



Highway Structures & Bridges  
Maintenance & Operation

## CM 431

# Maintenance painting of steelwork

(formerly BD 87/05)

Revision 0

### Summary

This document sets out the requirements for, and gives advice on, the development of maintenance painting schemes and specifications for steelwork in highway structures. The document also provides details of bespoke maintenance painting specifications that have been developed to address specific maintenance painting situations.

### 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](mailto:Standards_Enquiries@highwaysengland.co.uk)

**This is a controlled document.**

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Release notes

Version	Date	Details of amendments
0	Dec 2019	CM 431 replaces BD 87/05. This full document has been rewritten to make it compliant with the new Highways England drafting rules.

## **Foreword**

### **Publishing information**

This document is published by Highways England.

This document supersedes BD 87/05, which is withdrawn.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**

The content of this document is based on that of BD 87/05, rewritten to make it compliant with the new drafting rules. The technical content has been updated and improved to reflect current practice for the maintenance painting of steelwork.

### **Assumptions made in the preparation of this document**

The assumptions made in GG 101 [Ref 1.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 1.N].

# Abbreviations

## Abbreviations

Abbreviation	Definition
BBA	British Board of Agrément
HAPAS	Highway Authorities Product Approval Scheme
ICorr	Institute of Corrosion
NHSS 19A	National Highway Sector Scheme 19A
UKAS	United Kingdom Accreditation Service

## 1. Scope

### Aspects covered

- 1.1 This document sets out the requirements for, and gives supportive advice on the development of maintenance painting schemes for steelwork in highway structures, including the process that shall be followed to develop maintenance painting specifications.

*NOTE The document includes requirements relating to the painting of weathering steel in highway structures.*

### Implementation

- 1.2 This document shall be implemented forthwith on all schemes involving the maintenance painting of steelwork on the Overseeing Organisations' motorway and all-purpose trunk roads according to the implementation requirements of GG 101 [Ref 1.N].

### Use of GG 101

- 1.3 The requirements contained in GG 101 [Ref 1.N] shall be followed in respect of activities covered by this document.

## 2. General requirements for developing a maintenance painting scheme

2.1 Where it has been identified that a structure is possibly in need of maintenance painting, the following process shall be followed to confirm whether and to what extent maintenance painting is necessary, and if necessary, to develop a maintenance painting specification:

- 1) undertake a pre-specification survey of the existing coating in accordance with Section 3 of this document to determine whether and to what extent maintenance painting is required;
- 2) where the pre-specification survey indicates that maintenance painting is required, draw up a provisional maintenance painting specification in accordance with Section 4 of this document;
- 3) undertake feasibility trials in accordance with Section 5 of this document;
- 4) prepare a maintenance painting specification in accordance with Section 6 of this document.

**NOTE** *The possible need for maintenance painting of a structure can be identified for example as a result of a routine structure inspection.*

2.2 The need for maintenance painting of a structure shall be established based on an assessment of the condition of the existing protective coating using the descriptions given for the categories of failure of protective coatings in Appendix A of this document.

2.2.1 Where the condition of a protective coating has been assessed in the pre-specification survey as being Category III or Category IV, maintenance painting should be carried out at the earliest opportunity.

2.2.2 The maintenance painting of a structure should be undertaken before the condition of the protective coating has deteriorated to the extent that structural integrity is compromised as a result of corrosion of the steel substrate.

**NOTE 1** *Delaying maintenance painting work can lead to increased costs for restoring the protective coating to a satisfactory standard and can result in corrosion of the steel substrate.*

**NOTE 2** *Undertaking localised repairs can be beneficial in extending the service life of the protective coating whilst an overall maintenance painting scheme is put in place. Undertaking localised repairs can also extend the period to overall maintenance painting being required where the condition of a protective coating has been assessed in the pre-specification survey as being one of categories 0, I or II, but localised areas exhibit severe coating defects.*

2.3 All structural maintenance work that can affect the durability of a protective coating, including the remedying of deck leaks and the repair of leaking joints, shall be carried out before maintenance painting is put in hand.

2.4 Where the need for maintenance painting of a structure has been identified, the remaining life of the structure and its future use shall be clarified with the structure owner.

2.4.1 For structures with a remaining life of less than 20 years, advice on the most appropriate maintenance painting strategy should be sought from the structure owner.

**NOTE** *The remaining life of a structure can be limited for example as a result of structural defects or by the future need for a structure.*

### Maintenance painting of weathering steel

2.5 The processes described in this document for preparing a provisional and final maintenance painting specification, including undertaking feasibility trials, shall apply in the case of the maintenance of weathering steel in a structure when it is to be painted for the first time.

**NOTE** *The painting of weathering steel in a structure can be adopted to address poor performance of the material in service.*

2.6 Where weathering steel in a structure has been protected by a paint system, then any subsequent maintenance of the paint system shall be subject to the requirements of this document.



### 3. Pre-specification survey

- 3.1 Where it has been identified that a structure is possibly in need of maintenance painting, a pre-specification survey of the structure's protective coating shall be undertaken.

*NOTE The possible need for maintenance painting of a structure could be identified for example as a result of a routine structure inspection.*

#### Scope of the pre-specification survey

- 3.2 The scope of the pre-specification survey shall be to:
- 1) determine whether and to what extent maintenance painting of the protective coating is required;
  - 2) determine the condition of the protective coating to a structure and categorise it in accordance with the categories of failure given in Appendix A;
  - 3) determine pull-off adhesion and dry film thickness values of the protective coating;
  - 4) determine the nature and composition of the protective coating, including whether it is convertible or non-convertible;
  - 5) determine the presence of any toxic element content including lead, cadmium, chromium, arsenic, aluminium and zinc;
  - 6) determine the resin type of the paint coats;
  - 7) determine the types and levels of contaminants present on the surface of the protective coating including soluble salt;
  - 8) establish the extent, intensity and methods of surface preparation that will be required to ensure the satisfactory performance of a maintenance paint system;
  - 9) recommend a maintenance painting specification including a maintenance paint system specification;
  - 10) recommend measures to deal with any health and safety risks and risks to the environment;
  - 11) recommend measures to deal with waste including any hazardous waste;
  - 12) gather the information necessary to develop an accurate bill of quantities for the maintenance painting works.

#### Inspector competence

- 3.3 The planning, supervision, inspection and reporting of the pre-specification survey shall be undertaken by inspectors with a minimum qualification of Coating Inspector ICorr Level 2 or equivalent, with experience of undertaking inspections of coated steel highway structures and of related painting specifications.

#### Reporting of the pre-specification survey

- 3.4 A report shall be prepared covering the scope of the pre-specification survey.
- 3.4.1 In providing recommendations for the maintenance painting specification, reference should be made to Series 5000 [Ref 2.N] and Series NG 5000 [Ref 3.N] for requirements and advice on methods of surface preparation and maintenance paint systems.
- 3.4.2 In providing recommendations for the maintenance painting specification, the following should be identified, addressed and reported:
- 1) any risk management measures that are likely to apply to the maintenance painting works to mitigate any health and safety risks, and risks to the environment;
  - 2) any limitations and time constraints that are likely to apply during the maintenance painting works; for example restrictions on surface preparation methods or access to the structure.
- 3.4.3 The report may cover each main part of the structure separately.

- 3.5 The report shall include a Form HA/P1 (Maintenance) Paint System Sheet (see Series NG 5000 [Ref 3.N] Appendix 50/1) with the relevant sections of the form completed, providing initial recommendations for the maintenance painting works.

## **4. Provisional maintenance painting specification**

- 4.1 Where a pre-specification survey has indicated that maintenance painting is necessary, a provisional maintenance painting specification shall be drawn up based on the recommendations contained in the pre-specification survey report.
- 4.2 In preparing the provisional maintenance specification the following shall be addressed:
- 1) any risk management measures that are likely to apply to the maintenance painting works to mitigate any health and safety risks, and risks to the environment;
  - 2) any limitations and time constraints that are likely to apply during the maintenance painting works, for example restrictions on surface preparation methods or access to the structure.
- 4.3 The provisional maintenance painting specification shall include Form HA/P1 (Maintenance) Paint System Sheet (see Series NG 5000 [Ref 3.N], Appendix 50/1), with the relevant sections of the form completed for the maintenance painting works.

## 5. Feasibility trials

5.1 Feasibility trials of the proposed method(s) of surface preparation and maintenance paint system(s) described in the provisional maintenance painting specification shall be carried out and reported except in the following cases:

- 1) where the surface preparation has been identified as blast cleaning to clean steel or Sa2 to BS EN ISO 8501-1 [Ref 2.I], over the whole surface area of the structure;
- 2) for small section steelwork having ready access (such as parapets and lighting columns remote from a carriageway), where there are no concerns over the compatibility of the propose maintenance paint system and any sound existing protective coatings that are to be overcoated.

*NOTE 1 Except in cases where the whole of the existing protective system is to be removed, it is not always possible to quantify accurately the full extent or intensity of the surface preparation required, or to predict the compatibility of new paints when applied over existing paints, without carrying out feasibility trials.*

*NOTE 2 The feasibility trials are intended to assist in preparing a suitable maintenance painting specification for the maintenance works, based on the provisional maintenance painting specification.*

*NOTE 3 Changes to the provisional maintenance painting specification shown to be necessary during the feasibility trials can prevent delays and additional costs during the maintenance painting works due to inappropriate specification requirements.*

5.2 The feasibility trials shall be undertaken by an organisation that is registered to NHSS 19A [Ref 1.I] by a UKAS-accredited certification body.

5.3 Except in the case of weathering steel being painted for the first time, the feasibility trials shall comprise a minimum of two separate representative areas of the structure such that each proposed method of surface preparation and at least two different paint manufacturer's paint systems are subject to a trial.

*NOTE Two trial areas allow one method of surface preparation and two paint manufacturer's paint systems to be trialled.*

5.3.1 In the case of weathering steel being painted for the first time, the feasibility trials may comprise one representative area to trial the proposed method(s) of surface preparation only.

5.4 The surface preparation and paint application shall be undertaken in accordance with Series 5000 [Ref 2.N].

5.5 Following each stage in the treatment of the trial areas (that is surface preparation, the application of each paint coat, and the curing of each paint coat), the treated areas shall be inspected and reported by a paint inspector with a minimum qualification of ICorr Painting Inspector Level 2 or equivalent.

5.5.1 Where the inspection cannot confirm compliance with the provisional maintenance painting specification and Series 5000 [Ref 2.N] requirements in respect of the standard of substrate preparation and of paint coat quality, the reasons for any defects should be identified and any necessary remedial action implemented before proceeding further with the trial.

5.6 Following application and curing of the complete paint system, the inspection shall include testing the adhesion of the applied maintenance paint system to the substrate.

*NOTE Satisfactory adhesion is >5.2 MPa, with pull-off adhesion tested in accordance with ASTM D4541 [Ref 3.I].*

### Reporting of the feasibility trials

5.7 A report shall be prepared providing full details of the feasibility trials to include the following:

- 1) details of the organisation that undertook the trials;
- 2) details of the provisional maintenance painting specification that has been trialled;

- 3) details of the representative areas that have been used for the trials, referenced to the method of surface preparation, paint system details and paint application method adopted for each representative area;
- 4) records of the environmental conditions (temperature, humidity and weather) that existed during the trials;
- 5) records of the standard of surface preparation that was achieved;
- 6) records of the wet and dry film thickness for each applied paint coat;
- 7) details of all inspections and testing undertaken of each paint coat to confirm compliance with the provisional maintenance painting specification requirements, including details of any defects that were found; and,
- 8) recommendations for changes that may be considered necessary to the provisional maintenance painting specification to provide a suitable maintenance painting specification for the works.

## **6. Maintenance painting specification**

- 6.1 Following completion of the feasibility trials, a maintenance painting specification shall be prepared using:
- 1) Series NG 5000 [Ref 3.N], Appendix 50/1 Form HA/P1 (Maintenance) paint system sheet;
  - 2) Series NG 5000 [Ref 3.N], NG sample Appendix 50/5: General requirements; and,
  - 3) Series NG 5000 [Ref 3.N], NG sample Appendix 50/2: Requirements for other work, if applicable.
- 6.2 The maintenance painting specification shall be based on the provisional maintenance painting specification, updated to account for any recommended changes identified from the feasibility trials, where such trials have been undertaken.
- 6.3 In preparing the maintenance painting specification, the colour of the finish coat shall be agreed with the structure owner.
- 6.4 The maintenance painting specification shall be used in conjunction with Series 5000 [Ref 2.N] for the maintenance painting works.

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. GG 101, 'Introduction to the Design Manual for Roads and Bridges'
Ref 2.N	Highways England. Series 5000, 'Manual of Contract Documents for Highway Works Volume 1 - Specification for Highway Works. Series 5000 - Maintenance Painting of Steelwork'
Ref 3.N	Highways England. Series NG 5000, 'Manual of Contract Documents for Highway Works Volume 2 - Notes for Guidance on the Specification for Highway Works. Series NG 5000 - Maintenance Painting of Steelwork'

8. Informative references

The following documents are informative references for this document and provide supporting information.

Ref 1.I	SSACCP. NHSS 19A, 'National Highway Sector Scheme 19A - Corrosion Protection of Ferrous Materials by Industrial Coatings'
Ref 2.I	BSI. BS EN ISO 8501-1, 'Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Rust grades and preparation grades of uncoated steel substrates and of steel substrates after removal of previous coatings'
Ref 3.I	ASTM. ASTM D4541, 'Standard test method for pull-off strength of coatings using portable adhesion testers'



## Appendix A. Categories of failure of protective coatings

The category of failure of protective coatings described in Table A.1 allows for an assessment of the condition of a protective coating to be made and the need for maintenance painting to be identified.

The categories of failure of protective coatings described in Table A.1 may be used in reporting routine structure inspections, to describe the extent of failure of protective coatings and to identify whether the need for maintenance painting should be investigated further through undertaking a pre-specification survey.

The purpose of allocating one of the five categories of failure described in Table A.1 as part of the pre-specification survey is to confirm the need for and extent of maintenance painting.

The categorisation also allows the prioritisation of the need for maintenance painting where a number of structures are exhibiting coating defects. It also assists in standardising the pre-contract procedure for maintenance painting works and helps in identifying the extent and nature of the maintenance painting that is required. Other criteria that can influence the latter are accessibility, environment, expected life of the structure and cost, including road user delay costs and rail access or train delay costs.

**Table A.1 Categories of failure of protective coatings**

Category of failure	Description	Maintenance requirement
0	Minor weathering of finish coat apparent but no evidence of denatured paintwork or substrate corrosion.	None
I	Small localised areas of denatured finish coat and intermediate coats visible. Paintwork generally sound elsewhere with no evidence of denatured primer, deterioration of metal coating if present or substrate corrosion. Less than 1.0% of the total area exhibits paintwork defects.	Possibly localised
II	Normal weathering of finish coat e.g. chalking, loss of gloss, surface affected by deposits. Localised areas of denatured paintwork affecting finish and intermediate coats and small localised areas of denatured primer possibly with some deterioration of metal coating if present or substrate corrosion. Small areas of white corrosion products may be apparent due to the deterioration of a metal coating if present. Less than 1.0 % of total area exhibits denatured primer, deterioration of metal coating if present or substrate corrosion, or greater than 1.0% but less than 3.0% of the total area exhibits paintwork defects or poor adhesion <sup>1</sup> .	Possibly localised
III	Areas of denatured paintwork affecting finish, intermediate and primer coats with evidence of deterioration of metal coating if present or substrate corrosion. Areas of white corrosion products may be apparent due to the deterioration of a metal coating if present. Less than 3.0% of the total area exhibits denatured primer, deterioration of metal coating if present or substrate corrosion, or greater than 3.0% but less than 10% of the total area exhibits paintwork defects or poor adhesion <sup>1</sup> .	Minor maintenance
IV	General failure of the coating system with numerous areas of denatured paintwork and areas of deterioration of metal coating if present or substrate corrosion. Substrate corrosion varying from surface rusting to heavy rusting. Areas of white corrosion products may be apparent due to the deterioration of a metal coating if present. Greater than 3.0% of the total area exhibits denatured primer, deterioration of metal coating if present or substrate corrosion, or greater than 10.0% of the total area exhibits paintwork defects or poor adhesion <sup>1</sup> .	Major maintenance
<p>Note:</p> <p><sup>1</sup> Coating adhesion: 5.2 MPa pull-off adhesion is the minimum adhesion value that is considered satisfactory for new coating systems, including where an existing coating is to be overcoated as a result of maintenance painting. However a pull-off adhesion value of less than 5.2 MPa may be sufficient for the continued satisfactory performance of an existing coating system to achieve its intended service life without maintenance. In undertaking a pre-specification survey of an existing coating, the inspector should consider the measured pull-off adhesion values, the overall condition of the coating and its expected remaining service life in making a judgement on whether the coating exhibits poor adhesion and is in need of maintenance.</p>		

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