
**VOLUME 8 TRAFFIC SIGNS AND
LIGHTING**
**SECTION 2 TRAFFIC SIGNS AND
ROAD MARKINGS**

PART 2

TD 26/07

**INSPECTION AND MAINTENANCE OF
ROAD MARKINGS AND ROAD STUDS
ON MOTORWAYS AND ALL-PURPOSE
TRUNK ROADS**

SUMMARY

This Standard sets out the inspection and maintenance requirements and recommendations for road markings and road studs on motorways and all-purpose trunk roads. It supersedes TD26/05. This edition contains a revised Annex H – Correlation Between High Speed Monitor and Handheld Retroreflectometer Readings.

INSTRUCTIONS FOR USE

This Standard is to be incorporated in the Manual.

1. This document supersedes TD 26/05.
2. Remove Contents pages for Volume 8 dated November 2005.
3. Insert new Contents pages for Volume 8 dated May 2007.
4. Remove TD 26/05 from Volume 8, Section 2, Part 2.
5. Insert TD 26/07 into Volume 8, Section 2, Part 2.
6. Archive this sheet as appropriate.

Note: A quarterly index with a full set of Volume Contents Pages is available separately from The Stationery Office Ltd.



THE HIGHWAYS AGENCY



TRANSPORT SCOTLAND



Llywodraeth Cynulliad Cymru
Welsh Assembly Government

WELSH ASSEMBLY GOVERNMENT
LLYWODRAETH CYNULLIAD CYMRU



THE DEPARTMENT FOR REGIONAL DEVELOPMENT
NORTHERN IRELAND

Inspection and Maintenance of Road Markings and Road Studs on Motorways and All-Purpose Trunk Roads

Summary: This Standard sets out the inspection and maintenance requirements and recommendations for road markings and road studs on motorways and all-purpose trunk roads. It supersedes TD26/05. This edition contains a revised Annex H – Correlation Between High Speed Monitor and Handheld Retroreflectometer Readings.

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1. INTRODUCTION

General

1.1 The requirements of this Standard relate to road markings^[1] and retroreflective and non-reflective road studs of all types and colours. It supersedes TD 26/05. Whilst the general principles of the advice and guidance contained in this document are endorsed, this standard is not mandatory for use in Northern Ireland. Reference should be made to ‘Roads Service Policy and Procedures Guide (RSPPG) E019’ (Ref. 15) for the procedures to be followed.

Scope

1.2 This Standard sets out the inspection and maintenance requirements for the regular monitoring of the performance of road markings and retroreflective road studs on motorways and all-purpose trunk roads; and adjacent local roads as agreed by the relevant Overseeing Organisation.

1.3 Other types of road studs may be treated as special road studs and accordingly dealt with to the manufacturers’ recommendations concurrently with the normal retroreflective road studs.

1.4 This Standard details the frequency of the associated inspections (by instrumental or visual means) to determine their condition and the required period within which maintenance is necessary to ensure that road markings and road studs are maintained to a consistent and satisfactory level.

1.5 Chapter 2 of this Standard covers road markings and Chapter 3 retroreflecting road studs. Common aspects are covered in this and other Chapters of this Standard.

Technical Information

1.6 Technical guidance on the correct use of road markings and retroreflective road studs is given in Chapter 5 of the Traffic Signs Manual (TSM) (Ref. 1). Some technical guidance on non-reflective road studs can be found in the User Manual for Routine Maintenance Management System (RMMS). Where there is no such guidance, the appropriate manufacturers or suppliers shall be consulted after seeking the advice of the Overseeing Organisation.

Regulations and Directions

1.7 The relevant regulations and general directions applicable to road markings and any type of road stud are set out in the Traffic Signs Regulations and General Directions 2002 (TSRGD) (Ref. 3).^[2]

Manual of Contract Documents for Highway Works (MCHW)

1.8 SA 1 in MCHW, Volume 0 lists Compliant/ Approved/Registered products (Ref. 4). This document, which is regularly updated, effectively publicises the details of all road studs approved for use in the UK. TSM, Chapter 5, Section 18 and Series D Drawings in Section 2 of MCHW, Volume 3, Highway Construction Details, also give useful technical guidance (Refs. 1 and 7).

British/European Standards

1.9 The relevant current Standards applicable to road markings are BS EN 1423, BS EN 1424, BS EN 1436, BS EN 1790, BS EN 1824 and BS EN 1871 (Ref. 8).

[1]: Traffic Signs, road markings and road studs are prescribed by the Traffic Signs Regulations and General Directions 2002. They are further detailed in supporting documents such as Working Drawings for Traffic Sign Design and Manufacture and Chapter 5 of the Traffic Signs Manual (Ref. 1). Markings outside the scope of these (e.g. speed camera calibration markings and dragon teeth markings) are to be dealt with in the same manner as normal markings for maintenance purposes. In cases where such markings are obsolete they shall be updated or removed with the agreement of the Overseeing Organisation.

[2]: In Northern Ireland the relevant regulations applicable to road markings and road studs are set out in the Traffic Signs Regulations (Northern Ireland) 1997. Details of road studs that are permitted on roads in Northern Ireland are provided in Manual of Contract Documents for Highways Works, SA1, Volume 0, Section 3.

1.10 The relevant BS ENs applicable to road studs are BS EN 1463-1 and 2 (Ref. 9).

Implementation

1.11 This Standard shall be used forthwith on all current and future maintenance contracts on trunk roads, including motorways on safety grounds unless there are very good reasons to the contrary. Maintaining Organisations shall confirm this Standard's application to particular contracts with the Overseeing Organisation.

2. ROAD MARKINGS

General

2.1 Road Markings shall be inspected using the methods and frequency defined within this Standard.

2.2 The purpose of inspection is to identify when deterioration of road markings is such that a reduction in the delivery of safety benefits could result. Thus the appropriate timing for maintenance intervention can be determined.

2.3 Many markings are used to give effect to regulatory provisions of the TSRGD and this legal status may be affected by their deterioration.

Characteristics requiring inspection

2.4 Road markings shall be routinely inspected for some or all of the following characteristics in accordance with the inspection methods set out in the flow diagrams in Annex A:

- (i) Retroreflectivity
- (ii) Wear
- (iii) Luminance factor
- (iv) Skid resistance.

The location of the road markings will determine which of these characteristics require inspection and the methods of inspection employed (detailed in Paragraphs 2.5, 2.6 and 2.7).

Methods of inspection and frequency

2.5 The network shall be surveyed on a routine **annual** basis, except for significant sections of newly laid markings which do not require inspection in the first year after application.

2.6 For all longitudinal road markings on high speed roads:

- (i) An **annual** survey of retroreflectivity by a High Speed Monitor (HSM) shall be carried out and assessed against the criteria shown in the Flow Diagram A in Annex A. The results shall be averaged by the HSM over 100m intervals.
- (ii) The HSM surveys may initiate further inspection by way of a visual assessment using the scoring system set out in Annex C and examples in Annex D. The visual assessment of broken road markings shall be for each marking for the area under investigation. The average will then be taken for each 100m interval. For continuous road markings an overall assessment will be made for each 100m under investigation.

2.7 The areas of the network that cannot be surveyed by HSMs (e.g. STOP lines, Give Way lines and exit arrows) shall be inspected **annually** by the alternative inspection methods set out in Flow Diagram B in Annex A. These inspections shall include:

- (i) An assessment of retroreflectivity by the use of handheld retroreflectometers. Measurements shall be carried out as set out in Annex G and assessed against the criteria set out in Annex A, Flow Diagram B.
- (ii) An assessment of wear. A visual assessment shall be carried out on **50%** of the road markings at each location or every **20m** on a **5m length of an area** for continuous road markings. An average of the results shall be taken and assessed against the criteria set out in Annex A, Flow Diagram B.
- (iii) An assessment of the luminance factor. Measurements shall be carried out on **50%** of the road markings at each location or every **20m** for continuous road markings. An average of the results shall be taken and assessed against the criteria set out in Annex A, Flow Diagram B.

2.8 Skid resistance measurements shall be carried out **annually on a quarter** of the critical areas of the network^[3] detailed in Annex A, Flow Diagram C and where possible in conjunction with inspections referred to in Section 2.5. Measurements should be taken on the most trafficked areas of the road markings at each location and an average calculated.

2.9 Road markings framed by longitudinal road markings, such as hatched road markings or ghost islands, shall not need to be inspected as these will deteriorate at a slower rate than the surrounding markings. Road markings of this type shall be maintained along with the replacement of any surrounding deteriorated continuous road markings.

2.10 In situations where earlier or additional inspections and/or in-situ measurements are warranted in the event of incidents or accidents they shall be carried out as necessary during the next available 'Safety Inspection'. Particulars of this Safety Inspection process as applicable to the motorways and all-purpose roads in England are given in TRMM, Volume 2, Section 1.1.5 (Ref. 12).

2.11 All results shall be stored for at least **seven** years and the survey date, location on the network and condition shall be easily identifiable.

Category of Defect and Maintenance

2.12 As a result of the inspections referred to above any defects noted shall fall into two categories described below.

2.13 **Category 1:** defects that require prompt attention because they represent an immediate or imminent hazard, there is a breach of statutory duty (e.g. a badly worn STOP or GIVE WAY line, double white lines) or a slippery road marking.

2.14 Category 1 defects shall be corrected or made safe at the time of inspection if reasonably practical or within no more than **24 hours** of notification. If it is not possible to repair the defects within **24 hours** then the appropriate prescribed sign (e.g. diagram 7012: "NO ROAD MARKINGS FOR X YARDS/MILES") shall be displayed until permanent repairs are carried out. Permanent repair shall be completed within **28 days** of notification of the defect.

2.15 **Category 2 (Lower Priority):** defects that require repair within six months of the inspection.

2.16 Category 2 defects may be repaired as part of a planned programme of works.

2.17 Replacement or repair of road markings shall comply with the Specification for Highway Works and its Notes for Guidance on the Specification for Highway Works of MCHW (Refs. 5 and 6), unless a departure is granted in writing by the Overseeing Organisation.

[3]: Critical areas of the network refer to those areas of the network that pose a risk to the road user through skidding or potential accidents, i.e. GIVE WAY lines, STOP lines, large areas of road markings (e.g. exit arrows to slips on the main line) and transverse yellow bars.

3. RETROREFLECTING ROAD STUDS

General

3.1 Retroreflecting road studs shall be inspected using the methods and frequency defined within this standard.

3.2 The purpose of inspection is to identify when deterioration of road studs is such that a reduction in the delivery of safety benefits could result. Thus the appropriate timing for maintenance intervention can be determined.

3.3 Many studs are used to give effect to regulatory provisions of the TSRGD and this legal status may be affected by their deterioration.

Characteristics requiring inspection

3.4 Retroreflecting road studs shall be routinely inspected for the following characteristics in accordance with the inspection methods set out in the flow diagrams in Annex B:

- (i) Wear, corrosion, damage
- (ii) Loose or missing studs or inserts
- (iii) Loss of or damage to retroreflective lenses
- (iv) Sinkage^[4]
- (v) Settlement^[5]
- (vi) Detritus on lenses
- (vii) Integrity and security of casings of “embedded” studs (housings)
- (viii) Loss of adhesion or breaking up of surface mounted road studs under traffic loading
- (ix) Misalignment with existing road markings.

3.5 It shall be required that all retroreflecting and any other similar road studs, such as light-emitting studs, approved by the Secretary of State, shall be fixed in accordance with the manufacturers’ instructions and maintained to their recommendations as already tested in the road trials preceding certification. Retroreflecting and light-emitting studs complying with the statutory requirements of TSRGD are listed in SA 1 of MCHW, Volume 0 (Ref. 4).

Inspection methods and frequency

3.6 Routine visual inspections of road studs for the characteristics listed in Paragraph 3.4 shall be carried out at **6 month** intervals in accordance with the methods set out in Annex B, Flow Diagram D.

3.7 Single carriageway roads shall be inspected for defects in both directions where bi-directional road studs have been installed.

3.8 In situations where earlier or additional inspections and/or in-situ measurements are warranted in the event of incidents or accidents they shall be carried out as necessary during the next available safety inspection. Particulars of this safety inspection process as applicable to the motorways and all-purpose roads in England are given in TRMM, Volume 2, Section 1.1.5 (Ref. 12).

3.9 Inspections for reflective conspicuity of retroreflecting road studs shall be carried out during the hours of darkness using a reference sample in case of doubt and in accordance with the method set out in Annex B, Flow Diagram E. Whenever possible road stud inspections should be carried out synchronized with night outage inspections referred to in TD 25, TD 23 and TRMM (Refs. 10, 11 and 12).

[4]: This occurs when surface mounted studs are pushed down into the road surface in heavily trafficked areas or where the strength of the road surface is insufficient to support the downward loading.

[5]: This occurs when studs embedded in the road surface have settled below their specified level within the cavity. This may result from the incorrect application of, or the movement of the supporting asphalt compound. The correct height requirements are laid down in the manufacturers’ instructions and are subject to the provisions of TSRGD, which impose maximum permitted heights.

3.10 Loose casings of “embedded” studs can have serious safety implications; they should therefore, be classed as Category 1 defects. However, inspection of all road studs for looseness is a time-consuming and costly operation particularly on heavily trafficked roads. Therefore detailed inspections for this purpose should, wherever possible, be carried out when lane closures for other activities are in operation. Displacement occurring in significant groupings may be indicative of a general fault condition and specific closures for road stud inspection shall be arranged.

3.11 All inspections shall be programmed to enable maintenance works to be completed, **before the winter season by 1 October**. Further inspections shall be carried out as soon as possible after the winter season to detect damage by snow ploughs in affected areas.

Category of Defect and Maintenance

3.12 As a result of the inspections referred to above where any **single stud** associated with prohibitory lines (that have a legal requirement) or **more than one in any ten consecutive studs** have any defects they shall fall into two categories as determined by Flow Diagrams D and E in Annex B.

3.13 **Category 1:** defects that require prompt attention because they represent an immediate or imminent hazard, or there is a breach of statutory duty.

3.14 Category 1 defects shall be corrected or made safe (including filling of any cavities) at the time of inspection if reasonably practical or within no more than **24 hours** of notification.

3.15 **Category 2 (High and Medium Priority):** defects that require replacement within **3 months** of notification.

3.16 Replacement of road studs shall comply with the Specification for Highway Works (Series 1200) and its Notes for Guidance (Series NG1200) of MCHW (Refs. 5 and 6).

4. ROAD SAFETY

4.1 To protect personnel during maintenance operations, traffic management shall comply with the requirements of Chapter 8 of TSM (Ref. 2).

4.2 All maintenance personnel (including Inspectors) shall be suitably trained and qualified to operate the applicable safety regulations for any maintenance activity and comply with the National Highways Sector Scheme Nos. 7, 12A/12B and 12D in Volumes 1 and 2 of MCHW (Refs. 5 and 6).

5. RECORDS AND INVENTORY

Records

5.1 An inspection report in a format agreed by the Overseeing Organisation (e.g. RMMS) shall be maintained for all inspections.

5.2 All measurements collected and defects identified during inspection shall be reported and recorded, including details of any action taken or required.

5.3 All records shall be retained for a minimum of **seven years** and disposed of only with the written agreement of the Overseeing Organisation. These records shall be handed over to the Overseeing Organisation or their Agents on termination of the agreement with the Maintaining Agent.

5.4 An annual report including a summary of inspections, routine maintenance operations and changes in the network shall be supplied to the Overseeing Organisation at the end of the financial year. Relevant parts of the report shall be included in the Agent's Business Plan.

5.5 "As installed" drawings shall be kept up-to-date by the Maintaining Agent.

Inventory

5.6 An accurate computerised inventory shall be maintained and made available to the Overseeing Organisation on request.

5.7 The inventory shall include records specified in Annex E.

5.8 The inventory shall be stored, using commercially available software, on a computer system which is able to output records in a format agreed by the Overseeing Organisation.

5.9 The integrity of the inventory shall be maintained through back-up facilities with agreed security procedures.

6. REFERENCES

1. Traffic Signs Manual, Chapter 5: Road Markings 2003.
 2. Traffic Signs Manual, Chapter 8: Traffic Safety Measures and Signs for Road Works and Temporary Situations Part 1: Design (2006) and Part 2: Operations (2006).
 3. The Traffic Signs Regulations and General Directions 2002 and its subsequent amendments and subsequent version with the appropriate cross-references in the text of this standard.
 4. Manual of Contract Documents for Highway Works, Volume 0, Section 3, Part 1: SA 1: Lists of Compliant/Approved/Registered Products.
 5. Manual of Contract Documents for Highway Works, Volume 1: Specification for Highway Works.
 6. Manual of Contract Documents for Highway Works, Volume 2: Notes for Guidance on the Specification for Highway Works.
 7. Manual of Contract Documents for Highway Works, Volume 3, Highway Construction Details, D – Series Drawings.
 8. BS ENs for Road Markings:
 - 1423: Road marking materials – Drop on materials – Glass beads, antiskid aggregates and mixtures of the two
 - 1424: Road marking materials – Premix glass beads
 - 1436: Road marking materials – Road marking performance for road users
 - 1790: Road marking materials – Preformed road markings
 - 1824: Road marking materials – Road trials
 - 1871: Road marking materials – Physical properties
 - DD ENV 13459-3:1999 – Road Marking. Materials. Quality Control. Performance in Use.
 9. BS ENs for Road Studs:
 - 1463 Part 1: Road marking materials – Retroreflecting road studs – Initial performance requirements
 - 1463 Part 2: Road marking materials – Retroreflecting road studs – Road test performance specifications
 10. Design Manual for Roads and Bridges, Volume 8, Section 2, TD 25: Inspection and Maintenance of Traffic Signs on Motorway and All-Purpose Trunk Roads.
 11. Design Manual for Roads and Bridges, Volume 8, Section 3, TD 23: Trunk Roads and Trunk Road Motorways: Inspection and Maintenance of Road Lighting.
 12. Trunk Road Maintenance Manual (TRMM), Volumes 1-3.
 13. User Manual for the Highways Agency's Routine Maintenance Management System (RMMS).
 14. Traffic Signs Regulations (NI) 1997.
 15. Road Services Policy and Procedures Guide (RSPPG) E019.
 16. The Roads Service Client System.
 17. Evaluation of high-speed retroreflectivity monitors Stage 4 by S McRobbie and J Pynn (TRL Report PPR 081).
- NOTES
- For items 1 and 2: See website at www.dft.gov.uk/roads/signs and search under 'Traffic Signs Manual'.
- For item 3: See website at www.dft.gov.uk/roads/signs and search under 'Traffic signs legislation'.
- For items 4, 5 and 6: See website at www.standardsforhighways.co.uk/mchw/index.htm
- Items 1-7, 12, 13 and 14 are available from The Stationery Office, see website at www.tso.co.uk/bookshop

For items 8 and 9: See website at
www.bsi-global.com/bsonline for further particulars.

For items 10 and 11: See website at
www.standardsforhighways.co.uk/dmrb/index.htm

For items 15 and 16: See website at
www.roadsni.gov.uk for contact address.

For item 17: See www.highways.gov.uk and search
under 'Knowledge Centre'/'Research Compendium'.

7. ENQUIRIES

All technical enquiries or comments on this Standard should be sent in writing as appropriate to:

Chief Highway Engineer
The Highways Agency
123 Buckingham Palace Road
London
SW1W 9HA

G CLARKE
Chief Highway Engineer

Director of Trunk Roads: Infrastructure and
Professional Services
Transport Scotland
Trunk Road Network Management
8th Floor, Buchanan House
58 Port Dundas Road
Glasgow
G4 0HF

A C McLAUGHLIN
Director of Trunk Roads: Infrastructure
and Professional Services

Chief Highway Engineer
Transport Wales
Welsh Assembly Government
Cathays Parks
Cardiff
CF10 3NQ

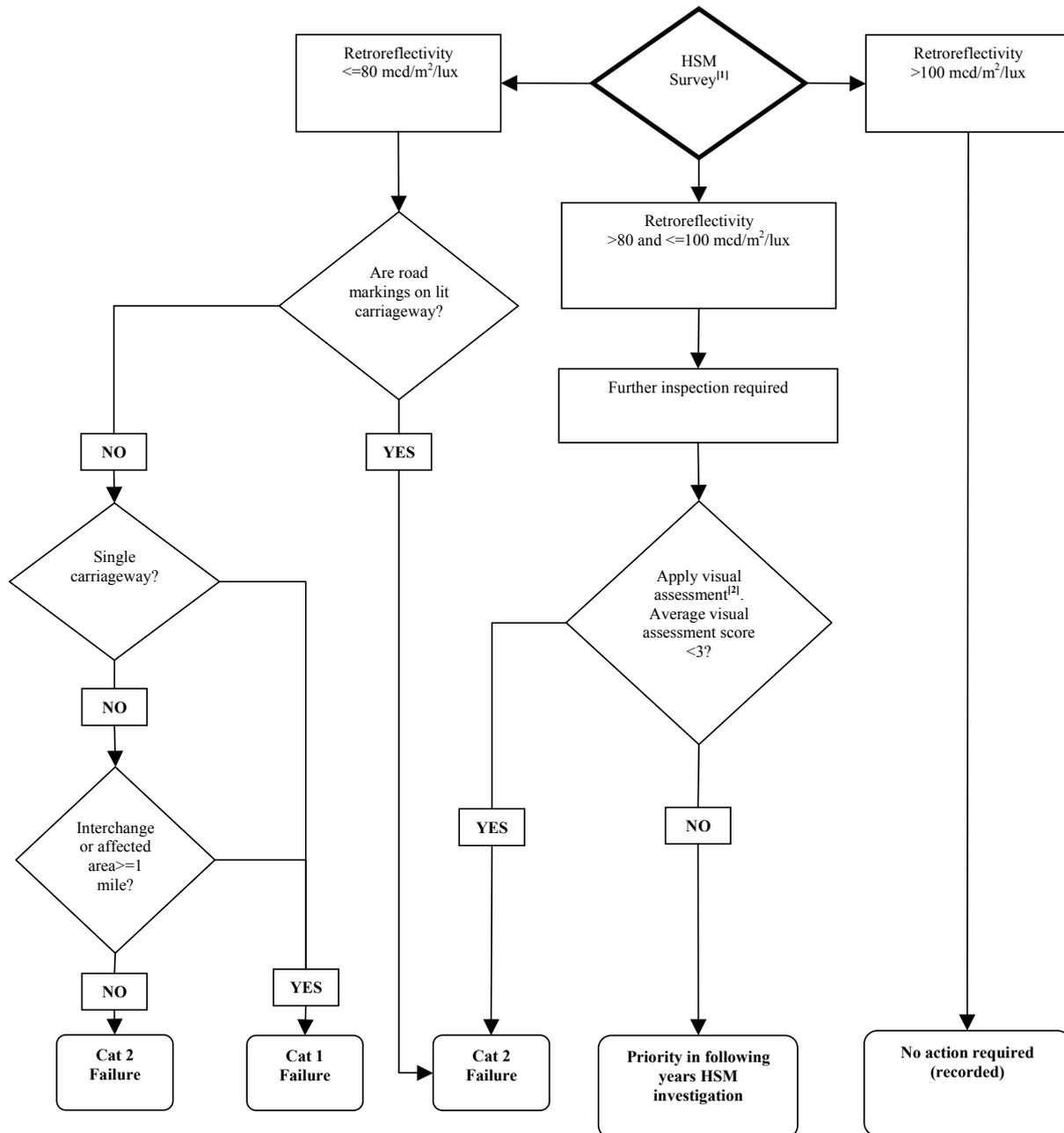
M J A PARKER
Chief Highway Engineer
Transport Wales

Director of Engineering
The Department for Regional Development
Roads Service
Clarence Court
10-18 Adelaide Street
Belfast BT2 8GB

R J M CAIRNS
Director of Engineering

ANNEX A FLOW DIAGRAMS OF ROAD MARKING INSPECTION METHODS

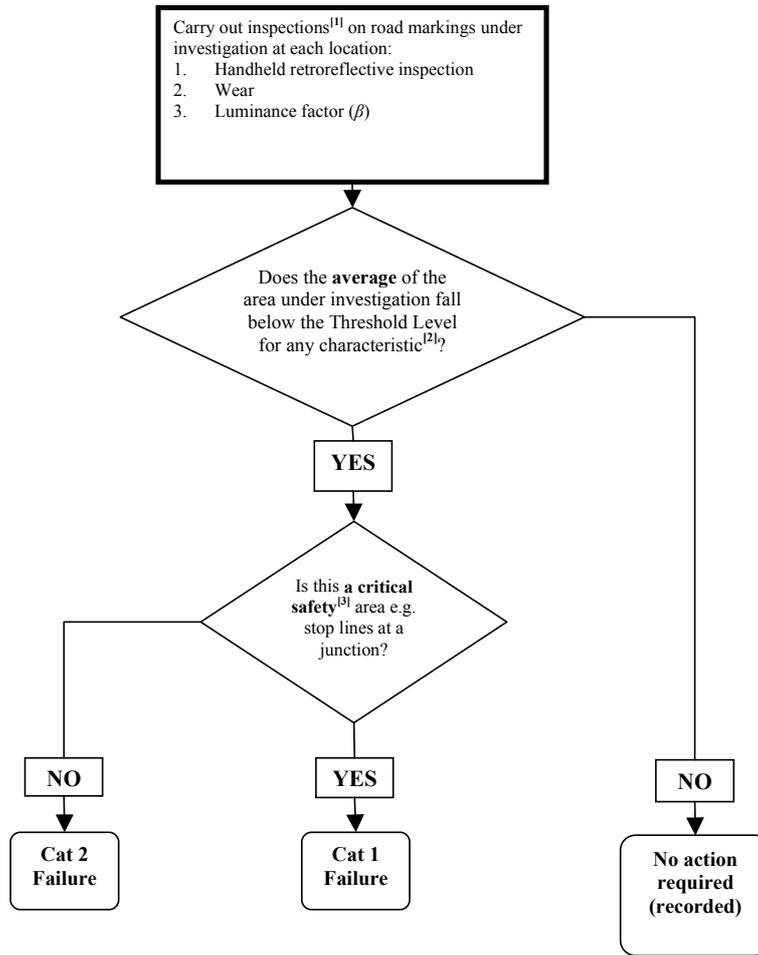
Flow Diagram A: Assessment of Longitudinal Road Markings



Note 1: HSM results should be aggregated and reported over 100m lengths.

Note 2: The visual assessment system is detailed in Annex C and should be applied to each road marking and aggregated over 100m lengths.

Flow Diagram B: Assessment on Areas Not Surveyable by HSMs (e.g side road junctions, exit arrows etc.)



Note 1: Measurements of retroreflectivity shall be carried out as set out in Annex G. Measurements for wear and luminance factor shall be carried out on **50%** of the road markings at each location or every **20m** for continuous road markings. Optionally, where “Wet Night” markings have been laid, markings may be assessed by the inspection method stated in Annex G, Section 6.

Note 2:

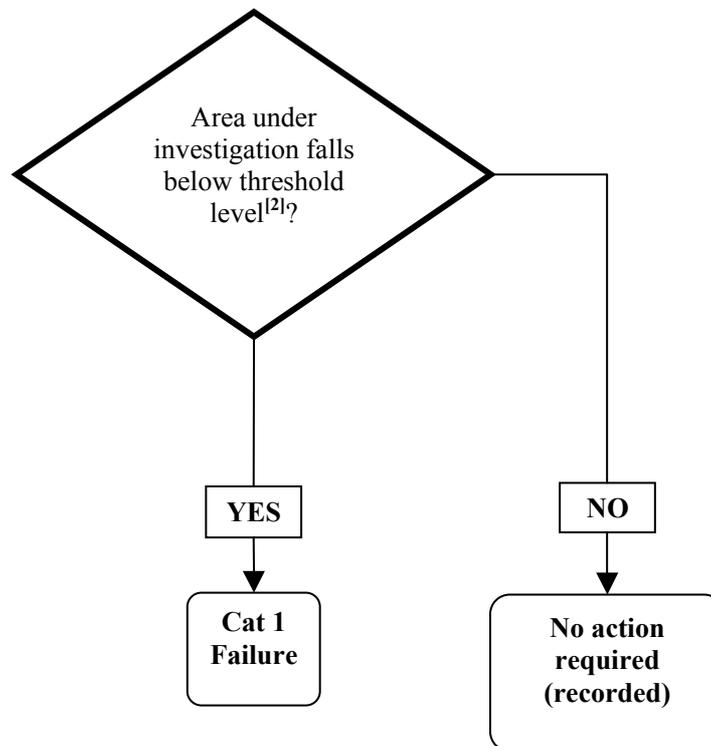
Characteristic	Threshold Level	Method
Retroreflectivity (R_L)	< 100 mcd/m ² /lux for (i) below < 80 mcd/m ² /lux for (ii) < 35 mcd/m ² /lux for optional “Wet Night” assessment	BS EN 1436 & Annex G
Wear	< 70% of marking remaining	Visual assessment
Luminance factor (β)	< 0.30 for white < 0.20 for yellow for (iii)	BS EN 1436

- (i) GIVE WAY lines and/or STOP lines
- (ii) Large areas of paint, e.g. exit arrows to slips on the main line
- (iii) Transverse yellow bars

Note 3: Critical areas of the network refer to those areas of the network that may pose a risk to the road user if badly worn.

Flow Diagram C: Skid Resistance on Critical Areas

Pendulum measurements of the critical areas of the network^[1] shall be taken where possible in conjunction with the inspections detailed in Flow Diagram B (“Assessment on Areas Not Surveyable by HSMs”). Measurements should be taken on the most trafficked areas of the road markings at each location and an average calculated.



Note 1: Critical areas of the network refer to those areas of the network that pose a risk to the road user through skidding or potential accidents -

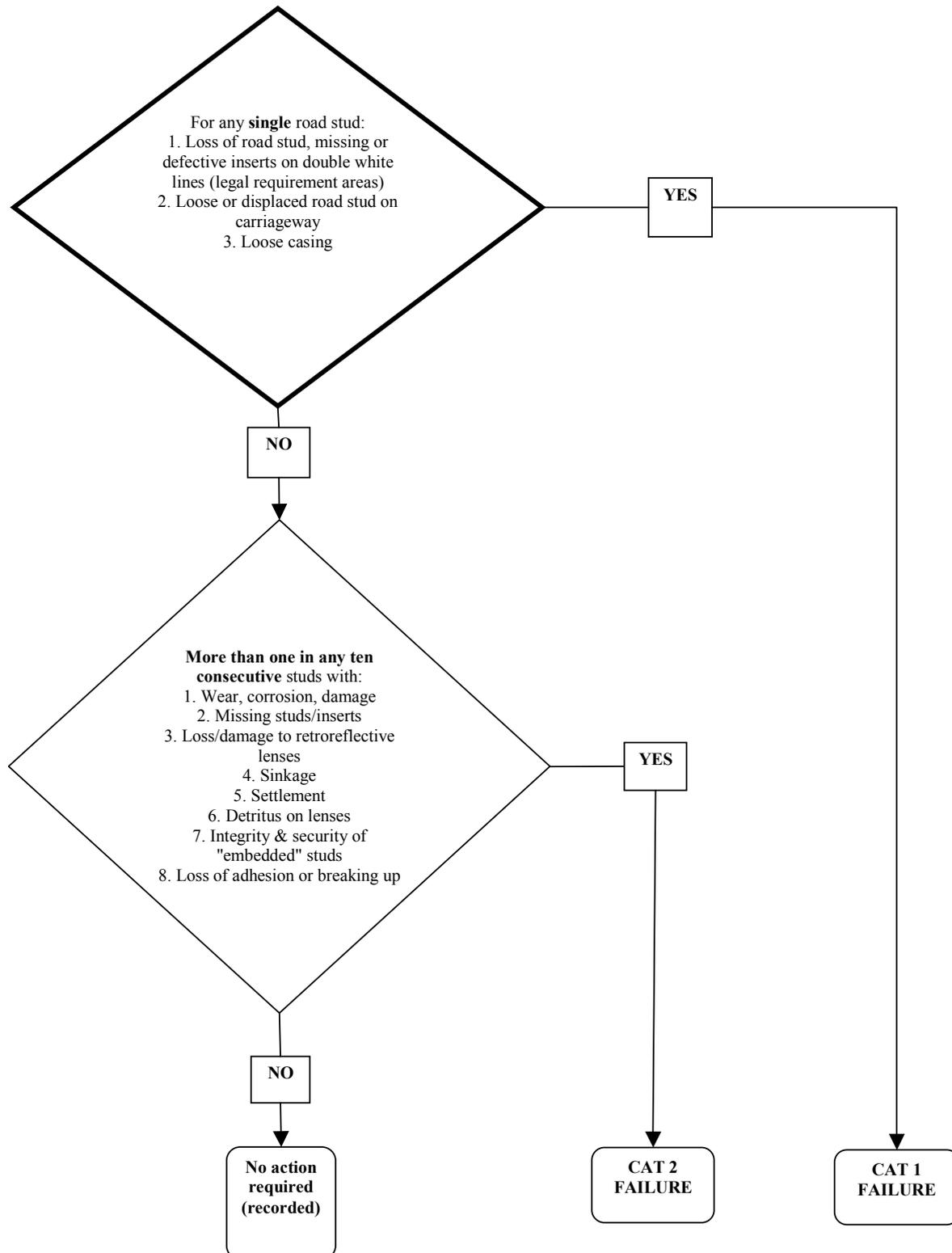
- (i) GIVE WAY lines and/or STOP lines
- (ii) Large areas of paint, e.g. exit arrows to slips on the main line
- (iii) Transverse yellow bars

Note 2: Skid Resistance Criteria

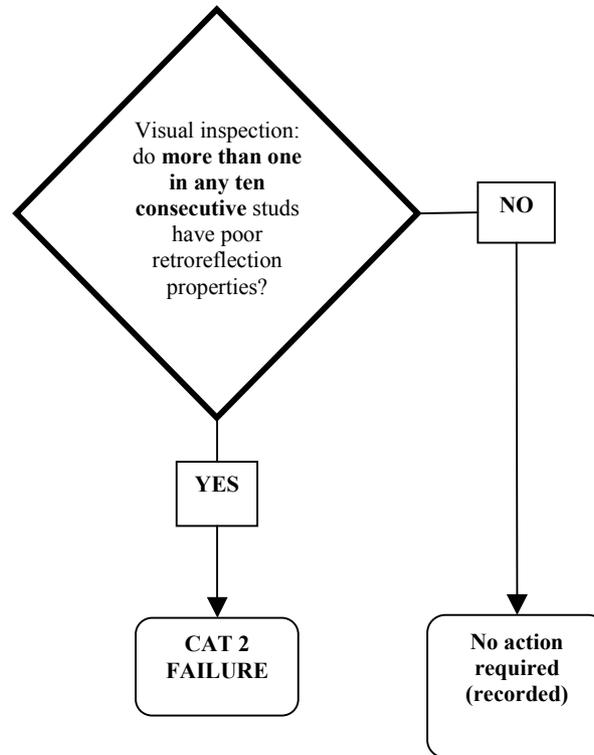
Area	Threshold Level	Method
Normal	<45	BS EN 1436
Large surface areas, e.g. letters, numbers or arrows	<55	
Transverse yellow bar markings	<55	

ANNEX B FLOW DIAGRAMS OF ROAD STUD INSPECTION METHODS

Flow Diagram D: Daytime assessment of retroreflecting road studs



Flow Diagram E: Night time assessment of retroreflecting road studs



ANNEX C VISUAL ASSESSMENT SCORING SYSTEM

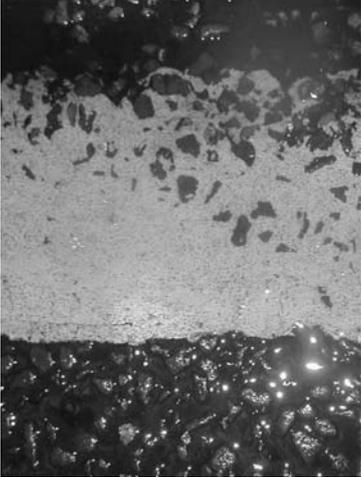
Photographic examples for each of the scores below can be found in Annex D

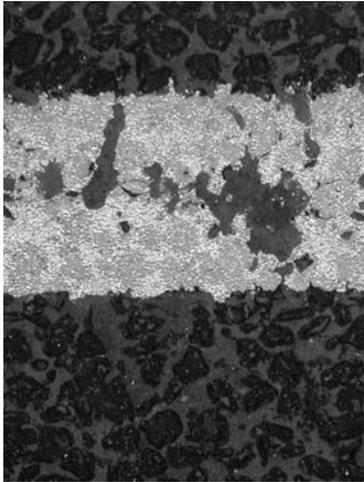
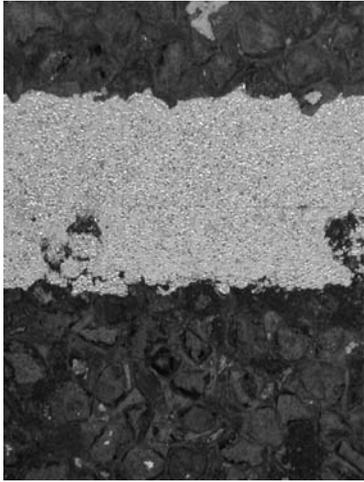
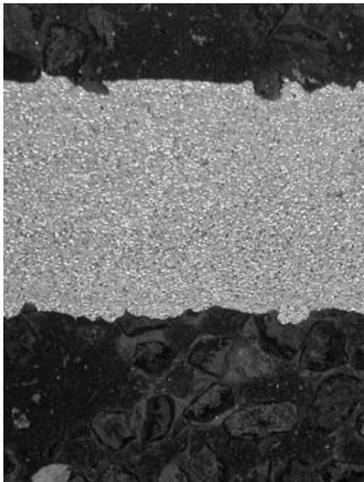
Assessment ^[1]	Score
Non-existent	0
Barely visible	1
Visible, but has bare spots and low night time conspicuity characteristics	2
Marginal – some visible wear and/or fair night time conspicuity characteristics	3
Good night time conspicuity and very little wear	4
Good night time conspicuity and no wear	5

Note 1:

- The visual assessment of broken road markings shall be applied to each road marking for the area under investigation and averaged over 100m intervals.
- For continuous road markings an overall assessment will be made for each 100m under investigation.

ANNEX D PHOTOGRAPHIC EXAMPLES TO VISUAL ASSESSMENT SCORING SYSTEM

Score	Example
0	
1	
2	

Score	Example
3	
4	
5	

ANNEX E INVENTORY DETAILS

	Records	Notes
1.	Road name, number and carriageway (where applicable)	Reference commonly used for road location
2.	Area location description	Street name, village name, junction reference, etc.
3.	Road marking and road stud details and representative photographs	Diagram number in the TSRGD, other authorised documentation, Highway Construction Details Series D Drawings, etc.
4.	Date of construction	Or best estimate
5.	Date of last inspection, if applicable	As detailed in Annex A
6.	Other useful information	E.g. specially authorised (non-prescribed) marking or authorised documentation, maintenance management, policy issue, historical information (e.g. how effectively previous defects have been repaired)

ANNEX F ADDENDUM FOR NORTHERN IRELAND

1. Section 1:
 - i. The reference to “The Traffic Signs Regulations & General Directions” shall be interpreted as “The Traffic Signs Regulations (NI) 1997” (Ref. 14). Any other reference to legislation shall be similarly interpreted as referring to the Northern Ireland equivalent legislation.
 - ii. Reference to “Trunk Road Maintenance Manual (TRMM)” shall be interpreted as referring to “Roads Service Policy & Procedures Guide (RSPPG) E019” (Ref. 15).
 - iii. Reference to “User Manual for Routine Maintenance Management System (RMMS)” shall be interpreted as referring to “The Roads Service Client System” (Ref. 16).
2. Paragraph 5.4: Not currently applicable in Northern Ireland.
3. Paragraph 5.5: Not currently applicable in Northern Ireland.

ANNEX G PROCEDURE FOR THE IN-SITU TESTING OF RETROREFLECTION USING HANDHELD DEVICES

1. Introduction

This Annex sets out the method of inspection of road markings that cannot be surveyed by High Speed Monitor vehicles as referred to in Paragraph 2.4 and Annex A Flow Diagram A. These areas shall be measured by hand-held retroreflectometers.

2. General

- a) This procedure is recommended for the use of handheld retroreflectometers as described in BS EN 1436 “Road marking performance for road users” – Annex B.
- b) Always calibrate and operate the equipment in accordance with the manufacturer’s instructions and BS EN 1436 – Annex B.
- c) Avoid moving the instrument through large temperature changes (i.e. allow time for equipment to acclimatise to prevailing operational temperatures).
- d) If necessary, ensure that the instrument is effectively shielded from direct sunlight.
- e) For longitudinal lines, position the equipment so that its light source shines in the same direction as a vehicle’s headlights would.
- f) Measurements on other road markings (such as symbols, letters etc.) should be taken, wherever appropriate, in the general direction from approaching vehicles.
- g) All markings to be measured should be free from dirt and completely dry. A suitable brush should be used to remove loose dirt and/or loose glass beads prior to testing.
- h) Safety must be given prime consideration during this type of operation. Constant attention must be given to the safety of the operator and of other road users. Refer to Section 4 of this standard – “Road Safety”.

3. Selection of the test area

- a) Choose an area of marking which appears to be representative of the total to be assessed.
- b) The recommended test intervals should be as given in DD ENV 13459-3.

4. Number of Readings

- a) 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.
- b) For intermittent lines, take 5 readings per mark for 3 consecutive marks. Note readings should not be taken at the very beginning or end of the line.
- c) For markings wider than 150mm, take readings down the central axis of the line but including some “off-centre” also. Take care to ensure that any such “off-centre” measurements are still made within the confines of the marking.
- d) For other markings, i.e. ‘symbols’, ‘lettering’, transverse lines etc., readings should be taken at 5 approximately equidistant points on the surface of the marking.
- e) If a particular reading appears inconsistent, that reading should be repeated.

5. Recording and interpretation of results

- a) A survey report for each location should be produced. Information to be included in the report should be as follows:
 - (i) Operator’s name
 - (ii) Equipment type and geometry
 - (iii) Test procedure
 - (iv) General location

- (v) Length of site
 - (vi) Location of measurement point
 - (vii) Date and time of test
 - (viii) Ambient temperature
 - (ix) Type and dimensions of markings
 - (x) Condition of marking
 - (xi) Pre-treatment of marking, i.e. washed/brushed
 - (xii) Weather conditions at time of testing
 - (xiii) Road surface type
- b) Calculate an average of all readings for a particular area.
- c) Readings for individual marks should be “sub-totalled” before being combined.

- b) The inspection method for “conditions of wetness” is as follows:
- (i) The test condition is created using clean water poured from a bucket with an approximate capacity of 10 litres and from a height of approximately 0.5m above the surface so that the measuring field and its surrounding area is momentarily flooded by a crest of water. The retroreflectivity shall be measured under the test condition one minute after the water has been poured^[6]. (Although not specifically defined in the Standard, a volume of 1 litre per metre of marking is generally sufficient for this purpose).

6. Optional Measurement of Retroreflectivity in Conditions of Wetness

- a) In addition to the measurement method for the retroreflectivity, R_L , of dry markings, BS EN 1436 also includes inspection methods for “conditions of wetness” and “conditions of rain”. The inspection method for “conditions of rain” is not intended for use with the standard measuring equipment currently in general use in the UK.

[6]: Retroreflectivity will begin to rise as the test section continues to drain. Therefore, it is recommended that **no more than FIVE** consecutive measurements are taken each time the test method is used. If more than five measurements are required the test method shall be repeated.

ANNEX H CORRELATION BETWEEN HIGH SPEED MONITOR AND HANDHELD RETROREFLECTOMETER READINGS

1. Suitable Reflectometers

1.1 The High Speed Monitors (HSMs) currently approved for use are ECODYN and LASERLUX.

1.2 For England, only those HSMs which meet the Standards certifiable by an independent organisation like TRL or similar shall be used on the network.

1.3 The benefits are:

- savings in traffic management costs as road closures are not required;
- fast and reliable data collection on straight roads for decision making.

1.4 The dis-benefits are:

- do not give the same results as hand held instruments for site location per se and hence multiplication factors are required as described below.

1.5 The hand held instruments currently approved are LTL 2000, Zehntner ZRM 1013 and Stripemaster.

1.6 The benefits are:

- reliable for small areas or areas where HSMs are not suitable; e.g. closely spaced junctions or sharp bends;

- easily carried.

1.7 The dis-benefits are:

- do not give the same results as HSMs for the same spots;
- road closures required for taking readings.

2. Correlation Factors

2.1 The research work carried out up to October 2006 (Ref. 17) indicate that the readings should be over lengths no shorter than 50 m for averaging purposes. This is a tighter control of 'over 100 m intervals' as quoted in para 2.6 of this Standard.

2.2 To arrive at a common benchmarking and for correlation purposes, recommended multiplication factors are given below.

2.3 These factors will convert an HSM reading to an equivalent reading by a hand held instrument.

2.4 The converted readings should be used for compliance to the investigatory or intervention levels given in this Standard. (For example if Prismo Ecodyn 1 monitor gave a reading of 110 mcd/m²/lux for continuous lines. The converted reading would be 110 x 1.02 = 112.2 mcd/m²/lux.)

2.5 For continuous lines:

Vehicle	Continuous lines	Comments
Prismo Ecodyn 1	1.02	
Prismo Ecodyn 2	0.71	Active suspension
RMTS Ecodyn	0.89	
AEPO Laserlux	1.10	
PTS Laserlux	0.97	

2.6 Broken lines:

Vehicle	Broken lines	Comments
Prismo Ecodyn 1	1.92	
Prismo Ecodyn 2	1.18	Active suspension
RMTS Ecodyn	1.15	
AEPO Laserlux	1.12	
PTS Laserlux	1.08	