOTE *Further guidance on the methodology that can be employed in order to determine inspection frequencies is provided in Appendix A.*

2.5.1 Targeted inspections should be carried out in response to reports of extreme conditions that have the potential to increase the risk of asset damage.

NOTE *For example, a major road traffic accident or extreme weather.*

Street lighting changes

2.6 Proposals to dim street lighting, or turn off street lighting (fully or partially) either via a trial or permanently, shall be supported by a current assessment (less than 6 months) of condition of road markings and road studs.

Road markings

2.7 The selected time period for the first formal inspection shall be determined by the claimed functional life.

2.7.1 The time period may be increased or decreased depending on:

1) the characteristics of the site;
2) the product genre and actual product used; and
3) assurance of the quality of installation, including the thickness of any in-situ markings and the road surface condition.

2.8 Evidence to support the choice of timing of the first formal inspection shall be recorded in accordance with the requirements of the Overseeing Organisation.

2.9 Where a risk based inspection regime is used, the rate of deterioration of a representative sample of road markings shall be measured in order to provide a knowledge base and further evidence of risk to assist in determining the future of:

1) inspection frequencies;
2) routine renewals of road markings.

2.10 Different classes of road have different accident rates and those with poorer accident performance, or individual roads historically performing worse than expected, shall attract a higher level of importance when determining risk profiles.

Characteristics requiring inspection

2.11 An inspection regime shall be devised to determine if any of the following characteristics are to be inspected, the priorities and how often they are inspected:

1) wear;
2) retroreflectivity (dry);
3) retroreflectivity (wet);
4) colour;
5) luminance factor or luminance co-efficient; and
6) skid resistance.

2.11.1 The needs and priorities of those characteristics deemed important for any given inspection site should be assessed.

NOTE *Road markings characteristics detailed above, combined with the site characteristics, present differing inspection priorities for lit and unlit locations.*

Retroreflecting road studs

2.12 Visual inspections of retroreflective road studs shall be carried out at intervals in accordance with the requirements of the Overseeing Organisation.

2.13 Where surface break-up is apparent due to replacement roads studs being placed too close to historical stud locations, this shall be recorded on inspections.

2.14 All inspections shall be programmed to enable maintenance works to be completed before the winter season.

2.15 Inspections shall be carried out after the winter season to detect damage by snow ploughs in affected areas.

Light emitting (active) road studs

2.16 The inspection regimes for light emitting (active) road studs shall be determined in line with the manufacturers requirements.

3. Inspection methods

General

3.1 Visual assessment surveys shall be carried out to obtain an overview of performance (see Appendix B Table B.1).

NOTE *Photographic examples for visual assessments of road markings can be found in Appendix C.*

Road markings

3.2 Visual assessment surveys shall be carried out for measuring wear.

3.3 Where machine surveys are not undertaken, visual digital surveys for assessing dry nighttime retroreflectivity shall be undertaken, using the method of determining preview times and visibility distances provided in Section 5.

NOTE *Visual assessment surveys can be employed to confirm visibility of road marking preview times both in daytime and nighttime dry conditions, although on unlit roads the nighttime performance is likely to be the most important factor.*

3.4 The network shall be formally surveyed in accordance with the requirements of the Overseeing Organisation for each route and homogeneous sections of a route.

3.4.1 A mixture of survey techniques may be appropriate.

3.4.2 Visual assessment surveys may be supplemented by machine surveys and/or residual performance data taken before replacement or renewal.

NOTE *For example, detailed measurements of smaller samples can be used as supporting evidence, if generally using higher level assessment for markings known to be of similar age, traffic level and material.*

Machine surveys

3.5 All survey devices and techniques (including vehicle mounted devices and handheld spectrometer devices) shall be approved by the Overseeing Organisation and calibrated and maintained in line with the manufacturer's recommendations as described in BS EN 1436 [Ref 8.N].

NOTE *Appendix B provides additional information on the use of current survey techniques for different circumstances.*

3.6 Vehicle mounted device survey results shall be aggregated and reported over 100m lengths.

Detailed surveys and skid resistance measurement

3.7 Where planned road closures can be utilised, hand held devices shall be used to provide a primary data source for characteristics not measurable from vehicle mounted devices, as well as spot checking measurements obtained from vehicle mounted devices, i.e. retroreflectivity of longitudinal markings.

3.7.1 Hand held devices may be used on areas of the network that cannot be surveyed using vehicle mounted devices.

NOTE *For example, "STOP" and "Give Way" lines, "SLOW" markings, yellow bar markings, lane designations and exit arrows.*

3.8 Hand held devices shall be used when wet retroreflectivity data is required as described in BS EN 1436 [Ref 8.N].

3.9 Where detailed assessment is carried out, the survey area shall be split into 100m segments for record storage purposes and carrying out the following assessments:

1) wear assessment:

a) for continuous longitudinal markings, measurement of a 5m length every 20m. Results are presented as averaged values;
b) for other markings, including modular longitudinal road markings, the assessment is to be carried out on the worst worn 25% of the markings at each location. Results are presented as averaged values;

2) retroreflectivity using a handheld device (see Section B1.4 in Appendix B);
3) an assessment of the luminance. Measurement of luminance factor of structured (Type II) markings is potentially unreliable. A marking is required to meet either the threshold for luminance factor or luminance co-efficient in Appendix B Table B.2.

3.10 Skid resistance measurements shall be carried out on a representative sample of defined critical areas of the network.

3.11 Critical areas shall be defined taking into account the examples given in Appendix B Table B.3 and the condition or age of the road marking material.

3.12 Measurements shall be taken on the most trafficked areas of the road markings at each location and an average calculated.

Preview time of road markings

3.13 Where visual assessments are used to both identify defects and to provide quantifiable performance data then marking preview times shall be identified, as shown in Table 5.3.

NOTE *The preview time is the number of seconds taken to drive a distance equal to the road marking visibility distance.*

3.14 Where performing surveys to ascertain preview times, the selected survey vehicle shall replicate the circumstances of a typical vehicle and driver.

3.15 To determine accurate visibility distances in a moving vehicle, visual digital equipment shall be used and mounted at a normal driving height.

NOTE *Use of visual digital data can allow initial desktop review of road marking preview times.*

3.16 Where requested by the Overseeing Organisation independent evidence shall be provided to demonstrate that visual digital survey replicates road users' experience when obtaining preview times and distances.

Retroreflective road studs

3.17 Bi-directional retro reflecting road studs installed on single carriageway roads shall be inspected for defects in both directions.

3.18 Inspections for reflective conspicuity of retroreflecting road studs shall be carried out during hours of darkness.

3.18.1 Retroreflective road stud inspections should be carried out to be synchronized with night outage inspections referred to in TS 501 [Ref 6.N] Road lighting inspection and CS 125 [Ref 2.N] Inspection of traffic signs.

3.19 The daytime visual inspection shall be in accordance with the methods set out in Appendix B Figure B.4 for the following characteristics:

1) identification of unlawful double–studding;
2) wear, corrosion, gaps, voids, ponding, damage;
3) loose or missing studs or inserts;
4) loss of or damage to retroreflective lenses, sinkage or settlement or masking due to adjacent raised road surfacing (e.g. surface dressing);
5) detritus on lenses or masking by adhesive;

6) integrity and security of casings of "embedded" studs (housings);
7) loss of adhesion or breaking up of surface mounted road studs under traffic loading; and
8) misalignment with existing road markings.

3.20 Visual inspections for night-time performance of retroreflective road studs shall be carried out during the hours of darkness using a reference sample in accordance with the method set out in Appendix B Figure B.5.

3.21 The definition of "safety critical location" for retroreflective road studs (as shown in Appendix B, Figure B.5) shall be agreed in accordance with the requirements of the Overseeing Organisation and include the following locations:

1) regulatory markings e.g. double white lines, solid edged ghost islands;
2) lay-bys, including emergency areas;
3) merge and diverge tapers;
4) roads where the horizontal alignment constitutes a departure from standard from CD 109 [Ref 1.N]; and
5) light emitting (active) road stud locations.

3.22 Retroreflective road stud inspections shall be arranged (with specific road closures) where significant groupings of displacement have occurred.

NOTE *For example, 3 or more consecutive road studs.*

3.23 Wear along the shoulders of the casting shall be checked when re-rubbering into existing inset castings, of embedded retroreflective road studs.

3.23.1 Re-rubbering into a worn casting may cause accelerated wear of the insert and can lead to its insert becoming detached.

4. Defect categories

4.1 Defects shall be categorised as critical or non-critical, using the requirements of this document, including the methodology given in Appendix B.

4.2 A road marking shall be deemed a critical defect three years after its application where there is no record of its expected functional life and no recorded value of in-service performance.

4.3 For road markings in defined critical areas, this period shall be reduced to two years after the marking is laid.

4.4 Where the expected functional life of a road marking is known, the road marking shall be deemed a non-critical defect after that period is reached and re-classified as a critical defect one year after it is reached, except where recorded in-service performance identifies higher performance or a critical defect.

4.5 A road marking with more than 30% of the surface area worn down to the road surface shall have a wear index, as identified in Appendix B, of less than 30.

4.6 Where the road marking is regulatory or is in a critical area with less than 70% of the surface area remaining, it shall be categorised as a critical defect.

4.7 Raised rib road markings with a wear index of 30 or more (refer to Appendix B, Table B.1), affecting a length of road marking equal to or greater than the desirable minimum preview distance, as defined in Section 5, shall be re-categorised as a critical defect where the residual rib height is;
1) 6mm or less on motorways;
2) 3mm or less on all-purpose trunk roads.

4.8 Road marking preview time values (as shown in Table 5.3) lower than the absolute minimum shall be classed as critical defects.

4.9 Road marking preview time values (as shown in Table 5.3) between absolute minimum and desirable minimum shall be classed as non-critical defects.

4.10 Loose casings of embedded road studs shall be classed as a critical defect.

4.10.1 Detailed inspections for this purpose should be carried out when lane closures for other activities are in operation.

5. Performance requirements

General

5.1 A risk based inspection regime for road markings and retroreflecting road studs shall result in the identification of any defects.

Road markings

5.2 Visual assessments surveys shall be undertaken to measure the wear index/score of road markings, as identified in Appendix B.

5.3 Visual digital surveys for dry nighttime retroreflectivity shall use preview times and visibility distances as shown in Table 5.3 at locations where no machine survey data is available.

Table 5.3 Required road marking visibility distances (m) for various speed limits and preview times (dry conditions)

Preview time (secs)	**Speed limit (miles per hour)**					
	20	**30**	**40**	**50**	**60**	**70**
1.8 (absolute minimum)	16m	24m	32m	40m	48m	56m
2.2 (desirable minimum)	20m	30m	39m	49m	59m	69m

NOTE *The preview time values presented in Table 5.3 are based on the assumption that typical vehicles are used i.e. a typical family car with standard headlight height and output not exceeding 1150 lumens.*

5.4 On multi-lane carriageways each lane shall be assessed separately.

5.5 Where nearside and offside road markings are present and are visible for different distances, the longest achieved visibility can be used, but both shall be recorded.

5.6 For all visual survey methods (excluding calibrated visual digital play back and stationary observation during a road closure), the age of the observer shall be applied in accordance with the correction percentages in Table 5.6.

Table 5.6 Age related corrections to achieve visibility distances from initial surveys

Age (years) related corrections to visibility distances				
Age <30	**Age 30-40**	**Age 40-50**	**Age 50-60**	**Age >60**
-14.2%	-9.5%	-4.8%	-2.4%	N/A

NOTE *In Table 5.6 the corrections take account of the fact that eye structures become less effective as a person ages. For example if a 31 one year old carrying out the test can see a road marking at 100m, the survey record will show a corrected distance of 90.5m to take account of the relatively young age of the observer.*

5.7 Road markings shall exceed the values identified in Appendix B Tables B.2 and B.3 for the characteristics included in BS EN 1436 [Ref 8.N].

5.8 Specific locations where road markings framed by longitudinal road markings are subject to increased wear or deterioration (e.g. reduced lane widths, reduced ghost island width) shall be identified and managed in accordance with the requirements of the Overseeing Organisation.

5.9 Visual inspections of road markings framed by longitudinal road markings shall identify specific locations where additional sweeping is required in order to deal with build-up of detritus that can affect the legibility of road markings of this type.

Light emitting (active) road studs

5.10 Physical characteristics of active road studs not related to the active element shall be inspected in the same manner as retroreflecting road studs, if not specified by the manufacturer or in the type approval document.

Street lighting regimes

5.11 Where street lights are dimmed or switched off (full or part-time), road markings and retroreflecting road studs shall be inspected as if the road is unlit.

Special circumstances

5.12 Health and safety files of schemes completed since the last inspection shall be reviewed to enable any site specific performance requirements to be identified.

NOTE *For example, at a safety critical location, wet night retroreflectivity might have been increased.*

6. Asset management data records

6.1 Inspection data and records shall be collected, maintained and placed on a asset data management system that is able to output records in an agreed format, as identified by the Overseeing Organisation, either directly or via interface, in accordance with contractual requirements.

NOTE *The integrity of the inventory can be maintained through back-up facilities with agreed security procedures.*

7. Normative references

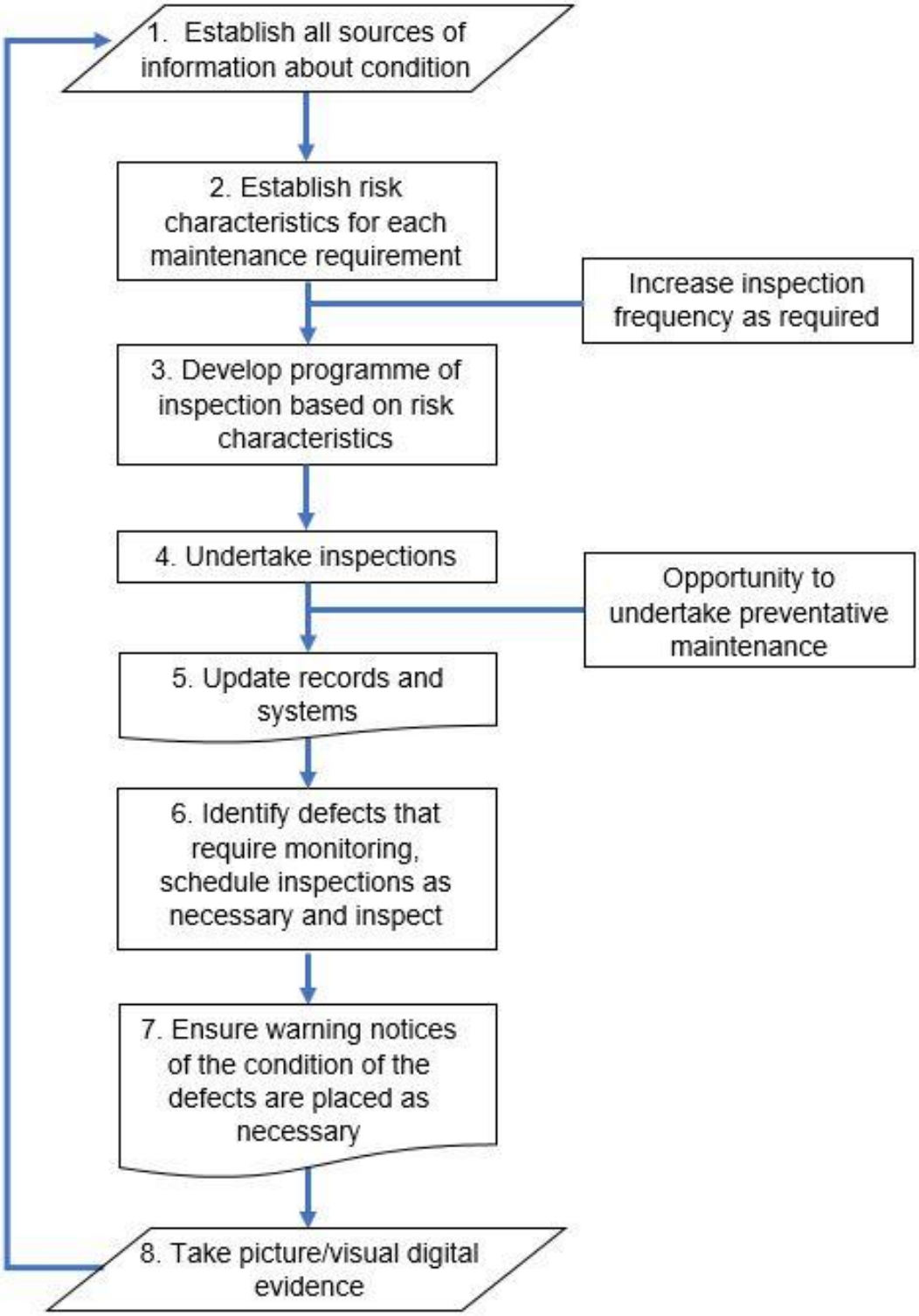
The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Ref 1.N	Highways England. CD 109, 'Highway link design'
Ref 2.N	Highways England. CS 125, 'Inspection of traffic signs'
Ref 3.N	Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges'
Ref 4.N	Highways England. SA 1, 'MCHW Volume 0, Section 3, Part 1: SA 1: Lists of Compliant/Approved/Registered Products.'
Ref 5.N	Sector Scheme Advisory Committee for Road Markings. NHSS 7, 'National Highways Sector Schemes for Quality Management in Highway Works No7: For the application of road marking materials and road studs to road surfaces'
Ref 6.N	Highways England. TS 501, 'Road lighting inspection'
Ref 7.N	BSI. BS EN 1463-1, 'Road marking materials – Retroreflecting road studs – Initial performance Requirements'
Ref 8.N	BSI. BS EN 1436, 'Road marking materials – Road marking performance for road users'
Ref 9.N	BSI. BS EN 1824, 'Road marking materials – Road trials'
Ref 10.N	The Stationery Office. TSRGD 2016, 'The Traffic Signs Regulations and General Directions 2016'
Ref 11.N	The Stationery Office. TSM Chapter 5, 'Traffic Signs Manual Chapter 5 - Road Markings'

Appendix A. Risk based inspection process

If the Overseeing Organisation has identified the potential to use a risk based inspection process in order to determine inspection frequencies of road markings and road studs, use Figure A.1

Figure A.1 Risk based inspection process



Appendix B. Asset inspection methods and defect categorisation

B1 Road markings

B1.1 Detailed visual assessment scoring system

Table B.1 provides information on visual assessment scoring. Photographic examples for each of the scores below can be found in Appendix C. The visual assessment system should be applied to each road marking and aggregated over 100m. The assessment should not mix materials or line types i.e. each line type should be associated with its own averaged score. In the case of lane dividing lines, each lane line should also be associated with its own average score.

Use of Table B.1 may be required when carrying out the process in Figures B.1 and B.2 for vehicle mounted surveys.

Where detritus or vegetation encroaches onto a road marking the assessment score should be taken before and after remedial action has been taken to remove the defect. The defect should be scored and categorised in the same way as wear defects based on the residual visible area.

Table B.1 Visual assessment scoring for wear

Assessment	Wear index/score	Defect type when score is averaged
Non-existent, residue only	0	Critical defect
Barely visible	10	Critical defect
Visible, but has randomly spaced small bare spots	20	Potentially critical defect – judgement required taking into account location and function. Plan should be put in place to manage
Marginal – some visible wear, larger bare spots	30	Non-critical defect
Very little wear	40	Non-critical defect
No obvious wear	50	Not a defect

Note 1: The criteria in Table B.1 applies to raised rib edge road markings when viewed from above (plan view) as well as the vertical profile of raised road markings as these provide an auditory function as well as a visual function.

B1.2 Machine surveys

Figures B.1 and B.2 provide requirements when carrying out vehicle mounted device surveys in unlit and lit areas respectively. Figure B.3 is for areas that cannot be surveyed by vehicles.

Figure B.1 Assessment of longitudinal road markings by vehicle mounted device in unlit area

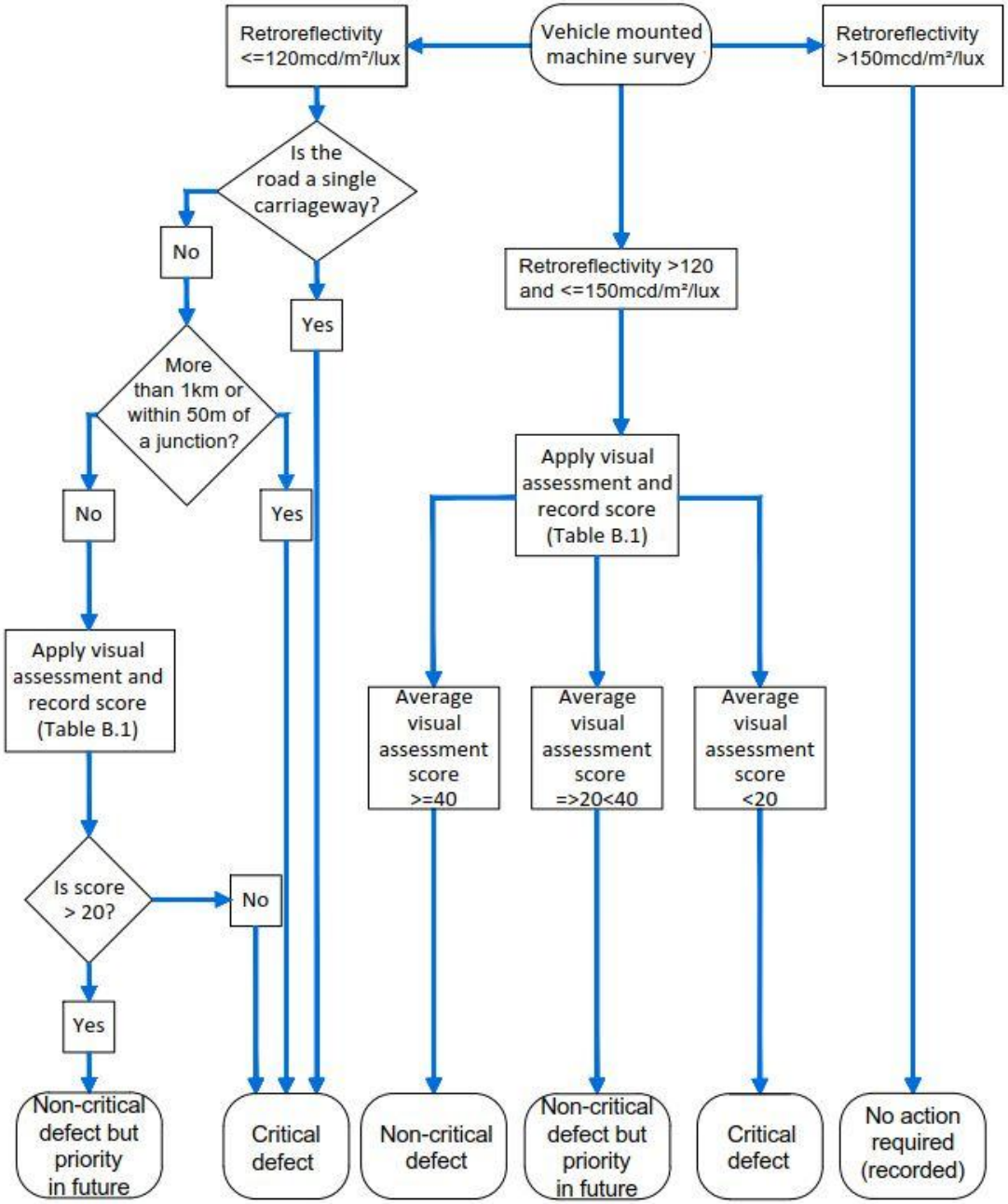
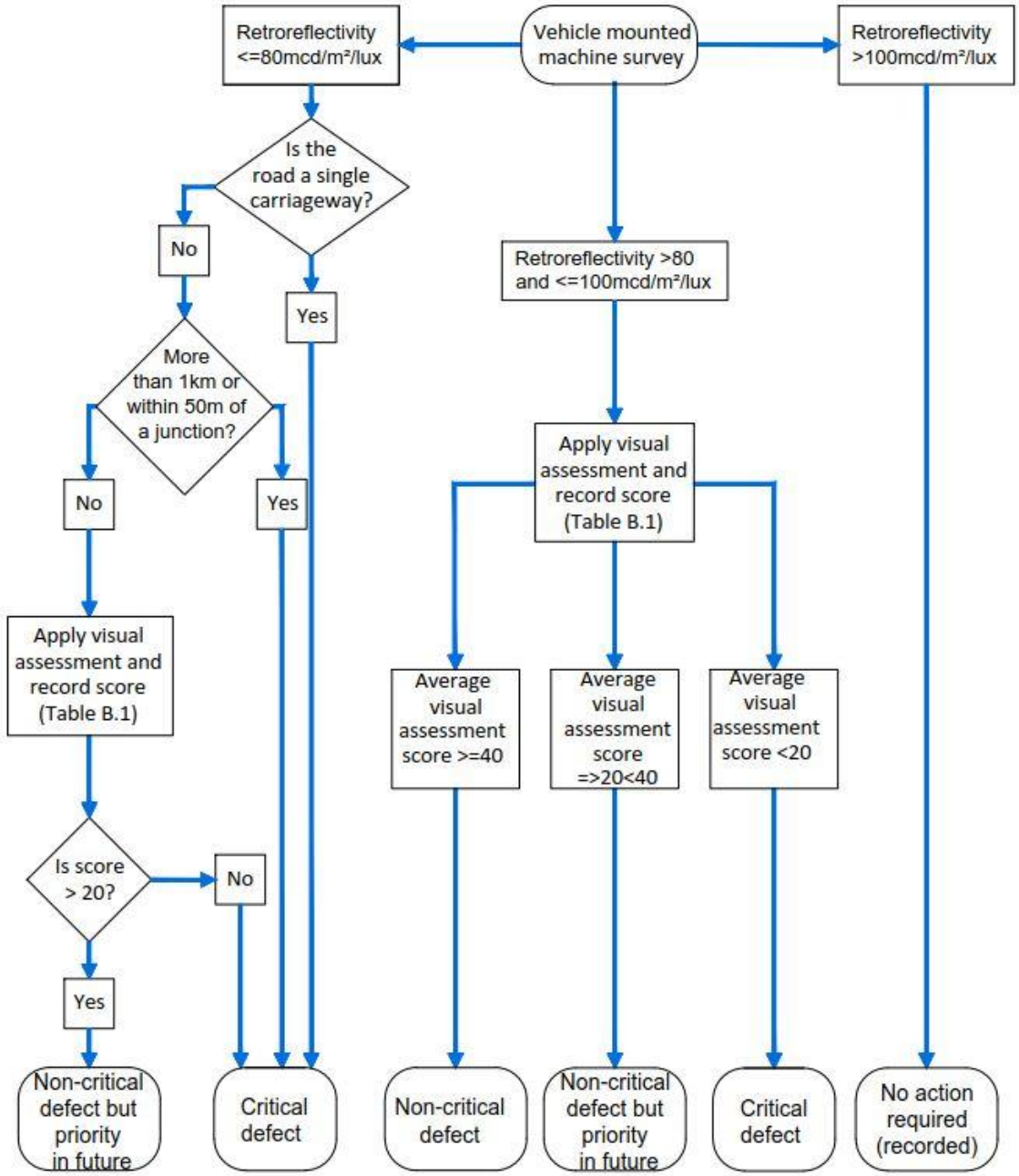


Figure B.2 Assessment of longitudinal road markings by vehicle mounted device in lit areas



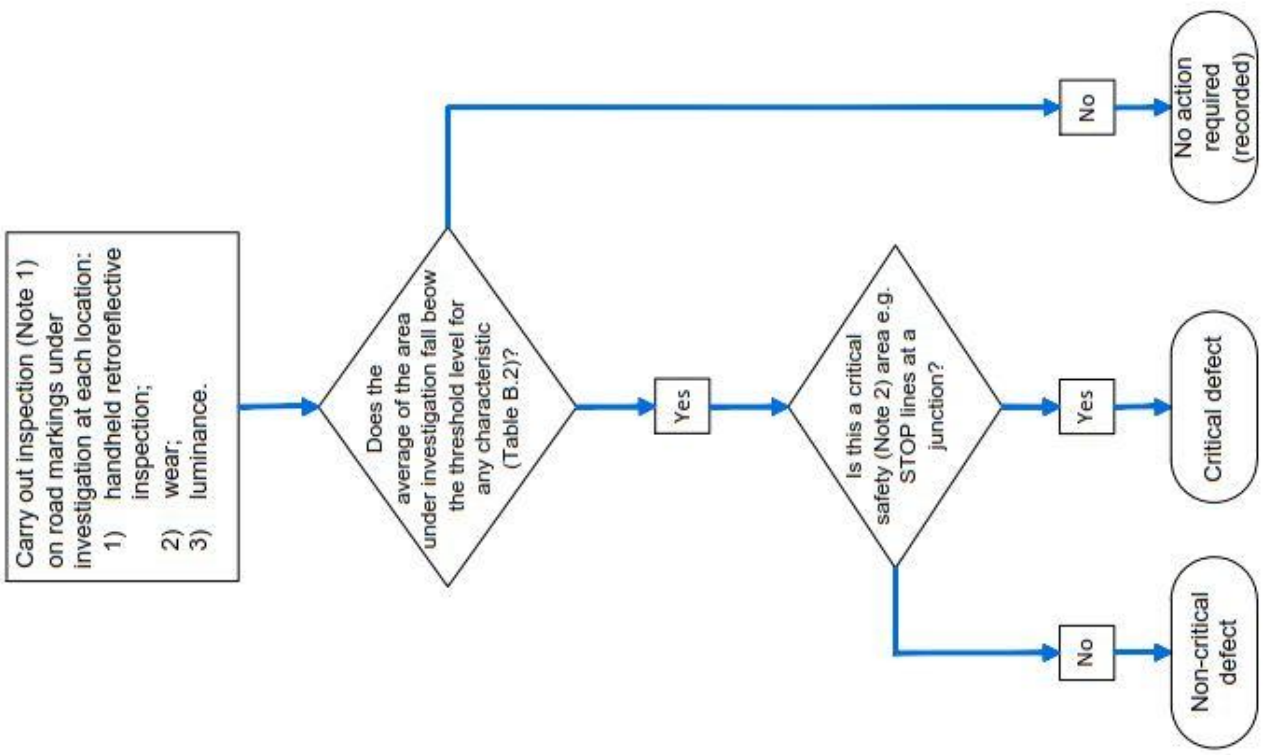


Figure B.3 Assessment of areas that cannot be surveyed by vehicle mounted device

Note 1: Measurements of retroreflectivity should be carried out as set out in B1.4. Measurements for wear and luminance factor should be carried out in accordance with Section 3.

Table B.2 Threshold levels for characteristics

Characteristic	Threshold level	Method
Retroreflectivity (R)	< 100 mcd/m^2/lux in lit areas and < 150 mcd/m^2/lux in unlit areas for line type (a) - see note 2 < 80 mcd/m^2/lux in lit areas and < 120 mcd/m^2/lux in unlit areas for line type (b) - see note 2 < 35 mcd/m^2/lux for "Condition of wetness" (where applicable for markings specified to SHW [Ref. 5])	BS EN 1436 [Ref 8.N]
Wear	< 30 Score for each type of marking	Visual assessment (Table B.1)
Luminance factor (β) or Luminance co-efficient (Qd)	< 0.30 for white or < 0.20 for yellow line type (c) or Q2 or B3	BS EN 1436 [Ref 8.N]

Note 2: Critical areas of the network refer to those areas of the network that may pose a risk to the road user if badly worn. These should be defined with local knowledge and should include:

1) "Give Way" lines and "STOP" signs;

2) regulatory road markings, e.g. double white lines, solid edged ghost islands;

3) large areas of markings, e.g. "SLOW" markings, exit arrows to slips on the main line and on-carriageway 'destinations';

4) transverse yellow bars;

5) road markings at or within 50m of a junction.

B1.3 Skid resistance on critical areas

Pendulum measurements of the critical areas of the network should be taken using Table B.3. Measurements should be taken on the most trafficked areas of the road markings at each location and an average calculated.

Table B.3 Skid resistance criteria

Area	Critical defect threshold level (Skid Resistance Tester Value - SRT)	Method
Critical areas (as Note 2 of Figure B.3)	<55	BS EN 1436 [Ref 8.N]
Non-critical areas	<45	

B1.4 Procedure for the in situ testing of retroreflection using handheld devices

B1.4.1 General

This procedure is for the use of handheld retro-reflectometers as described in BS EN 1436 [Ref 8.N] "Road marking performance for road users".

B1.4.2 Number of readings

For continuous lines, take 15 readings over a 5 metre section minimum. If the marking is a centre line, take 15 readings with the equipment facing in each direction.

For broken lines, take 5 readings per mark for 3 consecutive marks. Readings should not be taken at the very beginning or end of the line. If the marking is a centre line, take 5 readings with the equipment facing in each direction.

For markings wider than 150mm, take readings down the central axis of the line but including some "off-centre" ensuring that any such measurements are still made within the confines of the marking.

For other markings, i.e. 'symbols', 'lettering', transverse lines etc., readings should be taken at approximately 5 equidistant points on the surface of the marking.

If a particular reading appears inconsistent, that reading should be repeated.

B1.4.3 Recording and interpretation of results

A survey report for each location should be produced in a format agreed by the Overseeing Organisation, to include for example averages or sub-totals of markings.

B1.4.4 Measurement of retrospective in conditions of wetness

Where required, the inspection method for conditions of wetness, as described in BS EN 1436 [Ref 8.N]. The inspection methods for "conditions of rain" is not intended for use with the standard measuring equipment currently in general use in the UK.

B2 Comparison of vehicle mounted device and handheld retroreflectometer readings

B2.1 Advantages and disadvantages of different devices

Advantages of using vehicle mounted devices are that they provide:

1) savings in traffic management costs as road closures are not required;
2) fast and reliable data collection on straight roads for decision making; and
3) a focus for further investigations.

Disadvantages of using vehicle mounted devices are that:

1) they do not give consistently the same results as hand held instruments for site location and hence multiplication factors may be required as described below;
2) they can generate large amounts of missing data for single carriageway roads as vehicles cannot drive sufficiently close to centrelines due to oncoming traffic;
3) the level of data confidence can vary, dependent on device; and
4) they can only measure dry retroreflectivity values and therefore require dry conditions, if required by vehicle manufacturer, to produce accurate results.

Advantages of using handheld instruments are:

1) they are reliable for small areas or areas where use can be made of existing road closures (for other reasons) or where vehicle mounted devices are not suitable; e.g. closely spaced junctions or heavily trafficked single carriageways;
2) they can be used to measure wet retroreflectivity values; and
3) they are easily carried.

Disadvantages of using handheld instruments are:

1) they do not provide the same results as vehicle mounted devices for the same spots; and
2) road closures (with associated risks for road workers) are required for taking readings.

B2.2 Correlation factors

Where hand held readings are taken, they should be recorded over lengths no shorter than 50m for averaging purposes. Manufacturers produce correlation factors and these should be applied converting a vehicle mounted device reading to an equivalent reading by a hand held instrument.

B3 Road studs

Figures B.4 and B.5 provide guidance on survey of road studs. A non-critical defect from applying Figure B.4 may need to be re-classified after applying Figure B.5.

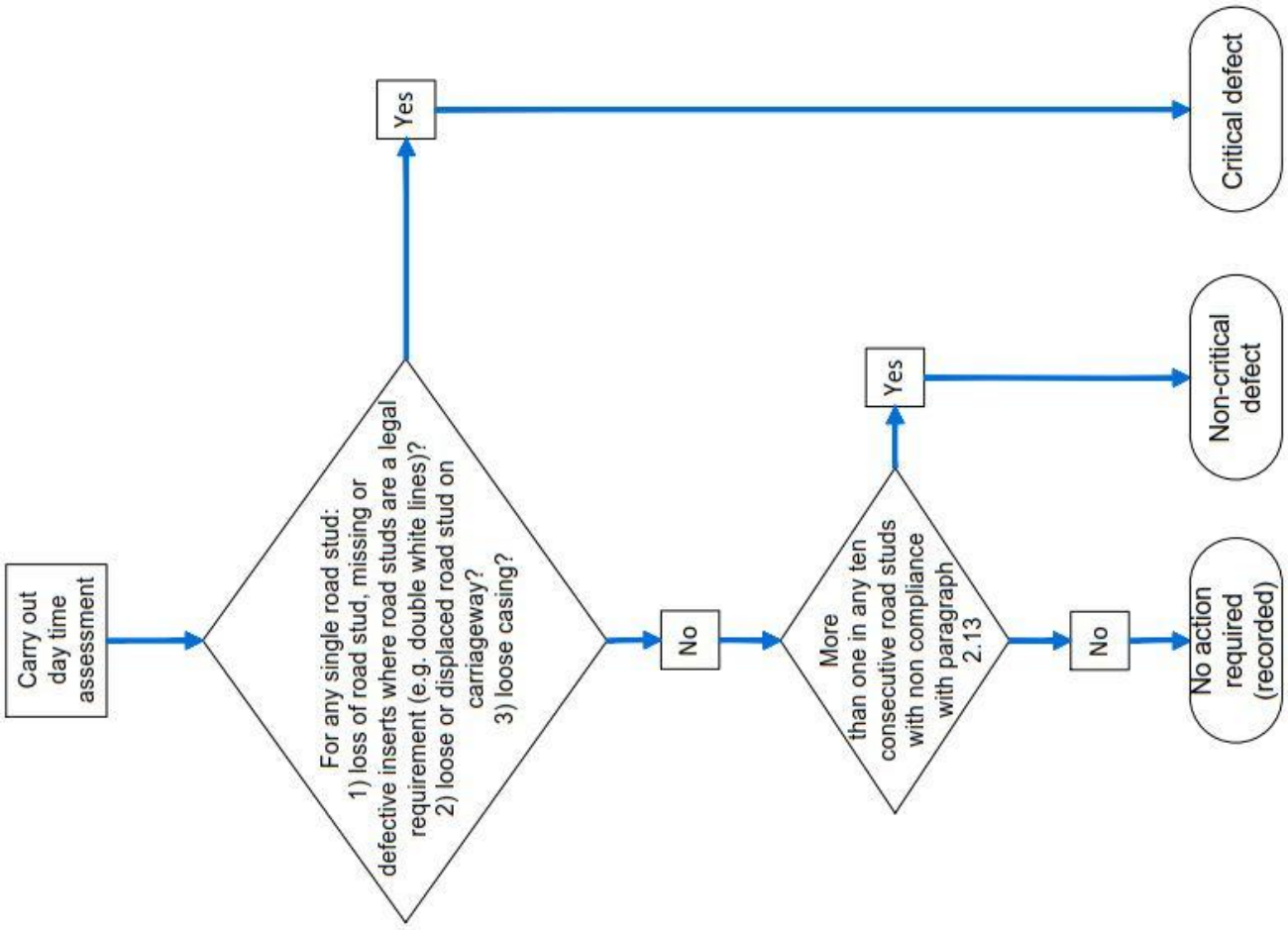


Figure B.4 Daytime assessment of retroreflecting road studs

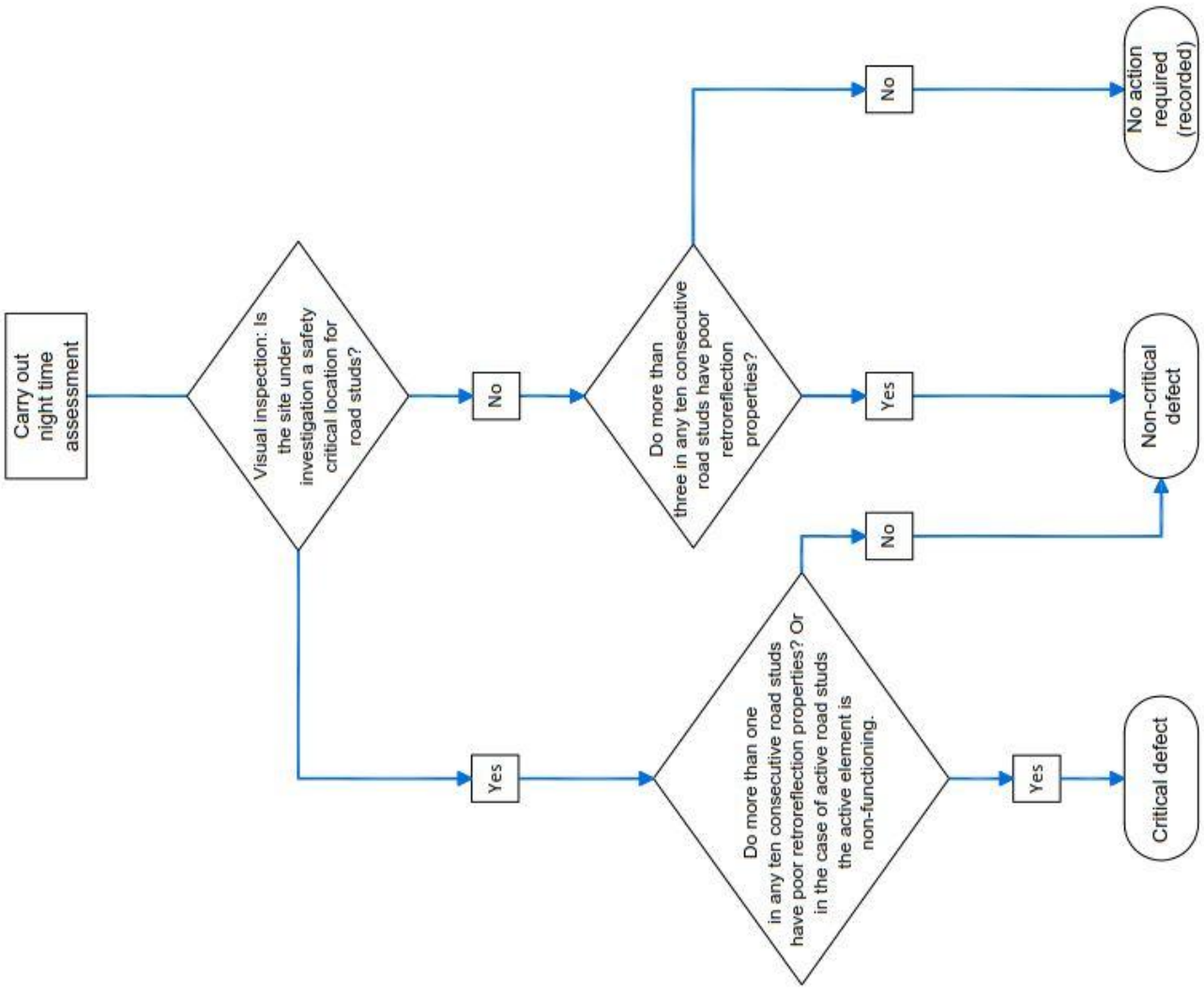


Figure B.5 Night-time assessment of retroreflecting road studs

Appendix C. Photographic examples for detailed visual assessment

Below are photographs to provide guidance on scoring the level of condition of road markings:

Figure C.1 Condition score 50 – close-up

Figure C.2 Condition score 50 – close-up of profiled line designed for wet visibility

Figure C.3 Condition score 50 – long view

Figure C.4 Condition score 40 - close-up

Figure C.5 Condition score 40 – long view

Note - although not ideal, the surface patch repair being at the end of the marking will be unlikely to have an effect on road user understanding, but may in time become a surfacing hazard, particularly for motorcyclists.

Figure C.6 Condition score 30 – close-up

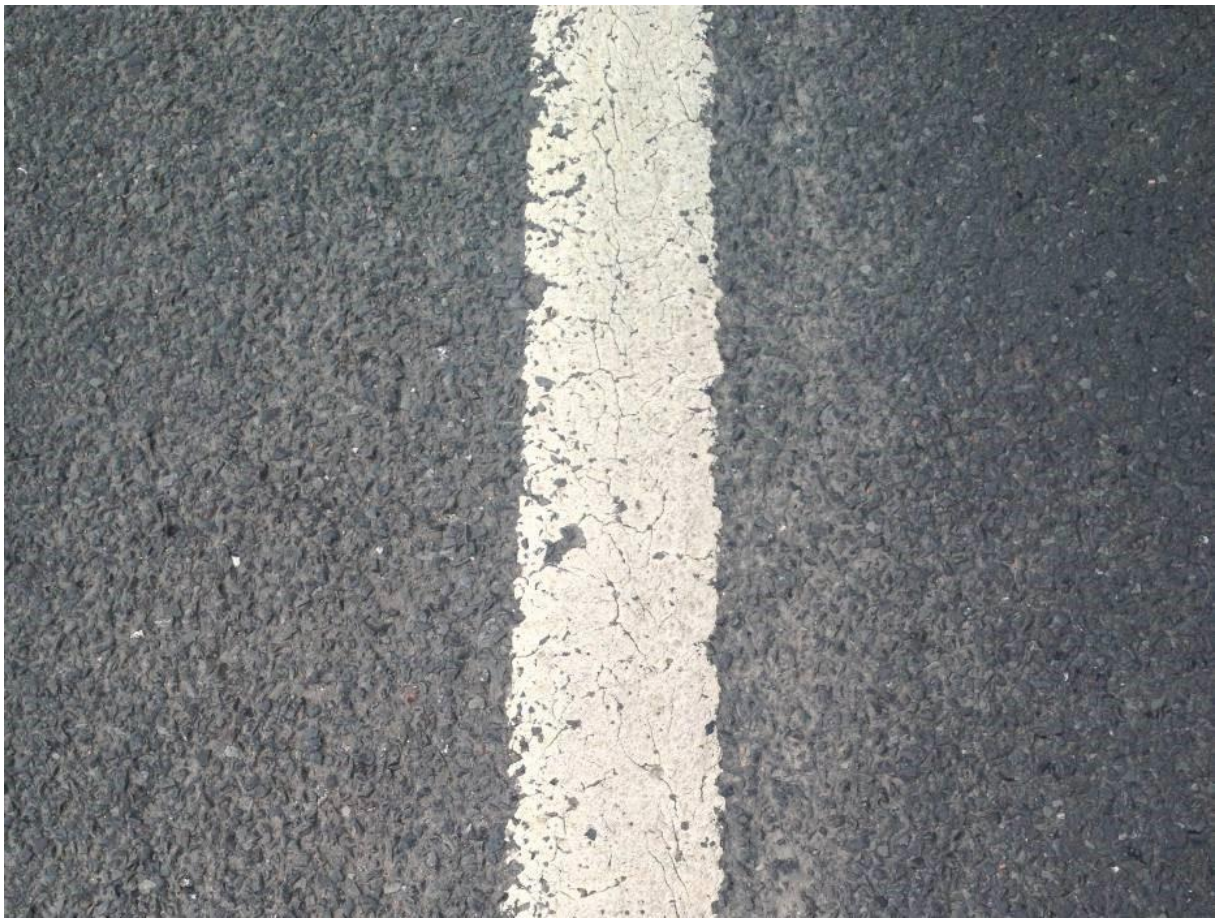


Figure C.7 Condition score 30 – long view

Figure C.8 Condition score 20 – close-up

Figure C.9 Condition score 20 – close-up of profiled line designed for wet visibility

Figure C.10 Condition score 20 – long view

Figure C.11 Condition score 10 – close-up

Figure C.12 Condition score 10 – long view

Figure C.13 Condition score 0 – close-up

Figure C.14 Condition score 0 – long view

Road Layout
Inspection & Assessment

CS 126
England National Application Annex to CS 126 Inspection and assessment of road markings and road studs

(formerly TD 26/17)

Revision 0

Summary
This National Application Annex contains Highways England specific requirements related to inspection and assessment of road markings and road studs.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Highways England team. The email address for all enquiries and feedback is: Standards_Enquiries@highwaysengland.co.uk

This is a controlled document.

Contents

Release notes

Version	Date	Details of amendments
0	Mar 2020	Highways England National Application Annex to CS 126.

Foreword

Publishing information

This document is published by Highways England.

This document supersedes TD 26/17 which is withdrawn.

Contractual and legal considerations

This document forms part of the works specification. It does not purport to include all the necessary provisions of a contract. Users are responsible for applying all appropriate documents applicable to their contract.

Introduction

Background

This National Application Annex gives the Highways England specific requirements related to inspection and assessment of road markings and retro-reflective road studs.

Assumptions made in the preparation of this document

The assumptions made in GG 101 [Ref 1.N] apply to this document.

Terms and definitions

Terms

Term	Definition
Contract	Legal document that states the formal agreement between two different groups, enforceable by law. In some forms of procurement this is termed as an "Agreement".
Critical areas	Critical areas of the network refer to those areas of the network that can pose a risk to the road user if badly worn.
Skid resistance	Measurement on road markings carried out using the standard British pendulum apparatus. BS EN 1436 [Ref 2.N] specifies skid resistance classes.

E/1. Inspection frequencies

Road markings

Representative sample (CS 126, 2.9)

E/1.1 For a representative sample of road marking data, a minimum of 10% of the network shall be collected each year for each characteristic, or for safety critical areas, 20% of the network.

NOTE *This evidence can be from measurements taken between renewals, using road closures undertaken specifically (if necessary) or evidence taken when road or lane closures are applied for other reasons.*

E/1.2 Where there is insufficient data to undertake a risk based inspection process the following maximum intervals shall not be exceeded, for the initial inspection:

1) retroreflection of road markings - safety critical locations: two years, other locations: three years;
2) visual survey of markings for wear - yearly;
3) road studs - six months for visual surveys.

E/2. Inspection methods

Detailed surveys and skid resistance measurements

Representative sample (CS 126, 3.10)

E/2.1 For a representative sample of data, a minimum of 10% of the network shall be collected each year, or for safety critical areas, 20% of the network.

NOTE *This evidence can be from measurements taken between renewals, using road closures undertaken specifically, (if necessary) or evidence taken when road or lane closures are applied for other reasons.*

E/3. Defect categories

E/3.1 To align with national contracts in England, the score range currently illustrated in CS 126 Appendix B, Table B.1 and the photographs shown in Appendix C shall be converted in accordance with Table E/3.1N2.

NOTE 1 For example, in CS 126, a score of 30 is equivalent to a revised score of 3.

NOTE 2 There is no equivalent to the score of 0 as it is considered that the marking has ceased to exist at this point.

Table E/3.1N2 Wear index/Score conversion table

CS 126 Description wear index/score	New score
0	N/A
10	5
20	4
30	3
40	2
50	1

E/3.2 On unlit carriageways of four lanes or wider, any roadmarking that produces a result of < 160mcd/m^2 /lux shall be defined as a critical defect.

E/4. Normative references

The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Ref 1.N	Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges'
Ref 2.N	BSI. BS EN 1436, 'Road marking materials – Road marking performance for road users'

Road Layout
Inspection & Assessment

CS 126
Northern Ireland National Application Annex to CS 126 Inspection and assessment of road markings and road studs

(formerly TD 26/17)

Revision 0

Summary
This National Application Annex contains Department for Infrastructure, Northern Ireland specific requirements related to inspection and assessment of road markings and road studs.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated team in the Department for Infrastructure, Northern Ireland. The email address for all enquiries and feedback is: dcu@infrastructure-ni.gov.uk

This is a controlled document.

Contents

Release notes

Version	Date	Details of amendments
0	Mar 2020	Department for Infrastructure, Northern Ireland National Application Annex to CS 126.

Foreword

Publishing information

This document is published by Highways England on behalf of Department for Infrastructure, Northern Ireland.

This document supersedes TD 26/17, which is withdrawn.

Contractual and legal considerations

This document forms part of the works specification. It does not purport to include all the necessary provisions of a contract. Users are responsible for applying all appropriate documents applicable to their contract.

Introduction

Background

This National Application Annex contains the Department for Infrastructure, Northern Ireland specific requirements related to inspection and assessment of road markings and road studs.

Assumptions made in the preparation of this document

The assumptions made in GG 101 [Ref 1.N] apply to this document.

NI/1. Applicability

NI/1.1 The requirements in CS 126 shall not apply in Northern Ireland.

NI/1.1.1 The Department for Infrastructure should be contacted for further guidance and advice related to the inspection and assessment of road markings and road studs.

NI/2. Normative references

The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Ref 1.N	Highways England. GG 101, 'Introduction to the Design Manual for Roads and Bridges'

Road Layout
Inspection & Assessment

CS 126
Scotland National Application Annex to CS 126 Inspection and assessment of road markings and road studs

(formerly TD 26/17)

Revision 0

Summary
Please contact Transport Scotland for the application of CS 126. The email address is: TSStandardsBranch@transport.gov.scot.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Transport Scotland team. The email address for all enquiries and feedback is: TSStandardsBranch@transport.gov.scot

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Contents

Release notes

Version	Date	Details of amendments
0	Mar 2020	Transport Scotland National Application Annex to CS 126.

Llywodraeth Cymru
Welsh Government

Road Layout
Inspection & Assessment

CS 126
Wales National Application Annex to CS 126 Inspection and assessment of road markings and road studs

(formerly TD 26/17)

Revision 0

Summary
There are no specific requirements for Welsh Government supplementary or alternative to those given in CS 126.

Feedback and Enquiries
Users of this document are encouraged to raise any enquiries and/or provide feedback on the content and usage of this document to the dedicated Welsh Government team. The email address for all enquiries and feedback is: Standards_Feedback_and_Enquiries@gov.wales

This is a controlled document.

Contents

Release notes

Version	Date	Details of amendments
0	Mar 2020	Welsh Government National Application Annex to CS 126.