

PROTECTION OF STEELWORK AGAINST CORROSION

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Protection of Steelwork Against Corrosion

NG 1901 General

- 1 The 1900 Series Clauses cater for shop and site surface preparation and protective coating requirements for new steel in highway structures, from the start of fabrication to the completion of erection. Separate requirements exist for subsequent maintenance painting of steel highway structures.

The Clauses are applicable to steel sections and fabricated steelwork in bridges, parapets, gantries and other highway structures, including bearings and lighting columns which are to be protected with the basic systems described in NG 1901.9 to 18. Clause 1920 is concerned with requirements particular to steel in bearings only, and Clause 1921 is concerned similarly with steel lighting columns.

Reference has also been made, in other Series, to certain Clauses in the 1900 Series when appropriate, e.g. Clauses 1902 and 1903 for surface preparation and Clause 1911 for hot dip galvanizing.

The main surface preparation work, usually by dry blast cleaning, together with local surface treatment will be carried out within the fabricators works. After erection however, all surfaces of the shop applied systems which protect the steelwork during delivery and erection, and the surfaces of patch coatings applied during erection will require cleaning before the application of the final overall coat(s); site connections and welded joints will require special treatment, also areas of mechanical damage will need to be made good. On small structures e.g. sign/signal gantries all paint coats, including the finish coat, may be applied in the works in order to reduce access time for completion at site. This may be necessary where, say, a new gantry is to be erected over a motorway during a night-time possession. In such cases the Contractor will need to ensure that damage to the paint system during handling and erection is kept to a minimum and that any minor damage is satisfactorily restored. On large structures, final site painting may not be undertaken for as long as two or even three years, and in these cases wet blast cleaning may be the most effective method of removing contamination.

- 2 The choice of protective systems will depend mainly on the environment and accessibility for maintenance painting. The detailed requirements for surface preparation, the coatings and

their application are specified by means of appropriate 1900 Series Appendices. A consistent format should be adopted for the Appendices and the layout of the sample Appendices should be followed. The format is flexible and can cater for a single component contract, e.g. from a length of parapet, up to the involved requirements of a bridge strengthening and widening scheme.

Item numbers in the Basic Protective Systems and 1900 Series Sample Appendices are listed in the Manual of Paints for Structural Steelwork at Annex A of UK Department of Transport Standard BD 35. A current list of paint manufacturers whose paints have been registered with the UK Department of Transport is published in UK Department of Transport Advice Note SA1. Requirements for the registration of paints are given in UK Department of Transport Advice Note BA 27 Quality Assurance Scheme for Paints and Similar Protective Coatings.

Aluminium is the preferred metal spray coating. Zinc metal spray is not advised for highway structures and is excluded from the basic systems.

Hot dip galvanizing is viable for components such as parapets and lighting columns. For larger components and structures, the validity of hot dip galvanizing, whether painted or not, shall be assessed, and may be restricted by the size and weight of steel fabrication.

- 3 The information on environment, accessibility and durability provided in the Appendices will aid the Contractor in assessing the extent of, the cleaning likely to be necessary on site. The 'Required Durability' is not a contractual requirement but is a means of alerting the paint manufacturer as to the performance expected from the system he is offering. It is also useful information for the maintenance of the structures.

Substitute and Additional Clauses

- 4 Clauses 1901 to 1921, the basic systems described in NG 1901.9 to 18 and the sample 1900 Series Appendices should be scrutinised to ensure that all aspects of the Contract can be covered satisfactorily. When, exceptionally, Substitute or Additional Clauses are required, the alterations should be made after agreement with the National Roads Authority.

Appendices 19/1 to 19/4 - Sections 1 to 3

5 The environment, accessibility and required durability of the systems for the Permanent Works, should be described in Sections 1 to 3 of the Appendices, and should also be written into Appendix 19/5, Form BE/P2 (New Works) Paint System Sheet (parts 3 and 4): see Clause 1918 and NG 1918. The factors to be taken into account in determining the descriptions for Sections 1 to 3 of the Appendices are described below.

(i) Section 1, Environment

Location of structures

Two locations are considered; 'Inland' and 'Marine'.

Structures out of reach of sea salt spray are considered as being 'Inland'. Structures which can be affected by sea salt spray are considered as being 'Marine'.

(ii) Section 2, Accessibility

For maintenance painting purposes, new structures are described as having either Ready Access or Difficult Access.

The description Ready Access would apply to structures where future restrictions on working time due to road or rail traffic are likely to be minimal and where future access on site is unlikely to be a problem.

The description Difficult Access would apply, for example, to a bridge or sign gantry over a motorway or to a bridge over a railway where painting is likely to be restricted to one section at a time or halted completely at certain periods when traffic is heavy.

It would also apply on two counts to a high bridge, say, without painting gantries and built over difficult terrain or a river where movement on the ground would be difficult and because extensive scaffolding would be required.

(iii) Section 3, Required Durability

(a) For the basic systems (except for lighting columns), the periods 'No maintenance up to 12 years', 'Minor maintenance from 12 years' and 'Major maintenance after 20 years' will be sufficiently accurate for both access situations and the environments described in this sub-Clause. However when access is especially difficult, e.g. when dismantling of cover plates is necessary, a special system may be required. In such a case the usual periods for 'No

maintenance' and 'Minor maintenance' would not be applicable (N/A); 'Major maintenance' being given as, say, 20 years, or even 25 years.

The choice of system will depend finally on the following:

Type of structure, especially in the case of a bridge;

Expected service life of structure based on its use;

Environment;

Accessibility.

(b) The types of basic systems for steelwork in NG 1901.10 are designed to cover three main Environment/Accessibility situations, viz:

Type 4. Inland Environment Ready Access	Acrylated Rubber system
Type 4. Alternative Inland Environment Ready Access	High build, quick drying Epoxy (2 pack) system
Type 8. Marine Environment Ready Access	Acrylated Rubber system
Type 8. Alternative Marine Environment Ready Access	High build, quick drying Epoxy (2 pack) system
Type 10. Inland or Marine Environment Difficult Access	Aluminium Metal Spray plus Acrylated Rubber system
Type 10. Alternative Inland or Marine Environment Difficult Access	Aluminium Metal Spray plus high build, quick drying Epoxy (2 pack) system
Type 13. All environments	Galvanizing and Acrylated Rubber system

Basic system types 1,2,3,5,6,7 and 9 are not used.

Other basic systems are given for inside of box girders and parapets.

Basic systems for bridge bearings and lighting columns are also given.

- (c) The basic systems described should be detailed in Appendices 19/1, 19/2 and 19/3 respectively for bridge steelwork and parapets, gantries and other structures; bearings; lighting columns and bracket arms. An Appendix 19/4 may be incorporated for other works requiring protection.

Standard Terminology for the Description of Paints

6 Standard Terminology enables paints to be described in generic terms and without specifying trade names. It is used for the Registered Description in Paint System Sheets, in Data Sheets and in the Specification and should convey the following information in the order given:

- (i) Name of Pigment: where a pigment provides inhibitive or structural properties it must be named, e.g. MIO, Zinc Phosphate. Zinc Chromate. Where pigments provide colour, opacity or act as extenders etc. the pigments should not be named.
- (ii) Type of Medium: except for acid type Etch and Blast Primers the type of medium should be stated, e.g. Vinyl Alkyd, M/Phenolic, Phenolic (i.e. pure Phenolic), Silicone Alkyd, Polyurethane, Epoxy (2 pack), AR. (See (iv) below for meaning of abbreviations.)
- (iii) Use: i.e. Blast Primer, Etch Primer, Primer, Undercoat or Finish. If two pack, add '(2 pack)'.

The first coat only of a new system is described as a Blast Primer, Etch Primer or Primer, all subsequent intermediate coats are described as Undercoats, the last coat being the Finish. A Primer or Primer/Undercoat (i.e. a dual purpose paint) may be specified when it is desirable to obtain a relatively high film build in the first coat, usually for small areas on site.

- (iv) Colour: a descriptive colour must always be stated as part of the Registered Description in Appendix 19/5, Form BE/P2 (New Works) Paint System Sheet. If a BS colour is specified in the 1900 Series Appendices, the BS 4800 reference should follow the descriptive colour, e.g. green-yellow 12 B 21.

Examples:

Red Oxide/Zinc Chromate Blast Primer, red.

Zinc Phosphate AR Blast Primer, pink.

Zinc Chromate Etch Primer (2 pack), yellow. (Medium not stated).

Zinc Phosphate Epoxy Primer (2 pack).

Zinc Phosphate Epoxy Ester Undercoat, yellow.

MIO Phenolic Finish, natural grey (i.e. with pure phenolic resin).

MIO M/Phenolic Finish, medium grey (i.e. with modified phenolic resin).

MIO Epoxy (2 pack) Undercoat, medium grey.

Silicone Alkyd Finish, white (Pigment not stated).

Zinc Phosphate AR Undercoat, blue.

AR Undercoat, green-yellow (Pigment not stated).

MIO AR Finish, medium grey.

Zinc Phosphate High Build, quick drying Epoxy Blast Primer (2 pack).

MIO High Build, quick drying Epoxy Undercoat (2 pack).

Polyurethane (2 pack) Finish, 18 B 25.

MIO MC/Polyurethane Undercoat, natural grey.

Polyurethane (2 pack) Finish, green-yellow 12 B 21 to BS 4800 (Pigment not stated).

Convenient abbreviations have been introduced where these can be readily understood and used in Specifications, e.g.:

MIO	Micaceous Iron Oxide
M/Phenolic	Modified Phenolic
AR	Acrylated Rubber
MC Polyurethane	Moisture cured Polyurethane

Terminology Used in Painting Practice

- 7 For definitions of terms used in painting practice reference should be made to BS 2015. Specific meanings of the descriptions of workmanship standards for surface preparation of steel and coated steelwork are given in Clauses 1907 and 1908 respectively.

Consultations on Health Hazards and Environmental Restrictions

- 8 Health hazards associated with pollution of the atmospheric environment have to be taken into account during surface preparation and the application of protective coatings. Unless necessary precautions are taken and any limitations on the Contractor's method of working (Appendix 1723) are observed, people may be adversely affected, also the site ground area and waterways may become contaminated to an unacceptable extent. In the shops the avoidance of hazards arising from blast cleaning steel with abrasives is usually a matter of protection against dust. The precautions to be taken during the application of protective coatings are usually stated by the suppliers, e.g. ventilation to remove strong solvent vapour. On site, in the case of blast cleaning with non-metallic abrasives, particularly if large surface areas are involved, plans should be discussed with the Environmental Health Officer, the Health and Safety Authority, Water Authority and other interested parties and clearance obtained in writing for the proposals. The debris produced by combined wet and dry blast cleaning (see sub-Clauses 1903.14 and 15) can usually be contained satisfactorily. However in some cases it may be necessary to use dry blast cleaning only, e.g. to clean up a metal spray based system. This method is usually acceptable for a structure in an unpopulated area, even over a road.

However for a structure near or over a river, particularly near a water supply take off point or where fish stock is maintained, it may be necessary to prevent any debris from falling into the water or even on the ground nearby. In other areas, for example near a dust sensitive industrial process, the spreading of any dust in the atmosphere near the plant would be unacceptable.

On site also, although operators can usually be protected from the effects of spray application, it may be necessary in some cases to protect the immediate environment from overspray (see NG 124); it may even be expedient to specify brush application only.

If as a result of investigation it is clear that side sheeting or close boarded scaffolding is

required to reduce or prevent dust and debris being released into the atmosphere or from falling into a river, say, this should be stated in Appendix 19/9.

Basic Protective Systems for Steelwork Except Bearings and Lighting Columns

9 General

- (i) The basic systems for bridge and other highway structures include systems which are satisfactory for sign gantries, footbridges, parapets and also for structures such as towers and buildings. Systems for structures which have to withstand especially aggressive conditions, salt hoppers for example, are not listed. Systems for plastic coated items such as sign posts are covered in Series 1200 and fencing in Series 2600.
- (ii) Types 4, 8 and 10 basic systems, including alternative systems, should not require major maintenance up to 20 years. Type 10 and Type 10 alternative basic systems should require maintenance of paint coats only at the time of the first and second planned maintenance subject to the metal spraying of all welded or bolted site joints and to the avoidance of mechanical damage during erection. Treatment of site joints during erection requires particular care, e.g. selection of a satisfactory abrasive, achieving the required standard of cleanliness, avoiding damage to adjacent metal spray and ensuring that site metal spraying and sealing is completed immediately after blast cleaning; the required thickness of metal spray being obtained in one continuous operation [see sub-Clause 1911.2(iv)]. Site paint coats should be applied as soon as practicable over the sealed aluminium metal spray and in any case given within the timescale in sub-Clause 1914.27.
- (iii) Item 159 is an Aluminium Epoxy Sealer for use when aluminium metal spray plus Sealer is to be overcoated with AR or Epoxy paints.
- (iv) Acrylated Rubber (AR) paints are listed in the Manual of Paints for Structural Steelwork. AR paints have replaced Chlorinated Rubber paints in all situations. Although AR paints are thermoplastic, they have an increased degradation temperature and will generally recover completely from the effects of above normal temperatures e.g. when applied on the underside of a steel

deck which is to be asphalted. However a check should be made with the paint manufacturer before using AR or other paints in areas subject to high temperature.

Acrylated Rubber systems can be applied by brush (B) as well as by airless spray (AS) and may be specified for structures situated in areas where airless spray application during the erection stage or during maintenance would not be acceptable, e.g. in built up areas, or for structures more suited to brush application, e.g. parapets. Alternative brushing quality Item Numbers are given in brackets for all AR paints although in the shops a fabricator is more likely to apply AR paints by airless spray.

- (v) Colours of finishing paints. Where the appearance of the structure is of particular importance, colours for gloss finishes and matt finishes should be selected as in (a) and (b) below:

(a) Gloss Finishes

From the following colours in BS 4800:

Light Grey	00 A 05
Medium Grey	18 B 21
Dark Grey	18 B 25
Green-yellow	12 B 21
White	00 E 55

(b) Matt Finishes

When a matt finish is acceptable, or is specifically required such as for sign gantry steelwork, MIO paints should be used. Because these paints contain a comparatively high percentage of MIO, colour matching is not precise and colours are restricted to the following in BS 4800:

Medium grey	approximately 00 A 09
Natural grey	approximately 00 A 13
Dark blue	approximately 18 C 39
Dark green	approximately 14 C 39

Complete matching of the above MIO paints from batch to batch is not feasible. Pigment size, orientation in coating and application method all have an effect on the finish appearance. In areas where appearance is particularly important the finish should be supplied from one batch. See sub-Clause 1914.9.

When there is a need for other colours, for example in the case of a large bridge or one which is in an

environmentally sensitive area and visually dominant the matter should be referred to the National Roads Authority, describing the structure, its location and the proposed alternative BS 4800 colour and the reasons for selecting it. Advice on the choice and use of colour is available in the UK Department of Transport Highways Agency publication 'The Appearance of Bridges and other Highway Structures' Chapter 21.

Details of Basic Protective Systems for Steelwork Except Bearings and Lighting Columns

10 Basic Systems

Note: mdft = minimum dry film thickness
B = apply by brush
AS = apply by airless spray

Type 1 not used.

Type 2 not used.

Type 3 not used.

Type 4 (AR)

Inland Environment. Ready Access.

Shop. 1st Coat: Item 170(170), Zinc Phosphate AR Blast Primer.

Shop. 2nd and 3rd Coats: Item 172(171), Zinc Phosphate AR Undercoat

Site. 4th Coat: Item 174(173), MIO AR Undercoat.

Site. 5th Coat: Item 176(175), AR Finish, mdft 50 microns.

Minimum total dry film thickness : 250 microns.

Type 4 Alternative (Epoxy)

Shop. 1st Coat: Item 111, Zinc Phosphate High Build Quick Drying Epoxy Blast Primer (2 pack).

Shop. 2nd Coat: Item 112, MIO High Build Quick Drying Epoxy (2 pack).

Site. 3rd Coat: Item 168, Polyurethane Finish (2 pack), mdft 50 microns

or

Site. 3rd Coat: Item 164, Moisture Cured Polyurethane Finish, mdft 40 microns.

Minimum total dry film thickness: 300 microns.

Type 5 not used.

Type 6 not used.

Type 7 not used.

Type 8 (AR)

Marine Environment. Ready Access.

Shop. 1st Coat: Item 170(170), Zinc Phosphate AR Blast Primer.

Shop. 2nd and 3rd Coats: Item 172(171), Zinc Phosphate AR Undercoat.

Shop. 4th Coat: Item 174(173), MIO AR Undercoat.

Site. 5th Coat: Item 176(175), AR Undercoat, mdft 50 microns.

Site. 6th Coat: Item 176(175), AR Finish, mdft 50 microns.

Minimum total dry film thickness : 300 microns,

or

Type 8 Alternative (Epoxy)

Shop. 1st Coat: Item 111, Zinc Phosphate High Build Quick Drying Epoxy Blast Primer (2 pack).

Shop. 2nd Coat: Item 112, MIO High Build Quick Drying Epoxy Undercoat (2 pack).

Site. 3rd Coat: Item 168, Polyurethane Finish (2 pack), mdft 50 microns

or

Site. 3rd Coat: Item 164, Moisture Cured Polyurethane Finish, mdft 40 microns.

Minimum total dry film thickness: 300 microns.

Type 9 not used.

Type 10 (AR)

Inland or Marine Environment. Difficult Access.

Metal coating: Aluminium metal spray.

Shop. 1st Coat: Item 159, Aluminium Epoxy Sealer (2 pack) B or AS.

Application rate: 12 - 20 m²/litre.

Shop. 2nd Coat: Item 172(171), Zinc Phosphate AR Undercoat.

Shop. 3rd Coat: Item 174(173), MIO AR Undercoat.

Site. 4th Coat: Item 174(173), MIO AR Undercoat.

Site. 5th Coat: Item 176(175), AR Finish, mdft 50 microns.

Minimum total dry film thickness : 250 microns.

or

Type 10 Alternative (Epoxy)

Metal coating: Aluminium metal spray.

Shop. 1st Coat: Item 159, Aluminium Epoxy Sealer (2 pack), B or AS.

Application rate: 12 - 20 m²/litre.

Shop. 2nd Coat: Item 111, Zinc Phosphate High Build Quick Drying Epoxy Undercoat (2 pack).

Shop. 3rd Coat: Item 112, MIO High Build Quick Drying Epoxy Undercoat (2 pack).

Site. 4th Coat: Item 168, Polyurethane Finish (2 pack), mdft 50 microns

or

Site. 4th Coat: Item 164, Moisture Cured Polyurethane Finish, mdft 40 microns.

Minimum total dry film thickness: 300 microns.

Type 11 (Interior of box girders)

All Environments. Ready or Difficult Access.

Shop. 1st Coat: Item 111, Zinc Phosphate High Build Quick Drying Epoxy Blast Primer (2 pack), mdft 100 microns.

Shop or Site. 2nd Coat: Item 112, MIO High Build Quick Drying Epoxy Finish (2 pack).

Minimum total dry film thickness : 200 microns.

Two stripe coats are required for AR systems, one applied in the shop in Item 172(171) paint and one applied at site in Item 172(171) or 174(173) paint.

One stripe coat is required for Alternative (Epoxy) systems, to be applied in the shop in Item 112 paint, at mdf 75 microns.

Type 12 not used.

Type 13 (AR) (for galvanized surfaces, e.g. parapets)

All Environments.
Ready or Difficult Access.

Metal coating: Galvanizing.

1st Coat: Item 155, T' Wash.

2nd Coat: Item 172(171). Zinc Phosphate AR Undercoat.

3rd Coat: Item 174(173), MIO AR Undercoat.

4th Coat: Item 174(173), MIO AR Finish, medium grey.

Minimum total dry film thickness : 150 microns.

For parapets to be erected in a Marine environment, the T' Wash, the 2nd and 3rd coats shall be applied in the shops; the 4th Coat may be applied in the shops or on site at the Contractor's option. For parapets in an Inland environment, the T Wash and coats of paint may be applied in the shops or on site at the Contractor's option.

When a semi gloss, medium to dark finish, is required, an extra coat in Item 176(175) AR Finish should be applied. For a light colour finish the final MIO coat should be replaced by an AR Undercoat and AR Finish of Item 176(175).

Notes:

1. The finish coats in Types 4, 8 and 10 basic systems above are semi gloss coats. When a gloss finish is required the semi gloss finish should be replaced by Item 180 (179).
2. The finish coats in Type 4 Alternative, 8 Alternative and 10 Alternative basic systems above are either gloss coats (Item 168) or semi-gloss coats (Item 164). When a matt finish is required, e.g. fascia of a sign gantry, the semi-gloss or gloss finish should be replaced by Item 112.

3. Only the details of coatings have been given in the above Basic Systems and not the surface preparation requirements.
4. Advice on the specifying of abrasives for shop work is given in NG 1907.1. For site work see sub-Clause 1903.11 and NG 1903.11.

Basic Protective Systems for Steel in Bridge Bearings

11 General

- (i) The 'required durability' of Type 2 basic system which consists of aluminium metal spray plus a paint system, is no maintenance up to 12 years, minor maintenance after 20 years. The protective coatings on bridge bearings are likely to require repair of mechanical damage sustained during erection. The periods of 12 and 20 years are considered to be adequate for both environments.
- (ii) Type 2 basic system is suitable for bearings of bridges with Ready Access or Difficult Access.
- (iii) MIO Epoxy paints have been selected for the basic system to provide quick drying and impact resistant coatings which can be applied by either brush or airless spray. The Contractor may opt to apply the last two MIO Epoxy coats on site at the same time as he is painting the site fasteners and remedying any erection damage. Medium or dark grey MIO Epoxy Finish is usually suitable for bearings for concrete bridges, and hence special finish coats will be required less frequently than in the case of steel bridges where the colour of the bearings may be required to match the finishing paint on the steelwork. Provision has been made for replacing the last MIO Epoxy coat with a Polyurethane finish coat in case a different colour is required, e.g. to match main steelwork system. Details are shown in Sample Appendix 19/2.
- (iv) The use of MIO Epoxy (2 pack) paints is standard, and the fact that the Contractor applies the site coats and carries out any remedial work, should make it unnecessary for the bearing manufacturer to visit the site. See Application Instructions in the basic system below. It should be ensured, however that at each stage the bearing protective system is in good condition and that site coats are properly applied. See NG 1920.1.

Details of Basic Systems for Steel in Bridge Bearings (and Metal Coated Fasteners)

12 Basic System

Type 2 (Type 1 basic system not used)

- (i) Surface preparation.

All Environments. Ready or Difficult Access.

Area A

Exterior surfaces, excepting wearing surfaces but including a 25 mm minimum return on areas of top bearing plates or base plates in contact with grout or mortar.

Method: Blast clean with chilled cast iron grit.

Standard: Clean steel, 1st Quality, Medium profile.

Area B

Central area of top bearing plates or base plates in contact with grout or mortar.

Method: Blast clean with metallic abrasive.

Standard: Clean steel. 2nd Quality. Medium profile.

Area C

Areas of top bearing plates or base plates in contact with structural steel components.

Method: As Area A.

Standard: As Area A.

Area D

Exposed shop fasteners in components to be coated after assembly.

Method: As Area A.

Standard: As Area A.

Area E

Concealed shop fasteners.

Method: No requirement.

Standard: No requirement.

Area F

Site fasteners for fixing bearings to piers or abutments and for fixing bridge components to bearings.

Restore metal coating as necessary to specified standard of cleanliness.

- (ii) Protective system.

Area A

Aluminium metal spray minimum thickness 150 microns.

1st Coat: Item 159, Aluminium Epoxy Sealer (2 pack) B or AS. Application rate: 12 — 20 m²/litre.

2nd Coat: Item 118, MIO Epoxy Primer (2 pack), B or AS mdft 50 microns.

3rd Coat: Item 120, MIO Epoxy Undercoat/Finish (2 pack), B or AS mdft 50 microns.

Minimum combined dry film thickness for 2nd and 3rd coats 115 microns.

Additional coats for bearings for steel or concrete bridge beams.

Over Area A

4th Coat: Item 120, MIO Epoxy Undercoat/Finish (2 pack), B or AS mdft 50 microns.

5th Coat: Item 120, MIO Epoxy Undercoat/Finish (2 pack), B or AS mdft 50 microns.

Minimum total dry film thickness for paint system 225 microns.

Alternative 5th coat for bearings for steel bridge beams, applied on site.

Over Area A

5th Coat: Item 164, MC Polyurethane Finish, B, mdft 40 microns or Item 168, Polyurethane (2 pack) Finish, B, mdft 40 microns.

Colour to match finish on main steelwork.

Minimum total dry film thickness for paint system 225 microns.

Aluminium metal spray plus Item 159, Aluminium Epoxy Sealer (2 pack) only, are required on interfaces of machined surfaces of spreader plates and of bearing.

Area B

Item 118, MIO Epoxy Primer (2 pack) mdft 50 microns.

Area C

Aluminium metal spray minimum thickness 150 microns.

Sealer: Item 159, Aluminium Epoxy Sealer (2 pack) B or AS. Application rate: 12 - 20 m²/litre.

Area D

As Area A.

Area E

Fasteners unprotected by grease shall be zinc electroplated.

Area F

Metal Coating: Zinc electroplating.

1st Coat: Item 155, 'T' Wash.

2nd Coat: Item 118, MIO Epoxy Primer (2 pack), B or AS. mdft 50 microns.

3rd Coat: Item 120, MIO Epoxy Undercoat/Finish (2 pack), B or AS. mdft 50 microns.

4th Coat: Item 120, MIO Epoxy Undercoat/Finish (2 pack), B or AS. mdft 50 microns.

5th Coat: Item 120, MIO Epoxy Undercoat/Finish (2 pack), B or AS. mdft 50 microns.

Minimum total dry film thickness 225 microns.

Alternative 5th coat.

As Area A.

(iii) Application instructions.

Areas A, B or C, and D

The aluminium metal spray and Items 155, 118 and 120 (3rd coat) shall be applied at the bearing manufacturer's works.

Area A

Item 120 (4th and 5th coats) shall be applied at the bearing manufacturer's works or on site by the Contractor.

Items 164 or 168 (alternative 5th coat) shall be applied on site.

Area F

Item 155, T Wash shall be applied on site, either before or after erection, to surfaces to be painted. T Wash coming into contact with adjacent paint coats shall be removed immediately.

The remaining site coats shall be applied to exposed surfaces after erection.

Stripe coats for bearings only: (stripe coats are not required for bearing site fasteners).

A 1st stripe coat of undercoat shall be applied over the MIO Epoxy Primer at the bearing manufacturer's works.

A 2nd stripe coat of last undercoat shall be applied on site. MIO Epoxy coats shall be in contrasting colours, e.g. medium grey, dark grey.

Site coats shall be applied by the Contractor.

Note: When compiling Appendix 19/2, the appropriate finish paints should be selected from the basic system. The letter references, A, B, C etc. should be varied as appropriate, and the application instructions arranged to suit.

Basic Protective Systems for Steel Lighting Columns and Bracket Arms

13 General

- (i) The six basic systems and the setting out of the typical Sample Appendix 19/3 should be studied. For motorways and other trunk roads the basic system most appropriate to the environment, see (ii) and (iii) below should be selected, and then Appendix 19/3 compiled on the lines of the Sample Appendix, bearing in mind that lighting columns of 3 mm section thickness or less are to be galvanized.

The 'required durability' of the exterior coatings, which consist of aluminium metal spray plus sealer, galvanizing only or one of these metal coatings plus a paint system, is no maintenance up to 8 years, minor maintenance after 8 years and major maintenance after 15 years.

- (ii) The simplest (and cheapest) protection will be either aluminium metal spray plus sealer or galvanizing only (see Type A1 and G1 basic systems). These systems will be suitable for columns in an inland environment with ready access for maintenance. Columns situated in an inland environment with difficult access or marine environment with ready or difficult access will require a metal coating plus paint coats. See Type A2a, A2b (Alternative), G2a and G2b (Alternative) basic systems.
- (iii) The choice of metal coating and paint system [i.e. Type A2a, A2b (Alternative), G2a or G2b (Alternative)] may be left to the Contractor, in which case each type of system should be included in Appendix 19/3. Planted columns protected with A2b (Alternative) or G2b (Alternative) protective systems must have an additional sacrificial steel thickness of a minimum 1.0 mm above that needed in the design, from the bottom of the column to at least 250 mm above ground level.
- (iv) The policy for the protection at column bases is as follows:
 - (a) Columns, which have been aluminium metal sprayed externally, require internal protection for the ground section and door area. Blast cleaning, to 2nd Quality, medium profile, followed by application of Pitch Epoxy (2 pack) paints, extending from the bottom to 300 mm above the door opening, has been specified for internal protection of these columns.
 - (b) Galvanized columns do not require additional internal protection.
 - (c) External surfaces of the ground section of all rooted columns are protected by Pitch Epoxy (2 pack).
 - (d) External surfaces of flange mounted columns do not require special treatment at the base unless the flange is below ground level or built over, e.g. covered by a plinth. In this case Pitch Epoxy (2 pack) should be specified. See Sample Appendix 19/3 for details.

Note: So that the Contractor will know how far to extend the Pitch Epoxy (2 pack) a nominal 'ground' or 'plinth level' should be stated in Appendix 19/3 as being at a fixed distance below the door opening. A value of 600 mm will usually be appropriate.

Details of Basic Protective Systems for Steel Lighting Columns and Bracket Arms

14 General

- (i) In the case of basic system A2a, G2a, A2b (Alternative) and G2b (Alternative), the Contractor may opt to apply the finishes in the shop or at site, unless otherwise specified.
- (ii) The colour of the finish coat of paint in systems A2a and G2a in the sample Appendix 19/3 is blue/black 18 B 29 to BS 4800. When a white or pale tint finish is to be specified, an additional coat of Item 164 or 168 may be required to ensure complete obliteration of the MIO high build Epoxy (2 pack) Undercoat.

Before specifying white or pale tint finishes, any requirement for an additional coat of paint should be checked with the paint suppliers listed in section 7 of Appendix 19/3.
- (iii) Item 150, Pitch Epoxy (2 pack) polyamide cured has been specified. However Item 152, Pitch Epoxy (2 pack) isocyanate cured will be acceptable as an alternative if offered by the Contractor and subject to his taking the necessary health and safety precautions during application.
- (iv) Type A1, A2a and A2b (Alternative) basic systems are based on aluminium metal spray.
- (v) Type G1, G2a and G2b (Alternative) basic systems are based on galvanizing.

Note: In these basic systems the protection for the ends of flange mounted columns which are built over or protected by a plinth is assumed to be the same as for the ground section of planted columns. Appendix 19/3 should be written accordingly.

System A1 for Columns in an Inland Environment with Ready Access

15 Basic System

Type A1

- (i) External surface.

Flange mounted and planted columns, overall treatment.

Surface preparation.

Method: Blast clean with chilled cast iron grit or aluminium oxide grit.

Standard: Clean steel, 1st Quality, medium profile.

Protective system.

Aluminium metal spray.

Item 159. Aluminium Epoxy Sealer (2 pack) B or AS.

Application rate: 12 - 20 mVlitre.

Ground section, additional coat.

Item 150, Pitch Epoxy (2 pack) AS. mdft 100 microns.

Minimum total dry film thickness 110 microns.

(ii) Internal surfaces.

Flange mounted columns, flange to door area.

Planted columns, ground section to door area.

Surface preparation.

Method: Blast clean.

Standard: Clean steel, 2nd Quality, Medium profile.

Protective system.

1st Coat: Item 110, Zinc Phosphate Epoxy Primer (2 pack), AS. mdft 30 microns.

2nd Coat: Item 150, Pitch Epoxy (2 pack), AS. mdft 100 microns.

Minimum total dry film thickness 150 microns.

(iii) Application instructions.

Blast cleaning, aluminium metal spray and all shop paint coats on external surfaces shall be returned on to edges at ends, at door and other openings and 25 mm under base flange.

All paint coats shall be applied in the shops.

Item 159 shall be overcoated within 96 hours.

On external surfaces Item 150 shall be applied from the bottom to 250 mm above ground level.

On internal surfaces Items 110 and 150 shall be applied from the bottom to 300 mm above the door opening.

Systems A2a and A2b (Alternative) for Columns in an Inland Environment with Difficult Access or in a Marine Environment with Ready or Difficult Access

16 Basic Systems

Type A2a

(i) External surface.

Flange mounted and planted columns, overall treatment.

Surface preparation.

Method: Blast clean with chilled cast iron grit or aluminium oxide grit.

Standard: Clean steel, 1st Quality. Medium profile.

Protective system.

Aluminium metal spray.

1st Coat: Item 110, Zinc Phosphate Epoxy Primer (2 pack), AS. mdft 25 microns.

2nd Coat: Item 112, MIO High Build Quick Drying Epoxy Undercoat (2 pack), AS. mdft 100 microns.

Flange mounted columns, additional overall coat. Planted columns, additional coat for upper section only.

Item 164, Moisture Cured Polyurethane Finish, B or AS. mdft 50 microns

Item 168, Polyurethane Finish (2 pack), B or AS. mdft 50 microns.

Minimum total dry film thickness 175 microns.

Planted Columns, additional coat for ground section.

Item 150, Pitch Epoxy (2 pack) AS. mdft 100 microns.

Minimum total dry film thickness 250 microns.

(ii) Internal surface.

Flange mounted columns, flange to door area. Planted columns, ground section to door area.

Surface preparation.

Method: Blast clean.

Standard: Clean steel, 2nd Quality, Medium profile.

Protective system.

1st Coat: Item 110, Zinc Phosphate Epoxy Primer (2 pack), AS. mdft 30 microns.

2nd Coat: Item 150, Pitch Epoxy (2 pack) AS. mdft 100 microns.

Minimum total dry film thickness 150 microns.

(iii) Application instructions.

Blast cleaning, aluminium metal spray and all shop paint coats on external surfaces and site paint coats where access permits shall be returned on to edges at ends, at door and other openings and 25 mm under base flange.

All paint coats except Items 164 and 168 shall be applied in the shops. Items 164 and 168 may be applied in the shops or on site.

Item 110 shall be overcoated within 96 hours.

On internal surfaces Items 110 and 150 shall be applied from the bottom to 300 mm above the door opening.

For planted columns:

On external surfaces Item 150 shall be applied from the bottom to 250 mm above ground level.

Item 164 or 168 shall be applied down to 225 mm above ground level, overlapping Item 150 by 25 mm.

Type A2b (Alternative)

Planted columns shall have an additional sacrificial steel section thickness of a minimum 1.0 mm, above that needed in the design, from the bottom of the column

to at least 250 mm above ground level; additional thickness to be recorded in Part A of Appendix 13/2, Column and Bracket Data Sheet.

(i) External surface.

Flange mounted and planted columns, overall treatment.

Surface preparation.

Method: Blast clean with chilled cast iron grit or aluminium oxide grit.

Standard: Clean steel, 1st Quality, Medium profile.

Protective system.

Aluminium metal spray.

Item 159, Aluminium Epoxy Sealer (2 pack). B or AS.

Application rate: 12 - 20 m²/litre.

Flange mounted columns, additional overall coats. Planted columns, additional coats for upper section only.

1st Coat: Item 130, Vinyl/Vinyl Copolymer Primer. B or AS. mdft 75 microns.

2nd Coat: Item 131, Vinyl/Vinyl Copolymer Finish. B or AS. mdft 75 microns.

Minimum total dry film thickness 175 microns.

Planted columns, additional coat, for ground section only.

Item 150, Pitch Epoxy (2 pack). B or AS. mdft 100 microns.

Minimum total dry film thickness 110 microns.

(ii) Internal surface.

Flange mounted columns, flange to door area. Planted columns, ground section to door area.

Surface preparation.

Method: Blast clean.

Standard: Clean steel, 2nd Quality, Medium profile.

Protective system.

1st Coat: Item 110 Zinc Phosphate Epoxy Primer (2 pack). AS. mdft 30 microns.

2nd Coat: Item 150, Pitch Epoxy (2 pack). AS. mdft 100 microns.

Minimum total dry film thickness 150 microns.

(iii) Application instructions.

Blast cleaning, aluminium metal spray and all shop paint coats on external surfaces, and site paint coats where access permits, shall be returned on to edges and 25 mm inside at ends, at door and other openings and 25 mm under base flange.

On internal surfaces, Items 110 and 150 shall be applied from the bottom to 300 mm above the door opening.

Item 159 shall be overcoated within 96 hours.

For planted columns:

On external surfaces, Item 150 shall be applied over Item 159 from the bottom to 250 mm above ground level.

On external upper section, Items 130 and 131 shall be applied down to 225 mm above ground level, overlapping Item 150 by 25 mm. Item 131 may be applied in the shops or on site, to overlap Item 150 by 25 mm.

System G1 for Columns in an Inland Environment with Ready Access

17 Basic System

Type G1

(i) External and internal surfaces.

Flange mounted and planted columns, overall treatment.

Galvanize.

(ii) External surface.

Ground section, additional coats.

1st coat: Item 155, 'T' Wash.

2nd Coat: Item 110, Zinc Phosphate Epoxy Primer (2 pack) AS. mdft 30 microns.

3rd Coat: Item 150, Pitch Epoxy (2 pack) AS. mdft 100 microns.

Minimum total dry film thickness 150 microns.

(iii) Application instructions.

The requirements of sub-Clause 1914.21 need not apply for lighting columns which remain in a shop environment after galvanizing.

T Wash and shop paint coats on external surfaces shall be returned on to edges and 25 mm inside at ends and under base flange.

All paint coats shall be applied in the shops.

Item 110 shall be overcoated within 96 hours.

Items 155, 110 and 150 shall be applied from the bottom to 250 mm above ground level.

Systems G2a and G2b (Alternative) for Columns in an Inland Environment with Difficult Access or in a Marine Environment with Ready or Difficult Access

18 Basic Systems

Type G2a

(i) External and internal surfaces.

Flange mounted and planted columns, overall treatment.

Galvanize.

(ii) External surface.

Flange mounted and planted columns, additional overall coats.

1st Coat: Item 155, T Wash.

2nd Coat: Item 110, Zinc Phosphate Epoxy Primer (2 pack) AS. mdft 30 microns.

3rd Coat: Item 112, MIO High Build Quick Drying Epoxy Undercoat (2 pack), AS. mdft 100 microns.

Flange mounted columns, additional overall coat.

Planted columns, additional coat for upper section only.

Item 164, Moisture Cured Polyurethane Finish, B or AS. mdft 50 microns, or Item 168, Polyurethane Finish (2 pack), B or AS. mdft 50 microns.

Minimum total dry film thickness, including Primer, 200 microns.

Planted columns, additional coat for ground section only.

Item 150, Pitch Epoxy (2 pack) AS. mdft 100 microns.

Minimum total dry film thickness 275 microns.

(iii) Application instructions.

The requirement of sub-Clause 1914.21 need not apply for lighting columns which remain in a shop environment after galvanizing.

T' Wash, all shop paint coats on external surfaces and site paint coats where access permits shall be returned on to edges and 25 mm inside at ends, at door and other openings and under base flange.

All paint coats except Items 164 and 168 shall be applied in the shops. Items 164 and 168 may be applied in the shops or on site.

Item 110 shall be overcoated within 96 hours.

For planted columns:

Item 150 shall be applied over Item 110 from the bottom to 250 mm above ground level.

Item 164 or 168 shall be applied down to 225 mm above ground level, overlapping Item 150 by 25 mm.

Type G2b (Alternative)

Planted Columns shall have an additional sacrificial steel section thickness of a minimum 1.0 mm, above that needed in the design, from the bottom of the column to at least 250 mm above ground level; additional thickness to be recorded in Part A of Appendix 13/2, Column and Bracket Data Sheet.

(i) External and internal surfaces.

Flange mounted and planted columns, overall treatment.

Galvanize.

(ii) External surfaces.

Flange mounted and planted columns, overall treatment.

1st Coat: Item 155, T Wash.

Flange mounted columns, additional overall coats. Planted columns, additional coats for upper section only.

1st Coat: Item 130, Vinyl/Vinyl Copolymer Primer. B or AS. mdft 60 microns.

2nd Coat: Item 131, Vinyl/Vinyl Copolymer Finish. B or AS. mdft 60 microns.

Minimum total dry film thickness 130 microns.

Planted columns, additional coats, for ground section only.

1st Coat: Item 110, Zinc Phosphate Epoxy Primer (2 pack). B or AS. mdft 30 microns.

2nd Coat: Item 150, Pitch Epoxy (2 pack). B or AS. mdft 100 microns.

Minimum total dry film thickness 150 microns.

(iii) Application instructions.

The requirements of sub-Clause 1914.21 need not apply for lighting columns which remain in a shop environment after galvanizing.

T Wash and shop paint coats on external surfaces, and site paint coats where access permits, shall be returned on to edges and 25 mm inside at ends, at door and other openings and 25 mm under base flange.

Items 110 and 150 shall be applied from the bottom to 250 mm above ground level.

Items 130 and 131 shall be applied down to 225 mm above ground level, overlapping Item 150 by 25 mm.

Item 131 may be applied in the shops or on site.

NG 1902 Surface Preparation - General Requirements

Shop and Site Work

- 1 In most cases the use of a cleaning agent followed by rinsing is considered to be more effective than the use of a solvent. If traces of oil or grease remain after the first attempt, further cleaning may be necessary. However if wetting of the surface is not permissible, use of a solvent may be necessary.
- 2 It should be ensured that, throughout the duration of the work, clean water is used for wet cleaning and rinsing. Generally, potable water will be satisfactory, but there should be a check that the water (or the cleaning agent) does not leave harmful residues on the surface. Warm water may be used where appropriate.
- 3 There should also be a check that the cleaning agents offered do clean satisfactorily and do not themselves leave harmful residues on the surface after final rinsing. Abrasives should be checked for freedom from impurities which could contaminate the surface to be cleaned.
- 4 Dry blast cleaning in particular may have to be repeated if the steel to be used for the Permanent Works has become rusted and contaminated before fabrication as a result of being stored in the open in an industrial environment. In some cases the site coats may not be applied for a considerable time and repeated cleaning down may be required.
- 5 Blast cleaning will not remove all weld spatter; it should therefore be ensured that firmly adhering spatter is removed before blast cleaning. In most cases weld spatter can be removed before the application of a protective system. It will not, however, be possible inside some hollow sections, e.g. tubes, even if these are to be galvanized internally.
- 6 Except at site welded joints, dry methods of surface preparation should be specified for the inside of box girders otherwise excessive water will accumulate on the bottom surfaces especially between stiffeners, also surfaces may remain wet for some time and delay painting. The internal surfaces of hollow sections which are to be coated should be free from dust and debris as far as practicable.
- 7 Although the initial surface preparation may have been satisfactory, and all dust and debris removed, further dust may well collect on the cleaned surface. In harsh environments further pollutants may also be deposited. It is essential therefore to check surfaces immediately before painting.

- 8 If particles of abrasive are allowed to fall onto a freshly painted surface they are likely to become embedded in the wet paint. Shop coats in particular may also become contaminated by metallic dust from badly contained metal spraying operations. Embedded abrasive in fresh paint should be removed, and if necessary, the affected coat restored. Wet paint which has been contaminated by metal spray dust should be removed completely. If dried films only have been affected, wet cleaning may prove effective in removing such surface dust, however careful checks should be made. Metal spray dust remaining on an MIO pigmented coat, for example, would be difficult to remove later and could cause early failure of site coats.
- 9 Cleaning of the shop coats before painting on site will usually be necessary as it is not possible to check that all areas are free from contamination.

NG 1903 Surface Preparation - Materials and Methods

Dry Blast Cleaning in the Shops

- 1 There should be a check that the grading and hardness of the abrasive used for the work complies with Clause 1903. It is important to realise that the restrictions on abrasive sizes necessary to keep the blast cleaning profile within the ranges covered by the Surface Profile Comparator will also reduce the number of 'rogue peaks'.
- 2 Samples should be taken from abrasive stored in the blast cleaning plant before the start and during the work to ensure that there are no oversize particles in the mix. All fresh supplies should also be checked before they are used to replenish abrasive in use. The inspector should have the necessary sieves in his possession in the shops. Abrasive which does not comply with the Specification should be rejected. Oversize particles in excess of that allowed by the relevant standard, for example, are unacceptable. The performance of equipment and the technique of the operator can affect the attainment of a satisfactory profile or cleaning rate. A working mix with oversize particles will increase the frequency and size of rogue peaks and affect the cover provided by the subsequent painting.
- 3 Contamination of abrasives is not generally a problem in the shops when new steel is being blast cleaned. However the whole mix may well have become contaminated if steel, which has been exposed to, say, sulphates or chlorides, has been put through the plant. Hence the importance of early and subsequent checks.

Abrading in the Shops or on Site

- 4 Power wire brushing, whether or not preceded by chipping or scraping, is unlikely to achieve a satisfactory standard of cleanliness and is therefore considered as no more than an aid prior to abrading.
- 5 Abrading will be used mainly to repair mechanical damage and during restoration of local failure in the shop paint system. Water should not be allowed to come into contact with exposed metal spray coatings which are porous, nor if possible with bright steel. However, wet abrading can be usefully employed where galvanizing is present.
- 6 Only power tools which rotate at the relatively fast speeds necessary for power wire brushing or abrading should be used. Deposits of concrete are difficult to remove if allowed to harden, hence it is important that appropriate chipping and scraping tools are used otherwise the paint system is likely to be damaged. The use of hard grinding wheels is not permitted for abrading as their edges can easily cut into the surface.
- 7 Electric drill speeds are relatively slow, the use of hand-held drills as a power source for wire brushing often results in a polished appearance due to the formation of a patina of pollutants and corrosion products.
- 8 Sub-Clause 1903.8 caters for the protection of exposed areas of cleaned steel substrate or metal spray coatings before they can be adversely affected by wetting or debris from adjacent surface preparation.

Wet Cleaning in the Shops or on Site

- 9 Shop coats which may have been exposed on site for a considerable time, particularly in an Inland or Marine environment, should be thoroughly cleaned. Scrubbing of flat surfaces is usually satisfactory, however light wet blast cleaning may be necessary to remove harmful contamination from areas difficult to clean. The selected cleaning agent should be used as recommended.

Dry Cleaning in the Shops or on Site

- 10 Dry cleaning is usually satisfactory for internal surfaces as these are less likely to have become contaminated. Nevertheless these surfaces should be checked before painting and further cleaning carried out if necessary. If this is unsatisfactory, advice should be sought from the National Roads Authority.

Dry Blast Cleaning on Site

- 11 Copper slag can be used to blast clean steel surfaces which are to be painted only, also to remove unsound paint; however if surfaces have become heavily contaminated, dry blast cleaning may not be adequate and wet blast cleaning may be necessary. Modern and efficient blast cleaning equipment which will recirculate metallic abrasive is available. The requirements for fasteners are covered in Clause 1904.

Sand (or other substance) containing free silica may not be used as an abrasive for blast cleaning.

Wet Blast Cleaning on Site

- 12 The main advantages of wet blast cleaning on site are that it keeps dust down and that it is the best method of removing heavy contamination. It should not be used to clean up metal spray coatings because they are porous. Wet blast cleaning as a first time method will not produce a satisfactory profile for the application of metal spray. It should only be used on bolted connections if dry blast cleaning is impractical, otherwise water will penetrate into the joint. It is, however, satisfactory for welded joints which are to be painted, also for cleaning up or removing paint over a steel substrate. It can also be used to clean up the surface only of a paint system applied over metal spray, but no further, as wetting of metal spray should be avoided.
- 13 Unless blast cleaned and adjacent surfaces are cleared of abrasive and debris within a short period, re-contamination is likely.

Combined Wet/Dry Blast Cleaning on Site

- 14 When wet blast cleaning is used to prepare steel surfaces, flash rusting may occur if painting is delayed. The required standard of cleanliness should be restored by light dry blast cleaning and paint should be applied while the surfaces are still clean.
- 15 As already mentioned, one of the main advantages of wet blast cleaning is its effectiveness in removing contamination; however, if this is not achieved using wet blast cleaning any subsequent light dry blast cleaning, although it may restore a clean appearance, is unlikely to remove contamination remaining on the surface or in the blast cleaned profile.

Other Requirements

- 16 Sub-Clause 1903.16 is an important sub-Clause as it informs the Contractor of the sequence of operations necessary to keep contamination of adjacent surfaces to a minimum when different methods of surface preparation are used.

Grinding After Surface Preparation in the Shops or on Site

- 17 Visible surface defects should have been rectified by grinding during fabrication and before blast cleaning in the shops. Blast cleaning may reveal further defects and these should be dealt with before shop painting. Heavy mechanical damage or scoring caused during transport or during erection should also be rectified by grinding but subject to thickness limitations specified in 1800 Series. Grinding has to be carried out with minimum damage to the surface and only skilled operators should be allowed to carry out this work.

NG 1904 Procedures for Treatment at Joints

General

- 1 The treatment specified at joints prior to assembly or welding, covers both shop and site conditions.

Most erection joints are prepared in the shops for completion later on site. In these cases particular attention has to be given to limiting the application of the primers and to stepping back the undercoats on the parent material.

Treatment at completed joints includes sealing against the ingress of water, this should be carried out concurrently with the painting of either shop or site joints.

The requirements are also adequate in the case of joints which have to be prepared and made entirely on site e.g. in permanent strengthening of steelwork. Generally, contact surfaces at HSFSG bolted joints are blast cleaned only or blast cleaned and aluminium sprayed.

Any metal coatings to be applied to fasteners in painted only joints, metal sprayed joints or metal sprayed and painted joints or where uncoated fasteners are to be provided, should be specified in Appendix 19/1. (see NG 1904.4).

Fasteners, Joint Material and Parent Material in Joints, Before Assembly or Welding in the Shops or on Site

Fasteners, Including Bolts, Nuts and Washers

- 2 Uncoated HSFSG fasteners are usually delivered with oiled threads or with all the surfaces lightly oiled. Blast cleaning should remove traces of light oil remaining after assembly of the joint. Heavier oil or grease should be removed before assembly.
- 3 Hot dip galvanized fasteners should generally be specified for joints in hot dip galvanized and painted steelwork. However stainless steel fasteners may have an application in some cases.
- 4 The usual metal coatings for fasteners are galvanizing, zinc electro-plating and sherardizing. In order to prevent rust staining of fasteners to be aluminium metal sprayed after assembly either in the shops or on site, zinc electroplating, as a temporary coating, should be specified, but this will be blast cleaned off preparatory to metal spraying. In the case of small structures stainless steel fasteners may be considered as an alternative. Hot dip galvanizing applied before assembly (seldom after), and metal spray coats applied to fasteners after assembly provide long term protection. Other than hot dip galvanizing, metal coatings applied before assembly, including zinc electro-plating and sherardizing, only provide short term protection and will require a full protective paint system. T Wash should not be applied to fasteners in assembled site joints as it is likely to penetrate into the joint. It can also run down on to painted surfaces, and cause problems if splashed on to other surfaces as it is a weak acid.
- 5 Coated fasteners are usually delivered free of oil. As the threads are dry, difficulty in tightening may occur if the fasteners have been exposed outside in conditions where the nut and bolt threads have become corroded, this applies particularly to galvanized fasteners. Fasteners affected to this extent should be replaced.

Joint Material and Parent Material in Joints

- 6 Steel contact surfaces or steel surfaces which are to be painted on site need only be restored to 2nd Quality. Surfaces of metal spray should be restored by blast cleaning to sound metal. Galvanized surfaces are only likely to need wet cleaning. The Contractor may opt to use abrading, grinding or sometimes blast cleaning to restore a clean surface at weld preparation areas.

Wire brushing of even lightly rusted previously blast cleaned surfaces is not acceptable.

At Joints Made with HSFG Bolts

- 7 It is important that paints other than a primer or sealer should not be taken into the contact surface area, and that the primer should not be applied further than specified. HSFG bolted joints in galvanized steelwork are unusual.
- 8 When paint is applied to the outer faces of joint material at HSFG bolted joints, a check should be made that joint plates are not reversed during assembly; also if the maximum of 20 microns of paint is exceeded the whole coat should be taken off before the joint is made, otherwise the load carrying capacity of the joint may not be achieved. This also applies to sealer.

At Non Friction Bolted Joints

- 9 There are instances where HSFG or other high tensile fasteners may be used in shear and bearing rather than the more usual mild steel fasteners. As friction is not a criterion, paint may be taken over the joint surfaces. It is usually impracticable to apply the full shop system to the contact surfaces, but at least the primer and first undercoat should be applied.
- 10 Sealing of joints by assembling the plies on wet paint is not necessary for galvanized steelwork.

At Welded Joints

- 11 It is only necessary that surfaces to be welded should have a bright clean appearance. A check should be made however to ensure that they are free of metal coating, and other protective coatings, otherwise the weld could be impaired.

Parent Material, Shop Treatment Adjacent to Joints Which Are to be Assembled or Welded Later at Site

At HSFG Bolted Joints

- 12 Paint coats should be stepped back at breaks in the system, viz. at joints, otherwise the break will show on completion and a potential weakness in the protective coating may result.

At Non Friction Bolted Joints

- 13 It will usually be practical to take the full shop system over the joint surfaces.

At Welded Joints

- 14 Metal spray and paint should be kept back from weld areas not only to avoid degradation of the weld, but also to prevent damage to the

coating by heat and the possible production of toxic fumes. Galvanizing must be removed from the prepared joint area otherwise fumes and spatter may be excessive.

At Completed Joints

- 15 It should be checked that bad weather conditions or a severe environment have not affected unprotected bolted joints adversely; if adverse conditions are likely the Contractor should seal any gaps and apply sufficient protection within 48 hours, or earlier if possible, of a joint being made.

The protective system on adjacent parent material will usually be satisfactory for all types of joints. However because of varying requirements for the protection of welded site joints, e.g. internal welds and joints in metal sprayed or galvanized steelwork, the appropriate surface preparation for site welded joints should be specified in Appendix 19/1. See NG 1904.18 below. Advice on the treatment for site welds, including the use of phosphating agents may be sought from the National Roads Authority.

At Bolted Joints

- 16 Dry blast cleaning is preferable at newly-made joints as wet cleaning and wet blast cleaning in particular will lead to difficulties if water penetrates into the joints. If the registered priming coat on the outer surfaces is sound, dry cleaning may be adequate provided that the surfaces are checked finally for freedom from detrimental contamination.
- 17 Wet cleaning is usually suitable for galvanizing. It does not damage the surface and has been found to be satisfactory, for example for the type of joints used in parapets.

At Welded Joints

- 18 Site welds may be difficult to free from detrimental contamination by dry blast cleaning to 2nd Quality. After an external weld has been freed of slag and wire brushed, wet cleaning should be specified before dry blast cleaning.

Alternatively combined wet/dry blast cleaning can be used as this method is effective in removing contamination. When any form of blast cleaning is impracticable for external welds in painted only steelwork, wet cleaning should be followed by phosphating and a coat of Item 110, Zinc Phosphate Epoxy Primer, (2 pack). In most box girders, the water and debris from wet blast cleaning of internal surfaces would be difficult to clear up

satisfactorily and hence removal of slag, wire brushing and wet cleaning followed by phosphating and Item 109 should also be specified. Item 109 should be followed by the first undercoat of the system.

When a metal spray coating is to be applied over a welded joint, blast cleaning will be necessary.

The removal or stepping back of coatings (e.g. galvanizing) from the prepared joint area should prevent damage to the protective system. The protective treatment of welds and weld areas in galvanized steelwork should be dealt with separately in Appendix 19/1.

Sealing at Joints, Plies and Fasteners

- 19 If joints or steel plies have been exposed to water it should be ensured that they are free from moisture before gaps are sealed and the paint system applied.
- 20 There should be a check that paint penetrates the fine gaps sufficiently to provide an effective seal and that other gaps are painted in sufficient depth to maintain the seal in position.

NG 1905 Procedures for Treatment at Areas of Mechanical Damage or Other Surface Defects

- 1 Damaged coatings may require different treatment in the shops than on site. Reference should be made to Clauses 1907 and 1908 and related NG for requirements and guidance on workmanship standards for remedial treatment.
- 2 Damage in the shops to unprepared surfaces should be treated before blast cleaning. However minor areas of repair to blast cleaned surfaces which are to be painted need not be re-blast cleaned. Generally, most damage to coated surfaces is caused during transport and erection, often due to inadequate handling or stacking. Abrading is an effective method for dressing minor damage in steel surfaces or in metal coatings or for smoothing more heavily damaged areas after grinding. Fissures in the surface caused by the removal of 'hackles' or inclusions may need to be ground out, and when a metal spray is to be applied the area should be blast cleaned; however it should be ensured that mechanical damage or grinding, even if smoothed out does not reduce the thickness of the steel below specified limits.

- 3 Abrading is also an effective means of preparing small areas of damage in hard dry paintwork.
- 4 Blast primers less than 30 microns dry film thickness need not be replaced. However, other primers, e.g. AR and Epoxy (2 pack) Primers, which are usually applied at film thicknesses as greater than 30 microns, are an essential part of the protective system and should be replaced.
- 5 After surface preparation of a metal sprayed area by abrading or grinding, the whole of the affected area should be dry blast cleaned to ensure overall adhesion of the re-application of metal spray. There will be no clear demarcation between exposed steel substrate and the metal spray.
- 6 It is generally possible to restore metal spray coatings in the shops and replacement by paint should not be allowed.
- 7 When a metal spray coating together with any sealer is being restored on site during repairs to a damaged area the minimum thickness of metal coating should be increased to 150 microns. This is to ensure the required durability from the application on site.

It should be ensured that adhesion checks in accordance with ISO 2063, Annex A, method A1 are made at a representative number of repaired areas.

- 8 It would be uneconomical as well as unreasonable to expect metal spray coatings to be restored in every case of minor mechanical damage occurring on site, particularly on large components. However the extent of repairs by painting should be strictly limited.
- 9 The term 'in the shops' includes the galvanizer's works. A large proportion of hot dip galvanized components are delivered direct to site from the galvanizer, and generally any component with damaged hot dip galvanizing should be re-galvanized before despatch.
- 10 The incidence of damage is related to the type of component, care in storing and positioning for erection. For example a length of parapet laid out on a roadway for an unnecessarily long period is likely to be damaged. Minimum damage commensurate with proper care in handling only should be accepted. The relaxation at site applies to hot dip galvanized-only components (such as lighting columns) as well as to hot dip galvanized components protected by a paint system. Marking of the surface or light bruising of hot dip galvanizing should not be considered as damage referred to in Clause 1905.

- 11 The bevelling back of edges of adjacent, and apparently unaffected paint coatings, or metal coatings, into sound coatings will not only improve appearance but may also show up unsuspected adhesion defects. Only dry methods of surface preparation should be used when removing damaged or faulty paint from the surface of metal sprayed coatings (see NG 1903.5). Galvanizing on the other hand is not porous, either wet or dry methods may be used to remove paint and prepare the surface before coating.
- 12 T' Wash contains a weak acid and should be wiped off immediately if it has been applied over paint. Affected paint should then be wet cleaned.
- 13 It should be ensured that the Contractor does not extend the specified overcoating times, otherwise local failure early in the life of the system is likely.

NG 1906 Procedures for Treatment of Local Failure in Protective Coatings

- 1 Local failure of coatings may also require different treatment in the shops than on site. Remedial work is likely to be more extensive than in the case of repair to mechanical damage; this is because contamination or other cause of failure may affect a relatively wide area. Reference should be made to Clauses 1907 and 1908 and related NG for requirements and guidance on workmanship standards for remedial treatment.
- 2 Achieving adequate standards of surface preparation, including freedom from harmful residues and detrimental contamination, is most important when remedying areas of local failure in paint coats or metal spray coatings. Local failure, early in the life of the shop coats or after completion of a system on site, is usually due to painting in adverse conditions or inadequate surface preparation initially e.g. ineffective removal of contamination including oil or grease prior to painting. Early failure of a metal spray coating is often due to poor adhesion, the usual causes being delay in application, say overnight, excessive spraying distance or even steel at too low a temperature. The causes of local failure should be investigated as soon as possible so that the fault can be corrected. It should be ensured that all protective coatings are up to standard before steelwork leaves the shops.
- 3 Although site blast cleaning to 2nd Quality will be acceptable as far as visible residues are concerned, equivalent relaxation in the

standard of chemical cleanliness is not permissible. Particular attention should be paid to checking the latter as contamination may have caused the local failure.

- 4 Local failure of galvanizing, e.g. detachment of the coating, may be indicative of extensive unsound galvanizing. In all cases the component should be regalvanized.
- 5 It should be ensured that the full extent of the failure has been cleared of unsound paint and checked that any abrading of paint coats has not damaged any underlying galvanizing by reducing its thickness unduly.
- 6 The cause of any failure should be ascertained and it should be ensured that the Contractor achieves the required standard of surface preparation, including the removal of contamination, before overcoating. The expertise to mount tests to verify that surfaces have been cleaned adequately should be available.

NG 1907 Workmanship Standards for the Surface Preparation of Steel by Blast Cleaning, Abrading, Grinding and Cleaning

- 1 The method of surface preparation required, e.g. blast clean, and when appropriate the abrasive to be used, e.g. chilled cast iron grit or aluminium oxide (for metal spray in the shops) should always be specified in Appendices 19/1 to 19/4. The standard, e.g. clean steel, 1st Quality medium profile should also be specified. If the type of abrasive is not specified the Contractor may use any of the abrasives described in sub-Clause 1903.1 in the shops. Steel shot is satisfactory for blast cleaning surfaces to be painted only.
- 2 The Surface Profile Comparator is an 80 mm square stainless steel plate showing agreed ranges for fine, medium and coarse blast cleaning profiles. There are separate Comparators for assessing profiles produced by grit and by shot abrasives. The NSAI or BSI should be contacted for details and names of suppliers.
- 3 The amplitude of the blast cleaning profile on new steel is largely controllable by the size of abrasive used. Although the size and incidence of rogue peaks are also related to the size of abrasive, faulty manual blast cleaning techniques can greatly increase the problem. Regular use should be made of the Comparator

and frequent checks of the abrasive should be carried out to ensure compliance with sub-Clauses 1903.1 and 2.

- 4 'Hackles' ranging from small spikes, some just visible to the unaided eye to those which have to be pulled from the surface and leave fissures which require treatment by grinding, show up as a result of blast cleaning, even when fine grades of abrasive are used. It is difficult to distinguish between rogue peaks and small hackles, and because the latter can appear at any time during blast cleaning, even if the process is well controlled, continuous checking is necessary. If metal spray, in particular, is to be applied, then the remainder of the component as well as the dressed areas may have to be blast cleaned in order to comply with ISO 2063.

Even if paint only is to be applied, re-blast cleaning may be required if the dressed areas are large, viz. such that the surface preparation by blast cleaning overall can no longer be claimed to exist.

- 5 Generally, dry blast cleaning to 1st or 2nd Quality, of lightly rusted surfaces which may be contaminated to a minor extent, will reduce contamination to negligible quantities. However, as the levels of rust and contamination on stock steel increase, so will the quantity of soluble salts remaining after blast cleaning increase; these will be unevenly distributed, making inspection difficult. The abrasive in use is also likely to become contaminated and may spread salts over otherwise clean surfaces.

Surfaces should therefore be checked for contamination before and after blast cleaning particularly in the case of more heavily rusted stock steel. If blast cleaned steel is still contaminated to an unacceptable level it should be rejected immediately; the abrasive should also be checked, see sub-Clause 1903.3. The Contractor may decide to pre-clean steel so that it can be finally dry blast cleaned satisfactorily; some blast cleaning plants include a washing stage for this purpose.

- 6 The requirements for 'clean steel' and 'bare steel' to be achieved by blast cleaning are described in sub-Clause 1907.5, those for freedom from 'harmful residues' or 'detrimental contamination' are described in sub-Clause 1907.7. See also Clause 1908.

It will be seen that 'clean steel' can only be achieved by blast cleaning the surface to 1st or 2nd Qualities. 'Bright steel' can be chemically clean if the steel surface was chemically clean originally. However there may be cases where an 'overall bright appearance' will be obtained

in a contaminated area, in which case any remaining detrimental contamination will have to be removed. 'Bright steel' however can be accepted for final dressing of small areas, such as sharp corners and other surface defects prior to painting or galvanizing.

Blast cleaning to clean steel 1st Quality with chilled cast iron grit or aluminium oxide grit is necessary for the successful overall adhesion of metal spray coatings. 1st Quality should also be specified for exposed steelwork when minimum maintenance is required, that is without any rusting through from the substrate having occurred.

Note: For the extent and depth of surface defects permitted in steel, reference should be made to the thickness limitations specified in the 1800 Series.

- 7 At present, BSI or ISO specifications or accepted Codes of Practice setting limits on embedment of particles of abrasive are not available. Some small particles may remain embedded in the profile. Faulty blast cleaning techniques, e.g. too high an air pressure, and large sharp particles, will exacerbate the problem. Sharp particles projecting above the blast cleaning profile will be harmful, as will large quantities of abrasive particles lodged in the profile. However experience has shown that agreement on acceptable limits is reached without difficulty.
- 8 For systems for difficult access structures the limits for harmful residues and detrimental contamination will be 'virtually nil'. Where 'bare steel' has been specified, checking surfaces for detrimental contamination is most unlikely to be necessary.

The same principle also applies to protective coatings.

NG 1908 Workmanship Standards for the Surface Preparation of Coated Steelwork by Blast Cleaning, Abrading, Grinding and Cleaning

- 1 The standards of workmanship described in sub-Clause 1908.1 are for remedial work carried out in accordance with Clauses 1905 and 1906.
- 2 The terms listed in sub-Clause 1908.2 are in use for maintenance contracts as well as for new works.

- 3 The term 'restored' is now a defined term; lower standards for replaced coatings are not acceptable.
- 4 In the shops, the most frequent cause for having to remove a metal spray coating is lack of adhesion. Subject to proper control, dry blast cleaning will remove a metal spray coating completely, this being necessary in the case of adhesion failure. Wetting of the surface, over say 1.0 m², at regular intervals is a practical method of checking that the metal spray is being removed. The wetted area should show even rusting.

On site, prolonged exposure in a harsh environment is likely to cause corrosion of a metal spray coating. In severe cases all but traces of the coating allowed under sub-Clause 1908.4 should be removed, wet blast cleaning may have to be used in such cases followed finally by dry blast cleaning. Only dry blast cleaning should be used to remove a damaged or failed paint system over metal spray or to clean up the surface of the metal coating itself: this is because metal spray coatings are porous, retained moisture may cause early failure of a restored paint system.

NG 1909 Paint and Similar Protective Coatings

- 1 Grease paints are protective coatings based on Calcium Soaps of Oxidized Petroleum Wax and are applied by brush or airless spray and are similar in appearance to ordinary paints but do not harden completely. When the solvent has evaporated grease paints are hard enough to walk on. Epoxy Pitch (2 pack) coatings and bitumens are also covered by Clause 1909 requirements.
- 2 Appendix 19/5 should be checked to ensure that the registered dates have been entered by the Contractor. Late registrations will not be permitted.

The fact that paints have been registered does not imply approval and the Contractor remains responsible for the adequacy of the paints he has selected. It has been found, for example that the film thickness claimed by a paint manufacturer for high build brushing paints cannot always be attained where applied directly on a blast cleaned surface, even by a skilled applicator.
- 3 Tins should show all the specified markings and the required standard should be insisted on at the outset. Omission of the Item Number for example, can lead to delay in checking the

specific gravity on site and the despatch of A and B samples. A check of the batch numbers will enable the inspector to verify whether the first batch of paint consists of less than 200 litres. If so, the batch should be discarded as required under sub-Clause 1910.3.

- 4 In practice, a paint manufacturer issues Appendix 19/8, Form BE/P5 Paint Data Sheet, to the Contractor. The Data Sheets should be examined and any special stipulation as to application which may cause problems or delays during the work should be noted and brought to the attention of the Contractor. If, for example, the weather is likely to be unfavourable the Contractor should be fully aware of any relevant restrictions on the application of the paints.
- 5 A source of supply should only be rejected after consultation with the National Roads Authority. Rejection would be considered in circumstances such as late or non-registration, unusable paint or closing down of the paint manufacturer's works.

NG 1910 Testing of Paints

Provision of Samples

- 1 Quality assurance of paint as delivered, that is verification of the composition data and application characteristics given in paint manufacturers' registered formulations can only be carried out on paint samples taken from previously unopened tins; these are known as 'A' Samples.

Before the Contractor despatches the 'A' Samples to the address given in NG 1910.5 for testing in accordance with sub-Clause 1910.4, the checks referred to in NG 1910.3 below should be carried out but on paint taken from other tins of the same batch.

'B' Samples, on the other hand, should be taken from paint in use to ensure that it is as supplied. See sub-Clause 1910.8 and NG 1910.8.

'A' Samples

- 2 Although A' samples are not required in the case of certain bridge and other highway structures described in sub-Clause 1910.2, 'B' samples should still be taken as these make an effective contribution to quality control.
- 3 Special deliveries of single tins of paint arranged by the Contractor, to the site or to the testing authority, are not acceptable as A'

samples. Samples should be selected from fully representative batches at the shops or on site. As a minimum, the condition of the paint in the tins should be examined and, after mixing, the specific gravity checked; matching of finish colours to BS 4800 should also be checked. Paint found to be faulty, especially in the case of appreciably incorrect specific gravity should be rejected on site. For guidance on specific gravity tolerances reference should be made to the Notes Section in the Manual of Paints for Structural Steelwork. It should be ensured that the cause of any unsatisfactory application during the procedure trial is remedied before the start of the main painting.

- 4 After submission of the first A' samples of each type of paint, further A' samples should be submitted for testing as painting proceeds depending on the weight of structural steel in the Permanent Works.

The Contractor may deliver paint to the shops or site in containers up to 25 litres providing that the tops are of the completely removable clip-on type and that the contents are thoroughly stirred using a mechanical mixer when taking samples and prior to use. A' samples must be correctly labelled before despatching for testing.

- 5 Details of each set of samples despatched should be listed in Appendix 19/6, Form BE/P3 Paint Sample Despatch List. A copy of each form should be forwarded immediately to the National Roads Authority and a further copy to the Coatings Section, Materials Technology Department, Enterprise Ireland, Glasnevin, Dublin 9, which is the testing authority.

Single copies of completed Appendix 19/5, Form BE/P2 (New Works) Paint System Sheet should be sent to the National Roads Authority, and to the testing authority, at the same time that Appendix 19/6 is forwarded for the first A' samples or first 'B' samples (if A' samples are not required).

The testing authority will notify the results of tests on Form BE/P4 Paint Sample Analysis Report (Appendix 19/7).

- 6 It should be noted that at the height of the painting season, testing and assessment of the first A' samples may take up to ten weeks. Unless therefore special arrangements can be made with the testing authority, for priority in testing samples, the Contractor cannot be expected to start painting under ten weeks from the time of awarding the Contract.

Once the Contract has been awarded, the Contractor should order paint early enough to

enable the first A' samples to arrive at the testing authority at least ten weeks before painting is due to start, or sooner if possible, so that the results of the analysis can be assessed in time. Also, throughout the work, the remaining paint should be ordered sufficiently in advance to allow time for testing subsequent A' samples.

About 2 weeks is required for testing 'B' samples.

- 7 Painting may be permitted to be started before the results of testing A' samples have been received only if postponing the painting would mean an unacceptable delay in the work; however it should be made clear to the Contractor that such permission shall not relieve him of his obligations under the Contract. When a first A' sample is rejected, an A' sample of the replacement batch of paint should be submitted for testing as soon as possible. If painting is allowed to proceed with a replacement batch or a subsequent batch still under test, it should also be made clear to the Contractor, that such permission shall not relieve him of his obligations under the Contract.

'B' Samples

- 8 Control or 'B' samples are to be taken from a painter's kettle or from the airless spray gun nozzle, in order to ensure that paint actually being applied will be tested. 'B' samples are a check on the applicator rather than on the paint manufacturer, the main fault being lack of proper mixing; samples should be taken as spot checks on the thoroughness of the Contractor, with a minimum of, say, one batch in three being sampled. *B' samples of mixed two pack materials can only be tested in situ and before any reaction has taken place.

Provision of 500 ml Tins, Packing and Transport of 'A' and 'B' Samples

- 9 It should be ensured that the Contractor has provided an adequate number of tins, lids and lid clips at the start of the work, to enable samples to be taken.
- 10 Unless tin lids are clipped down securely, and the tins properly packed, the contents may be spilled. Even if only one tin leaks, the spilled contents may obliterate markings on other tins, testing thus being delayed until new samples are checked and delivered.
- 11 The selected A' or 'B' samples should be labelled correctly as described in Appendix 19/6

and despatched promptly throughout the Contract. Not only should the Contractor despatch samples promptly, but his transport arrangements should be such that the samples reach the testing laboratory without delay, particularly in the case of the first 'A' or 'B' samples.

NG 1911 Metal Coatings

- 1 Adequate control of the pickling process is important otherwise the properties of higher grade steels can be affected. However the requirements in Clause 1911 are precautionary and should prevent difficulties.

Passivation by chromating of galvanized surfaces should not be permitted if painting is intended, as this treatment, on lighting columns for instance, may prevent the action of TWash.

- 2 Effective protection is unlikely in areas where the thickness of a sprayed metal coating is less than 100 microns. The terms nominal or average are not used in the Specification. Although zinc metal spray is referred to in sub-Clause 1911.2, experience has shown that it is not suitable for overall application to highway structures such as bridges, gantries, lighting columns or parapets. Zinc metal spray will, however, have an application for other components, e.g. temporary structures in a mild environment.

It is now known that many failures of metal spray coatings have been due to unsatisfactory surface preparation leading to poor adhesion. Application in two layers and poor application technique have also caused problems. Particular close inspection at all stages is essential. The standard of blast cleaning must be clean steel, 1st Quality, medium profile using chilled cast iron grit or aluminium oxide grit.

- 3 Sherardized coatings offer temporary protection only, if fasteners cannot be free from detrimental contamination by dry methods, e.g. by dry cleaning or dry blast cleaning, they should be replaced.
- 4 The advice on sherardized coatings applies to zinc electroplated coatings.
- 5 The hot dip galvanizing of steelwork should only proceed when the procedure to be adopted by the Contractor will produce satisfactory workmanship complying with the Specification. In the case where acid pickling or fluxing is required prior to metal coating of higher grade HSPG bolts or components of higher grade

steels, e.g. steels with a tensile strength over 827 N/mm², possible defects caused by any hydrogen absorption or other adverse effects should be investigated.

NG 1912 Testing of Metal Spray Coatings

- 1 It is to be expected that contractors undertaking metal spraying have the necessary expertise, particularly in respect to understanding the importance of a clean sharp blast cleaning profile and of being able to check adhesion with modern equipment. Nevertheless it should be ensured that all the requirements are being met, otherwise experience has shown that early and very expensive failures can occur. Adhesion tests should be made in accordance with recommendations of the manufacturer of the testing equipment, for example the pull-off force must be normal to the surface. Usual reasons for lack of adhesion are bad application techniques or blast cleaned surfaces which have been exposed, even for a short time, in a damp environment and have lost their initial bright finish. When the overall adhesion is suspect, all the metal spray must be blast cleaned off the area in question as obviously any residual metal spray may also be defective. In the excepted areas, adhesion cannot be checked by the test panel method; the only practical method being the grid test described in ISO 2063, Annex A, carried out as the work proceeds.

NG 1913 Storage Requirements and Keeping Periods for Paint

- 1 It should be ensured that a suitable store has been provided and that paint is unloaded directly into it. The store temperature should be controlled within the limits specified. Extremes of temperature, freezing conditions in particular, can affect the properties of the paint. The paint store should be as near as practicable to the painting areas. If the paint store is at a considerable distance from the work area, paint is unlikely to be returned to the store at the end of the working day, or several tins may well be kept out on site to be ready for use and thus may be damaged by extremes of temperature; also if the inspector has to waste time in journeying to and from the paint store to check deliveries and select samples, his supervision of the work will be less effective.
- 2 The date of manufacture in particular must be marked on the tins, see sub-Clause 1909.3. If

the date of manufacture is not indicated the paint should always be rejected.

The requirement that paint in use should be returned to store and kept in sealed containers should be enforced for both brushing and airless spray grades. Paints with fast evaporating solvents will be adversely affected if the containers are left open in hot weather.

Only the types of paint referred to in sub-Clause 1913.4 should be considered for extended keeping times. The performance of other paints can be permanently affected if their keeping times are exceeded. The paint manufacturer's checks will include the following:

Property	Likely fault
Condition in tin	Settlement, skinning, separation
Viscosity	Tendency to body
Drying time	Absorption of dryers
Fineness of grind	Pigment agglomeration, resin "seeding"
Colour	Flocculation, agglomeration of colour pigments

Lastly, the paint manufacturer will verify that the specific gravity of paint about to be returned after any necessary reconstitution is correct.

Paints which have exceeded the keeping period before delivery, or during storage before or after testing under Clause 1910, should not be used. These paints should not be tested or retested until the requirements of sub-Clauses 1913.4 and 5 have been complied with.

NG 1914 Application of Paint

- 1 Up to an additional 5% solvent may be required when painting is carried out at extremes of temperature or to correct a minor deviation from the normal viscosity.
- 2 It should not only be checked that surface preparation has been carried out in accordance with the Specification but also that the standard has been maintained up to the time of application.
- 3 Paints and other protective coatings in the Manual of Paints for Structural Steelwork are generally applied either by brush or airless spray or by both. However, for paints with lower viscosities, e.g. etch primer, good use can be

made of air pressure spray equipment to avoid over application, flooding and overspray of paint.

Work should not be allowed to proceed outside the limits specified in Clause 1914. Records should be kept as these will be required should any premature failure occur.

Difficulties may arise on site in deciding when a surface is dry enough to paint. Most types of paint are intolerant of moisture at the time of application and during the curing period. At present, there is no method for checking the amount of moisture deposited on a surface, or advice on how much moisture types of paints will tolerate. Generally, the rule should be, if moisture is present or may be expected to be present at the time of application or during the curing period, then painting should not go ahead.

In winter or when weather conditions are unfavourable, it should be ensured that workshops, in which structural steelwork is to be painted, are properly enclosed.

A check on the amount of paint used after allowing for waste is a useful verification of film thickness. Notes on theoretical and actual quantities and cost comparison, also on attaining the required thickness of paint systems are available in the Manual of Paints for Structural Steelwork.

A record of wet film thickness checks should be kept. This is particularly important in the case of site painting; non-destructive checks of total mdft are unlikely to be conclusive although they are useful as a guide. If there is any doubt about the mdft of the shop or complete system it is possible to cut out 10 mm x 10 mm samples and have these checked. The usual practice however is to make a 90° 'V' cut into the system and to check the thickness of each coat with a small viewing microscope fitted with a graticule. A proprietary instrument of this type is available. Equipment necessary to carry out these checks should be kept on site. Reference should be made to the Notes Section of the Manual of Paints for Structural Steelwork for further information on paint coating thicknesses.

Defects are, as often as not, due to inadequate surface preparation rather than application of faulty paints. Compliance with the Specification, especially the requirement for satisfactory adhesion, should be checked from the time work starts and not left until the steelwork is about to be despatched from the shops or until the Contractor has dismantled

his scaffolding and is about to leave the site. Remedying faults in a difficult access situation, such as over a motorway, is usually time consuming and expensive. See NG 1901.91 v) regarding matching of MIO finishes.

Stripe Coats

- 9 Paint has a tendency to pull away from corners and even if the specified minimum total dft can be attained by careful application, it is unlikely to be maintained and stripe coating is always necessary. Excepting for alternative basic system Types 4, 8 and 10 and basic system Type 11 (see NG 1901.10) for which only one stripe coat in Item 112 paint is to be applied over Item 111 in the works, all other basic systems are to include two stripe coats. The first stripe coat is applied at the works to reinforce the shop system and the second on site to reinforce the site coats. When the whole system is applied at the works or on site, e.g. at connections, two stripe coats will still be required. It should be ensured that the first stripe coat on 'T Washed fasteners is brush applied carefully, any final traces of grease should be removed beforehand using a solvent, and not by wet cleaning down. On small square bars a single extra undercoat, applied in the shop or on site, replaces both the stripe coats.

Except for the above, application of stripe coats by airless spray is acceptable, and in most cases gives better and more uniform results. However in areas where space is restricted or when the system itself is brush applied, the Contractor will usually opt for brush application of stripe coats. 'Brushing out' of stripe coats should be avoided otherwise little paint will remain on the corners.

Exposure Times for Prepared Steel Surfaces and for Metal Coatings.

Exposure Times and Treatment of 'T' Wash and Overcoating Times for Paints

- 10 The times quoted in sub-Clauses 1914.15 to 20 and 23 to 27 are basic requirements when painting is carried out in average conditions in the shops or on site. However longer or shorter exposure times may be permissible depending on conditions. For example in an environment where the relative humidity is low, clean steel which has been dry blast cleaned in the shops or on site, can be left for longer than 4 hours provided that there will be no adverse effect.

Exposure times on site for sealed metal spray coatings may also be extended in good conditions. Components will be considered as not having been exposed, as described in sub-

Clause 1914.20, if they are fully protected during the short time which may be required for transport from shop to shop.

Transport should not be allowed during unfavourable weather, e.g. heavy rain, and should be restricted to a mile or so at the most.

- 11 Because of the variations in the surface condition of galvanizing and the lack of uniformity following the application and drying of T Wash with the exception of assembled T Washed fasteners, it has been found expedient to wash all T Wash treated surfaces before painting.
- 12 In a mild environment the time after delivery to site for the application of T Wash may be increased to allow painting to suit weather conditions or the work programme. In all cases the requirements of sub-Clause 1902.7 for removing dust and debris should not be overlooked.

NG 1915 Procedure Trials

- 1 The procedure trials are to ensure that the Contractor has the necessary knowledge and expertise, and that with the supervision, labour and equipment proposed to be used, the Contractor is capable of carrying out the work in accordance with the Specification.
- 2 The National Roads Authority attach considerable importance to procedure trials and permission to omit them should only be given in exceptional circumstances.
- 3 If changes in any paint formulation other than adding up to *b7e* by volume of solvent appear to be necessary, the Contractor should arrange for the paint manufacturer to forward the revised formulation to the Coatings Section, Materials Technology Department, Enterprise Ireland, Glasnevin, Dublin 9 and verify that the revised formulation has been registered before agreeing to the changes.
- 4 The requirement for further trials may be relaxed providing the Contractor can furnish evidence to demonstrate that replacement labour has the necessary skill and experience and that new equipment is suitable.

NG 1916 Storage and Transport of Steel and Fabricated Steelwork

- 1 It should be ensured that steel earmarked for the Works and held in stock for any length of time is adequately protected, e.g. stored under

cover. However if it is decided provisionally to accept rusted and possibly pitted steel as structurally satisfactory, checks should be made on the depth of corrosion defects and freedom from contamination, after blast cleaning. Dry blast cleaning may have to be repeated or air/water/abrasive blast cleaning employed in order to achieve the required standard of cleanliness.

- 2 Although relatively fast drying paints which keep down handling times for steelwork painted in the shops have been listed in the Basic Systems in NG 1901, overlapping of coats and cold weather may result in areas where the shop system takes longer to dry, thus delaying the handling and loading.
- 3 If at any time the Contractor has not complied with the requirements of sub-Clause 1916.3, the badly stored steelwork should be re-stacked immediately.

It is important, for example, that water is not allowed to pond inside box girders awaiting erection because restoring the specified standard of surface preparation by blast cleaning inside box girders after erection will be difficult to achieve.

- 4 If light steelwork is stored in the erection area it will be liable to damage during the handling of heavier components or from site traffic; it should therefore be stored out of the way until required.
- 5 Bridge parapets especially, and lighting columns tend to be laid out in position along the roadside for considerable periods where they are liable to site traffic damage and contamination. Therefore the requirements of sub-Clause 1916.5 must be complied with.
- 6 Damage to protective coatings can be avoided or kept to a minimum by careful slinging, stacking and general handling of steelwork. If preventable and excessive damage has been caused the Contractor should restore the coatings before undertaking further work. Such damage to protective coatings on lighting columns, for example, should be restored before erection.

NG 1917 Surfaces in Contact with Concrete

- 1 Steel surfaces in contact with concrete will usually be adequately protected from corrosion and therefore overall protective paint or other coatings are not normally required.

In areas where a steel/concrete bond is not required the adjacent primer and first undercoat, or the primer only if applied at a mdf of 40 microns, may be specified for the contact area to reduce rust staining before and during the erection stage. Uncoated aluminium metal spray is particularly reactive to wet concrete and, even when sealed, should not extend into the concrete/steelwork contact area when not protected by paint. Item 109 or 110, Zinc Phosphate Epoxy (2 pack) sealer applied at 25 microns mdf should cover the peaks of the aluminium metal spray and provide a barrier coat between the metal spray and concrete contact surfaces.

- 2 In areas such as the underside of galvanized base plates or in concrete/galvanised steel contact areas in composite construction, it is generally accepted that galvanizing does not react harmfully with concrete, and as selective galvanizing is impractical, the concrete may come into contact with galvanized surfaces. The 25 mm return for paint coats is still required.

Concrete or grout spatter or runs must however be cleaned off, see sub-Clause 1902.9. In higher risk areas, particularly in the presence of high humidity, the use of a protective membrane or sheathing should be considered.

NG 1918 Form BE/P2 (New Works) Paint System Sheet (Appendix 19/5)

Form BE/P5 Paint Data Sheet (Appendix 19/8)

- 1 Normally, a copy or copies of Appendix 19/5, Form BE/P2 (New Works) Paint System Sheet will be provided in the tender documentation, of which parts 1, 2, 3 and 4 (which are common to the various protective systems in the Contract) will have been completed. It should be ensured that in part 1 of Appendix 19/5 the National Grid reference required for the National Roads Authority's records has been included.

Grid references are not required for parapets only, or for lighting columns (other than high masts).

- 2 As soon as the Contract has been awarded the Contractor is required to prepare a copy or copies of Appendix 19/5 of which he will have completed parts 5 to 9 for each of the systems specified in Appendices 19/1 to 19/4. At the same time, the Contractor is required to provide relevant copies of Appendix 19/8, Form BE/P5 Paint Data Sheet, containing data which is required for checking paints before and after

application. Full application instructions are also given. The information provided in Appendix 19/8 is the responsibility of the Contractor.

Approved copies of Appendix 19/5 should be forwarded to the testing laboratory, together with the first Appendix 19/6, Form BE/P3 Paint Sample Despatch List. See NG 1910 for details of checks on samples and despatch requirements, also the instructions to the inspector in Appendix 19/6.

NG 1919 Access and Lighting

- 1 For surface preparation and coating application to be carried out satisfactorily, it is important that the working area and access should permit, wherever possible, unrestricted access to the workface by the operators. For example, if the blast cleaning nozzle or the airless spray gun cannot be held at the correct angle or be moved freely, then good uniform work will be difficult to attain. It is equally important that the supervisory staff and inspectors should feel secure when carrying out checks.
- 2 If lighting is inadequate, workmanship will also be adversely affected and thorough inspection difficult. It should therefore be ensured that natural lighting is supplemented by temporary lighting as necessary to maintain an intensity of illumination at the workface of at least the specified 500 lux during work and inspection. Spot lighting of small areas is not acceptable and hence the requirement that the lighting should cover at least 1.0 m².

NG 1920 Additional Requirements for the Protection of Steel in Bridge Bearings

Applicable Clauses

- 1 The testing of A' samples will seldom apply but 'B' samples should be taken and checked immediately in the shops for compliance. Also, as the procedure trials are unlikely to be necessary, it should be checked that the correct abrasive is being used and that the standard of blast cleaning and application of metal spray comply with the Specification.

It should be ensured that the Contractor complies with the requirements of Clause 1918 regarding the provision of Appendices 19/5 and 19/8.

Supply of Coatings

- 2 In order to minimise costs the bearing manufacturer may stock two-pack epoxy coatings supplied by a single manufacturer of his choice.

It should be checked that the 'T' Wash and other coatings are supplied by the paint manufacturer listed in the approved Appendix 19/5.

NG 1921 Additional Requirements for the Protection of Steel Lighting Columns and Bracket Arms

Applicable Clauses

- 1 The testing of A' samples is not required for lighting columns but 'B' samples should be taken and checked immediately for compliance. Also, as the procedure trials are unlikely to be necessary, it should be checked that the correct abrasive is being used and that the standard of blast cleaning and application of metal spray comply with the Specification. A separate Appendix 19/5 must be provided for each different system on each area of the columns in accordance with Clause 1918. For example, in the case of a Type A2b (Alternative) basic protective system for planted columns, the Contractor will need to complete three Appendices 19/5, one for the treatment of external upper surfaces, one for the treatment of external ground surfaces and one for the treatment of internal surfaces.

Surface Preparation

- 2 Because lighting columns are made of relatively thin steel the level of rusting of steel offered for the work should be limited as described in Clause 1921. Pitting inside columns, particularly those which have not been galvanized, will shorten the useful life of the column.

Stripe Coats

- 3 Lighting columns are manufactured on a production line, and to reduce the time required for painting only one stripe coat has been specified. When the last two coats are site coats, the stripe coat may also be applied on site.

PROTECTION OF STEELWORK AGAINST CORROSION

APPENDICES

Appendix 19/1

Protective requirements for bridges, parapets and other structures excluding bearings & lighting columns

Appendix 19/2

Protective requirements for bearings

Appendix 19/3

Protective requirements for lighting columns and bracket arms

Appendix 19/4

Protective requirements for other work

Appendix 19/5

Form BE/P2 (New Works) Paint System Sheet

Appendix 19/6

Form BE/P3 Paint Sample Despatch List

Appendix 19/7

Form BE/P4 Paint Sample Analysis Report

Appendix 19/8

Form BE/P5 Paint Data Sheet

Appendix 19/9

General Requirements

PROTECTION OF STEELWORK AGAINST CORROSION

CLAUSES AND APPENDICES

	SURFACE PREPARATION Clauses 1902-1908	Appendix 19/1 Appendix 19/2 Appendix 19/3 Appendix 19/4 Appendix 19/9
Register paint formulations i.e. component specifications (UK Department of Transport Standard BA 27 Methodology)	<hr style="width: 50%; margin: 0 auto;"/> Clause 1909 Register Paints with Registration Authority Form BE/P2	Appendix 19/5 Appendix 19/9
Provision of samples of the actual contract paint for testing and comparison with registered and approved formulations. Testing to UK Department of Transport Standard BD 35, by testing authority (Clause NG 1910).	Clause 1910 Provision of samples A' & 'B' from contract paint	Appendix 19/9
	METAL COATINGS Clauses 1911-1912	Appendix 19/9
	PAINT STORAGE REQUIREMENTS Clause 1913	
	APPLICATION OF PAINT Clause 1914	Appendix 19/1 Appendix 19/2 Appendix 19/3 Appendix 19/4 Appendix 19/5
	PROCEDURE TRIALS Clause 1915	Appendix 19/1 Appendix 19/2 Appendix 19/3 Appendix 19/4 Appendix 19/9
	STORAGE & TRANSPORT Clause 1916	
	CONTACT WITH CONCRETE Clause 1917	Appendix 19/1 Appendix 19/2 Appendix 19/3 Appendix 19/4 Appendix 19/5 Appendix 19/8 Appendix 19/9
	FORM BE/P2 & BE/P5 Clause 1918	
	ACCESS & LIGHTING Clause 1919	
	BRIDGE BEARINGS Clause 1920	
	STEEL LIGHTING COLUMNS Clause 1921	

NG SAMPLE APPENDIX 19/1: REQUIREMENTS FOR BRIDGES, PARAPETS AND OTHER HIGHWAY STRUCTURES EXCEPT BEARINGS AND LIGHTING COLUMNS

1 Environment: Inland.

2 Accessibility: Difficult Access.

3 Required durability:

No maintenance up to 12 years.

Minor maintenance from 12 years.

Major maintenance after 20 years.

4 Surface preparation and protective systems.

(i) Surface preparation. Bridge steelwork, fabrication stage.

Area A

Exterior main surfaces, including shop welds.

Method: Blast clean with chilled cast iron grit or aluminium oxide grit.

Standard: clean steel, 1st Quality, Medium profile.

Area B

Interior of box girder surfaces, except area C, but including shop welds.

Method: Blast clean with metallic abrasive.

Standard: clean steel, 2nd Quality, Medium profile.

Area C

Contact surfaces of parent material at HSFG bolted joints.

Method: As Area A.

Standard: As Area A.

Area D

HSFG bolted joints.

Contact and outer surfaces of joint material.

Method: As Area A.

Standard: As Area A.

NG SAMPLE APPENDIX 19/1: REQUIREMENTS FOR BRIDGES, PARAPETS AND OTHER HIGHWAY STRUCTURES EXCEPT BEARINGS AND LIGHTING COLUMNS (continued)

(ii) Surface preparation. Bridge steelwork, erection stage.

Area E

Exterior surfaces of site welds and weld affected areas.

Method: Remove slag, wire brush, wet clean and blast clean as Area A.

Standard: As Area A.

Area F

Interior surfaces of site welds and weld affected areas.

Method: Remove slag, wire brush and wet clean.

Standard: Bare steel.

(iii) Surface preparation. Parapets.

Area G

All surfaces, subject to accessibility.

Method: Pickling for galvanizing.

Standard: In accordance with Clause 1911.

(iv) Protective systems.

Area A

Metal coating: Aluminium metal spray.

Shop. 1st Coat: Item 159, Aluminium Epoxy Sealer (2 pack), B or AS.

Application rate: 12 - 20 m²/litre.

Shop. 2nd Coat: Item 172, Zinc Phosphate AR Undercoat.

Shop. 3rd Coat: Item 174, MIO AR Undercoat.

Site. 4th Coat: Item 174, MIO AR Undercoat.

5th Coat: Item 176, AR Finish, mdft 50 microns.

Colour of Finish: green-yellow 12 B 21 BS 4800.

Minimum total dry film thickness: 250 microns.

Area B

Shop. 1st Coat: Item 111, Zinc Phosphate High Build Quick Drying Epoxy Blast Primer (2 pack), mdft 100 microns.

NG SAMPLE APPENDIX 19/1: REQUIREMENTS FOR BRIDGES, PARAPETS AND OTHER HIGHWAY STRUCTURES EXCEPT BEARINGS AND LIGHTING COLUMNS (continued)

Shop or Site. 2nd Coat: Item 112, MIO High Build Quick Drying Epoxy Finish (2 pack)

Minimum total dry film thickness: 200 microns.

Area C

Metal coating: Aluminium metal spray.

Area D

Contact surfaces. Metal coating: Aluminium metal spray.

Outer surfaces. As Area A.

Area E

As Area A.

Area F

1st Coat: Phosphating solution.

2nd and 3rd Coats: As Area B, 1st and 2nd coats.

Area G

Metal coating: Galvanizing.

1st Coat: Item 155, T Wash.

2nd Coat: Item 172, Zinc Phosphate AR Undercoat.

3rd Coat: Item 174, MIO AR Undercoat.

4th Coat: Item 174, MIO AR Undercoat.

5th Coat: Item 176, AR Finish, mdf 50 microns.

Colour of Finish: green-yellow 12 B 21 BS 4800.

Minimum total dry film thickness: 200 microns.

Alternative protective systems

The Contractor may offer the following alternative protective system:

Area A

Metal coating: Aluminium metal spray.

Shop. 1st Coat: Item 159, Aluminium Epoxy Sealer (2 pack), B or AS. 12 - 20 mVlitre.

Shop. 2nd Coat: Item 111, Zinc Phosphate High Build Quick Drying Epoxy Undercoat (2 pack)

NG SAMPLE APPENDIX 19/1: REQUIREMENTS FOR BRIDGES, PARAPETS AND OTHER HIGHWAY STRUCTURES EXCEPT BEARINGS AND LIGHTING COLUMNS (continued)

Shop. 3rd Coat: Item 112, MIO High Build Quick Drying Epoxy Undercoat (2 pack).

Site. 4th Coat: Item 168, Polyurethane (2 pack) Finish, mdft 50 microns,

or

Site. 4th Coat: Item 164, Moisture Cured Polyurethane Finish, mdft 40 microns.

Colour of Finish: green - yellow 12 B 21 BS 4800.

Minimum total dry film thickness: 300 microns.

Area B

Shop. 1st Coat: Item 111, Zinc Phosphate High Build Quick Drying Epoxy Blast Primer (2 pack), mdft 100 microns.

Shop or Site. 2nd Coat: Item 112, MIO High Build Quick Drying Epoxy Finish (2 pack), medium grey.

Minimum total dry film thickness: 200 microns.

Area C

Metal coating: Aluminium metal spray.

Area D

Contact surfaces. Metal coating: Aluminium metal spray.

Outer surfaces. As Area A.

Area E

As Area A.

Area F

1st Coat: Phosphating solution.

2nd and 3rd Coats: As Area B 1st and 2nd coats.

Area G

Metal coating: Galvanizing.

1st Coat: Item 155, T Wash.

2nd Coat: Item 172, Zinc Phospahte AR Undercoat.

3rd Coat: Item 174, MIO AR Undercoat.

4th Coat: Item 174, MIO AR Undercoat

5th Coat: Item 176, AR Finish, mdft 50 microns.

Colour of Finish: green - yellow 12 B 21 BS 4800.

Minimum total dry film thickness: 200 microns.

NG SAMPLE APPENDIX 19/1: REQUIREMENTS FOR BRIDGES, PARAPETS AND OTHER HIGHWAY STRUCTURES EXCEPT BEARINGS AND LIGHTING COLUMNS (continued)

(v) Application Instructions.

- (a) All surfaces to receive protective coatings.

The method of application indicated by the Item No. and / or the number of paint coats may be changed by the Contractor, the new Item Nos. and/or additional paint coats being entered in Appendix 19/5 by the Contractor's paint supplier.

- (b) Parapets.

The 'T' Wash and coats of paint may be applied in the shops or on site at the Contractor's option.

- (c) Areas A, C, D and E.

Aluminium Epoxy Sealer (2 pack), Item 159, should not be over-applied and should not be included in the overall thickness of the protective paint system.

(vi) Fasteners.

Unless otherwise specified on the Drawings, bolts nuts and washers in bridge steelwork shall be supplied zinc electroplated or hot dip galvanized. After the joint is made, they shall be prepared and protected as for the joint material.

5 Paint suppliers.

Paints for any one system shall be obtained from the same manufacturer.

[Notes to compiler:

- (i) *The above is a sample Appendix 19/1 for the protection against corrosion for bridge steelwork and parapets. Further sheets of Appendix 19/1 may be included, e.g. for structures where the areas listed above may not be appropriate. In some cases it may be necessary to provide one Appendix 19/1 sheet for each structure. Sheets should be numbered for easy identification.*
- (ii) *The surface preparation and protection for joint material and at welds should also be specified in Appendix 19/1, as should any metal coating on fasteners unless defined clearly on the Drawings. See NG 1904 and Clause 1904.*
- (iii) *The Appendices for steel bridge bearings should follow if required, see NG 1901.11. It would not be necessary to repeat the descriptions for Environment or Accessibility if already given for the Bridgework Appendices. The Appendices for Lighting Columns should also be included if appropriate. Because rooted and flange mounted columns are dealt with simultaneously, the standard method of specifying Area A, Area B, etc has not been used.*
- (iv) *Paint coats may be applied by brush or airless spray. Application by brush is denoted by the letter B, application by airless spray is denoted by the letters AS, following the paint description. Acrylated Rubber (AR) paints are particularly amenable to brush application and may be brushed or airless sprayed. To facilitate compiling the 1900 Series Appendices both AS and B quality Item Nos are given in the AR Basic Systems. The two-pack Epoxy paints in the alternative basic system for the main steelwork and the two-pack Epoxy paints listed in the Basic Systems for bearings may be applied either by brush or air-less spray and hence there is only one Item Number for each paint of this type.*
- (v) *When a white or pale tint Moisture Cured Polyurethane Finish or Polyurethane Finish (2 pack) is to be specified, an additional coat of Item 164 or 168 may be required to ensure complete obliteration of the MIO Epoxy Undercoat.*

Before specifying white or pale tint finishes, any requirement for an additional coat of paint should be checked with the paint suppliers listed in section 7 of the relevant Appendix.]

NG SAMPLE APPENDIX 19/2: REQUIREMENTS FOR BEARINGS

(Basic system with site finish coats to match main steelwork paint system.)

1 Environment: All Environments.

2 Accessibility: Difficult Access.

3 Required durability:

No maintenance up to 12 years.

Minor maintenance from 12 years.

Major maintenance after 20 years.

4 Surface preparation and protective systems,

(i) Surface preparation.

Area A

Exterior surfaces, excepting wearing surfaces but including a 25 mm return on surfaces of top bearing plates and base plates in contact with grout or mortar.

Method: Blast clean with chilled cast iron grit or aluminium oxide grit.

Standard: clean steel, 1st Quality, Medium profile.

Area B

Central area of base plate in contact with grout or mortar.

Method: Blast clean with metallic abrasive.

Standard: clean steel, 2nd Quality, Medium profile.

Area C

Central area of top bearing plate in contact with structural steel components.

Method: As Area A.

Standard: As Area A.

Area D

Exposed shop fasteners in components to be coated after assembly.

Method: As Area A.

Standard: As Area A.

Area E

Concealed shop fasteners.

Method: No requirement.

NG SAMPLE APPENDIX 19/2: REQUIREMENTS FOR BEARINGS (continued)

Standard: No requirement.

Area F

Site fasteners for fixing bearings to piers or abutments and for fixing bridge components to bearings.

Restore metal coating as necessary to specified standard of cleanliness.

(ii) Protective systems.

Area A

Aluminium metal spray minimum thickness 150 microns.

1st Coat: Item 159, Aluminium Epoxy Sealer (2 pack), B or AS. Application rate: 12 - 20 mVlitre

2nd Coat: Item 118, MIO Epoxy Primer (2 pack), B or AS. mdft 50 microns.

3rd Coat: Item 120, MIO Epoxy Undercoat/Finish (2 pack), B or AS. mdft 50 microns.

Minimum combined dft for 2nd and 3rd coats 115 microns.

Additional site coats on exposed surfaces of Area A.

4th Coat: Item 168, Polyurethane Finish (2 pack) mdft. 50 microns

or

4th Coat: Item 164, Moisture Cured Polyurethane Finish, mdft 40 microns.

Colour of Finish: green-yellow 12 B 21 BS 4800.

Minimum total dft for paint system 175 microns.

Aluminium metal spray plus Item 159, Aluminium Epoxy Sealer (2 pack) only, are required on interfaces of machined surfaces of spreader plates and of bearing.

Area B

Item 118, MIO Epoxy Primer (2 pack), B or AS. mdft 50 microns.

Area C

Aluminium metal spray minimum thickness 150 microns. Item 159, Aluminium Epoxy Sealer (2 pack), B or AS. Application rate: 12 - 20 mVlitre.

Area D

As Area A.

Area E

Fasteners unprotected by grease shall be zinc electroplated.

NG SAMPLE APPENDIX 19/2: REQUIREMENTS FOR BEARINGS (continued)

Area F

Metal coating: Zinc electroplating or galvanizing.

1st Coat: Item 155, T Wash.

2nd Coat: Item 118, MIO Epoxy Primer (2 pack), B or AS. mdft 50 microns.

3rd Coat: Item 120, MIO Epoxy Undercoat/Finish (2 pack), B or AS. mdft 50 microns.

4th Coat: Item 168, Polyurethane Finish (2 pack), mdft 50 microns

or

4th Coat: Item 164, Moisture Cured Polyurethane Finish, mdft 40 microns.

Colour of Finish: green-yellow 12 B 21 BS 4800.

Minimum total dft 175 microns.

(iii) Application instructions.

(a) Areas A, B, C and D.

Aluminium metal spray, Items 159, 118 and 120 shall be applied at the bearing manufacturers works. Item 164 or 168 shall be applied on site.

Aluminium Epoxy Sealer (2 pack) should not be over-applied and should not be included in the overall thickness of the protective paint system.

(b) Area F

Item 155, 'T' Wash shall be applied on site, either before or after erection, to surfaces to be painted.

'T' Wash coming into contact with adjacent paint coats shall be removed immediately.

The remaining site coats shall be applied to exposed surfaces after erection.

(c) Stripe coats for bearings only: (stripe coats are not required for bearing site fasteners).

A single stripe coat in Item 120 paint shall be applied over the MIO Epoxy Primer (2 pack) at the bearing manufacturer's works. A second stripe coat is not required.

(d) MIO Epoxy (2 pack) coats shall be in contrasting shades, e.g. medium grey, dark grey.

(e) Site coats shall be applied by the Contractor.

5 Paint suppliers.

[The requirements of Clause 1920 should be noted.]

[Note to compiler:

See Note (iv) and (v) in NG Sample Appendix 19/1.]

NG SAMPLE APPENDIX 19/3: REQUIREMENTS FOR LIGHTING COLUMNS AND BRACKET ARMS

(Type A2a and G2a basic systems.)

1 Environment: Inland.

2 Accessibility: Difficult Access.

3 Required durability:

No maintenance up to 8 years.

Minor maintenance from 8 years.

Major maintenance after 15 years.

4 'Ground level' shall be taken as being 600 mm below the door opening

[Note to compiler: Amend this definition where appropriate].

5 Type of columns: Planted columns.

6 Surface preparation and protective systems (Type A2a basic system),

(i) External surfaces.

(a) Overall treatment.

Method: Blast clean with chilled cast iron grit or aluminium oxide grit.

Standard: Clean steel, 1st Quality, Medium profile.

Aluminium metal spray.

Item 159, Aluminium Epoxy Sealer (2 pack), B or AS, Application rate: 12 - 20 mVlitre.

1st Coat: Item 110, Zinc Phosphate Epoxy Primer (2 pack), AS. mdft 30 microns.

2nd Coat: Item 112, MIO High Build Quick Drying Epoxy Undercoat (2 pack), AS. mdft 100 microns.

(b) Upper section, additional coat.

Item 164, Moisture Cured Polyurethane Finish, AS. mdft 50 microns
or

Item 168, Polyurethane (2 pack) Finish, AS. mdft 50 microns.

Colour of finish: Medium grey, 00.A.09.

Minimum total dry film thickness 200 microns.

(c) Ground section, additional coat.

Item 150. Pitch Epoxy (2 pack), AS. mdft 100 microns.

NG SAMPLE APPENDIX 19/3: REQUIREMENTS FOR LIGHTING COLUMNS AND BRACKET ARMS (continued)

Minimum total dry film thickness 275 microns.

(ii) Internal surface.

Ground section to door area.

Method: Blast clean.

Standard: Clean steel, 2nd Quality, Medium profile.

1st Coat: Item 110, Zinc Phosphate Epoxy Primer (2 pack), AS. mdft 30 microns.

2nd Coat: Item 150, Pitch Epoxy (2 pack), AS. mdft 100 microns.

Minimum total dry film thickness 150 microns.

(iii) Application instructions.

- (a) Blast cleaning, aluminium metal spray and all shop paint coats on external surfaces and site paint coats where access permits, shall be returned on to edges at ends, at door and other openings.
- (b) All paint coats except Item 164 or 168 shall be applied in the shops.
- (c) Item 159 shall be overcoated within 96 hours.
- (d) On external surfaces, Item 150 shall be applied from the bottom to 250 mm above ground level.
- (e) Item 164 or 168 shall be applied on site and shall be taken down to 225 mm above ground level, overlapping Item 150 by 25 mm.
- (f) On internal surfaces, Item 110 and 150 shall be applied from the bottom to 300 mm above the door opening.
- (g) Brushing grade paints may be used at the option of the Contractor.
- (h) Aluminium Epoxy Sealer, Item 159, should not be over-applied and should not be included in the overall thickness of the protective paint system.

7 Paint suppliers.

Paints for any one system shall be obtained from the same manufacturer.

8 Alternative protective system (Type G2a basic system).

The Contractor may offer the following:

Surface preparation and protective system.

(i) External and internal surfaces, overall treatment.

Galvanize.

(ii) External surface.

- (a) Additional overall coats.

1st Coat: Item 155, T Wash.

2nd Coat: Item 110, Zinc Phosphate Epoxy Primer (2 pack), AS. mdft 30 microns.

3rd Coat: Item 112, MIO High Build Quick Drying Epoxy Undercoat (2 pack), AS. mdft 100 microns.

NG SAMPLE APPENDIX 19/3: REQUIREMENTS FOR LIGHTING COLUMNS AND BRACKET ARMS (continued)

(b) Upper section, additional coat.

Item 164, Moisture Cured Polyurethane Finish, AS. mdft 50 microns
or

Item 168, Polyurethane Finish (2 pack), AS. mdft 50 microns.

Colour of finish: Medium grey, OO.A.09.

Minimum total dry film thickness, including Primer 200 microns.

(c) Ground section, additional coat.

Item 150, Pitch Epoxy (2 pack), AS. mdft 100 microns.

Minimum total dry film thickness, including Primer, 275 microns.

(iii) Application instructions.

- (a) T Wash, all shop paint coats on external surfaces and site paint coats where access permits, shall be returned on edges and 25 mm inside at ends, at door and other openings.
- (b) All paint coats except Item 164 or 168 shall be applied in the shops.
- (c) Item 110 shall be overcoated within 96 hours.
- (d) Item 150 shall be applied from the bottom to 250 mm above ground.
- (e) Item 164 or 168 shall be applied on site and shall be applied down to 225 mm above ground level, overlapping Item 150 by 25 mm.
- (f) Brushing grade paints may be used at the option of the Contractor.
- (g) Sub-Clause 1914.21 need not be applied to lighting columns which remain in a shop environment after galvanizing.

9 Paint suppliers.

Paints for any one system shall be obtained from the same manufacturer.

NG SAMPLE APPENDIX 19/3 (ALTERNATIVE): REQUIREMENTS FOR LIGHTING COLUMNS AND BRACKET ARMS

(Type A2b and G2b alternative basic systems.)

1 Environment: Inland.

2 Accessibility: Difficult Access.

3 Required Durability:

No maintenance up to 8 years.

Minor maintenance from 8 years.

Major maintenance after 15 years.

4 'Ground level' shall be taken as being 600 mm below the door opening

[Note to compiler: Amend this definition where appropriate].

5 'type of columns: Planted columns.

Columns shall have an additional sacrificial steel section thickness of a minimum 1.0 mm, above that needed in the design, from the bottom of the column to at least 250 mm above ground level.

6 Surface preparation and protective systems (Type A2b (Alternative) basic system),

(i) External surfaces.

(a) Overall treatment.

Method: Blast clean with chilled cast iron grit or aluminium oxide grit.

Standard: Clean steel, 1st Quality, Medium profile.

Aluminium metal spray.

Item 159, Aluminium Epoxy Sealer (2 pack). B or AS Application rate: 12-20 mVlitre.

(b) Upper section, additional coats.

1st Coat: Item 130, Vinyl/Vinyl Copolymer Primer, AS. mdft 60 microns.

2nd Coat: Item 131, Vinyl/Vinyl Copolymer Finish, AS. mdft 60 microns.

Colour of finish: Medium grey, 00.A.09.

Minimum total dry film thickness 120 microns.

(c) Ground section, additional coats.

1st Coat: Item 110, Zinc Phosphate Epoxy Primer (2 pack), AS. mdft 30 microns.

2nd Coat: Item 150, Pitch Epoxy (2 pack), AS. mdft 100 microns.

Minimum total dry film thickness 130 microns.

**NG SAMPLE APPENDIX 19/3 (ALTERNATIVE): REQUIREMENTS FOR LIGHTING
COLUMNS AND BRACKET ARMS (continued)**

(ii) Internal surface.

Ground section to door area.

Method: Blast clean.

Standard: Clean steel, 2nd Quality, Medium profile.

1st Coat: Item 110, Zinc Phosphate Epoxy Primer (2 pack), AS. mdft 30 microns.

2nd Coat: Item 150, Pitch Epoxy (2 pack), AS. mdft 100 microns.

Minimum total dry film thickness 150 microns.

(iii) Application instructions.

- (a) Blast cleaning, aluminium metal spray and all shop paint coats on external surfaces and site paint coats where access permits, shall be returned on to edges and 25 mm inside at ends, at door and other openings.
- (b) All paint coats except Item 131 shall be applied in the shops.
- (c) Item 159 shall be overcoated within 96 hours.
- (d) On external surfaces, Item 150 shall be applied from the bottom to 250 mm above ground level.
- (e) On internal surfaces, Items 110 and 150 shall be applied from the bottom to 300 mm above the door opening.
- (f) On external upper section, Items 130 and 131 shall be applied down to 225 mm above ground level, overlapping Item 150 by 25 mm.
- (g) Aluminium Epoxy Sealer, Item 159, should not be included in the overall thickness of the protective paint system.
- (h) Item 131 may be applied in the shops or on site, to overlap Item 150 by 25 mm and shall be the last applied coat.
- (i) Brushing grades may be used at the option of the Contractor.

7 Paint suppliers.

Paints for any one system shall be obtained from the same manufacturer.

8 Alternative protective system (Type G2b (Alternative) basic system).

The Contractor may offer the following:

Surface preparation and protective system.

(i) External and internal surfaces, overall treatment.

Galvanize.

(ii) External surface.

- (a) Additional overall coats.

1st Coat: Item 155, T Wash.

**NG SAMPLE APPENDIX 19/3 (ALTERNATP/E): REQUIREMENTS FOR LIGHTING
COLUMNS AND BRACKET ARMS (continued)**

- (a) Additional overall coats.

1st Coat: Item 155, T Wash.

- (b) Upper section only, additional coats.

1st Coat: Item 130, Vinyl/Vinyl Copolymer Primer, AS. mdft 60 microns.

2nd Coat: Item 131, Vinyl/Vinyl Copolymer Finish, AS. mdft 60 microns.

Colour of finish: Medium grey, 00.A.09.

Minimum total dry film thickness 130 microns.

- (c) Ground section, additional coats.

1st Coat: Item 110, Zinc Phosphate Epoxy Primer (2 pack), AS. mdft 30 microns.

2nd Coat: Item 150, Pitch Epoxy (2 pack), AS. mdft 100 microns.

Minimum total dry film thickness 150 microns.

(iii) Application instructions.

- (a) The requirements of sub-Clause 1914.21 need not apply for lighting columns which remain in a shop environment after galvanizing.
- (b) T' Wash, all shop paint coats on external surfaces and site paint coats where access permits, shall be returned on to edges and 25 mm inside at ends, at door and other openings.
- (c) On external upper section, Items 130 and 131 shall be applied down to 225 mm above ground level, overlapping Item 150 by 25 mm.
- (d) All paint coats except Item 131 shall be applied in the shops. Item 131 may be applied in the shops or on site, to overlap Item 150 by 25 mm and shall be the last applied coat.
- (e) Items 110 and 150 shall be applied from the bottom to 250 mm above ground level.
- (f) Brushing grades may be used at the option of the Contractor.

9 Paint suppliers.

Paints for any one system shall be obtained from the same manufacturer.

NG SAMPLE APPENDIX 19/3 (ALTERNATIVE): G2b SYSTEM FOR FLANGE MOUNTED COLUMNS WITH A PLINTH BUILT OVER THE FLANGE

[Compiler to complete 1 to 5 as appropriate!]

6 Surface preparation and protective system.

(i) External and internal surfaces, overall treatment.

Galvanize.

(ii) External surface.

(a) Additional overall coats.

1st Coat: Item 155, T Wash.

(b) Upper section only, additional coats.

1st Coat: Item 130, Vinyl/Vinyl Copolymer Primer, AS. mdft 60 microns.

2nd Coat: Item 131, Vinyl/Vinyl Copolymer Finish, AS. mdft 60 microns.

Colour of finish: Medium grey, 00.A.09.

Minimum total dry film thickness 130 microns.

(c) Plinth area, additional coats.

1st Coat: Item 110, Zinc Phosphate Epoxy Primer (2 pack), AS. mdft 30 microns.

2nd Coat: Item 150, Pitch Epoxy (2 pack), AS. mdft 100 microns.

Minimum total dry film thickness 150 microns.

(iii) Application instructions.

- (a) The requirements of sub-Clause 1914.21 need not apply for lighting columns which remain in a shop environment after galvanizing.
- (b) T' Wash, all shop paint coats on external surfaces and site paint coats where access permits shall be returned on to edges and 25 mm inside at ends, at door openings and under base flange.
- (c) All paint coats except Item 131 shall be applied in the shops. Item 131 may be applied in the shops or on site, to overlap Item 150 by 25 mm and shall be the last applied coat.
- (d) Item 110 shall be overcoated within 96 hours.
- (e) Item 150 shall be applied over Item 110 from the bottom to 150 mm above plinth level.
- (f) Brushing grade paints may be used at the option of the Contractor.

7 Paint suppliers.

Paints for any one system shall be obtained from the same manufacturer.

NG SAMPLE APPENDIX 19/4: REQUIREMENTS FOR OTHER WORK

[Notes to compiler:

- 1 This Appendix should be in a similar format to Appendices 19/1 to 19/3 as appropriate.*
- 2 Refer to NG 1901.5(iii)(c).J*

(SPECIFICATION FOR ROAD WORKS) FORM BE/P2 (NEW WORKS) PAINT SYSTEM SHEET

STRUCT. No.:

GRID REF:

2. DATE OF ISSUE
OF DOCUMENTS TO
TENDERERS:

ROAD ACCESSIBILITY:

4. REQUIRED DURABILITY OF SYSTEM
NO MAINTENANCE:
MINOR MAINTENANCE:
MAJOR MAINTENANCE:

TO BE APPLIED OVER:

1st Coat

2nd Coat

3rd Coat

4th Coat

5th Coat

6th Coat

DESCRIPTION (Including Item No. and colour)

8. PAINT MANUFACTURER'S OFFICIAL STAMP:

MINIMUM DRY FILM THICKNESS OF PAINT SYSTEM:.... microns (See Note)
The total dry film thickness of the paint system, neglecting primers and sealers
shall be **W_{vi}**, greater (to the nearest 25 microns) than the sum of the dry film thicknesses of the individual coats.

10. APPROVED BY:

DATE

APPENDIX 19/6

(SPECIFICATION FOR ROAD WORKS)
FORM BE/P3 PAINT SAMPLE DESPATCH LIST: SHEET 1

Contract Title

Structure Name or No.

Supervising Engineer's Firm

Supervising Engineer's Name.....Tel No.

Address

Inspecting Firm

Paint Manufacturer

Inspector's Name:

Inspector's Signature

Samples Despatched From:

(Note 1) Date Despatched

SAMPLES: (Numbered A1, A2 etc. or B1, B2 etc.) (Note 2)																	
Sample No.			Item No.			Manufacturer's Reference No.						Batch No.				Sp. G. (Note 3 & 4)	

APPENDIX 19/6

(SPECIFICATION FOR ROAD WORKS)
FORM BE/P3 PAINT SAMPLE DESPATCH LIST: SHEET 2

INSPECTOR to complete Form BE/P3 and to forward single copies to each of the following within 24 hours of despatch of samples by the Contractor to Enterprise Ireland:

- | | |
|--|---|
| <p>1. National Roads Authority,
St. Martin's House,
Waterloo Road,
Dublin 4.</p> | <p>2. Coatings Section,
Materials Technology Department,
Enterprise Ireland,
Glasnevin,
Dublin 9.</p> |
|--|---|

INSPECTOR to forward Form(s) BE/P2 Paint System Sheet(s) with the first Form BE/P3 to both addresses. INSPECTOR to select 'A' samples and to ensure that manufacturers labels on tins comply with the Specification. INSPECTOR to take and mark each 'B' sample tin with Item No., manufacturer's name and brand reference No., batch No. and sample No. (NOTE 2).

CONTRACTOR to CLIP DOWN LIDS of all tins and to pack, address and despatch samples. In addition to address. CONTRACTOR to label each case (or tin sent loose): 'NRA (State structure name) and DATE (date of despatch as noted above)'.

Note 1. State whether from shop (give name and address) or site.

Note 2. Batch samples comprising unopened tins to be marked A1, A2, etc.
Control samples in 0.5 litre tins to be marked B1, B2, etc.
Samples No. to run consecutively, i.e. A1 and B1 onwards.

Note 3. For 'A' samples specific gravity (Sp.G.) to be measured by Inspector from separate tins of the same batch. For 'B' samples Sp.G. to be measured by Inspector when taking samples.
Samples will be rejected unless Sp.G. is filled in above by Inspector.

Note 4. If Sp.G. differs appreciably from data sheet do not despatch 'A' or 'B' samples.

APPENDIX 19/7

**(SPECIFICATION FOR ROAD WORKS)
FORM BE/P4 PAINT SAMPLE ANALYSIS REPORT**

From: Coatings Section, Materials Technology Department, Enterprise Ireland, Glasnevin, Dublin 9.

Tb: (Name of Supervising Engineer for Project)

Address:

Telephone confirmation:

Contract Title

Bridge Name and/or No.

Samples Despatched from

Despatch Date on BE/P3

Samples and BE/P3 Received at Enterprise Ireland

Paint Manufacturer

Satisfactory Samples

Sample No.	Reference No.	Batch No.

Unsatisfactory Samples and Technical Comment

Sample No.	Reference No.	Batch No.

Signed:

(Enterprise Ireland)

Date:

APPENDIX 19/8

**(SPECIFICATION FOR ROAD WORKS)
FORM BE/P5 PAINT DATA SHEET**

Sheet No.

Manufacturer :

Item No. :

Registered Description :

Brand Name and Reference No. :

Consistency and Method of Application :

Weight per 5 Litres (kg) :

Volume Solids % :

Manufacturer's Minimum
Dry Film Thickness Range

 Recommended lower mdft :

 Recommended upper mdft :

Full Application Instructions :

Flash Point :

		5°C	10°C	20°C	30°C
Drying Times	Surface dry				
	Hard dry				
Overcoating Times	Minimum				
	Maximum				

Cleaning Solvent

Effect on Drying Times of Temperatures
below 20°C

Manufacturer's Application Restrictions,
e.g. for Temperatures or Humidity

Manufacturer's General Recommendations

NG SAMPLE APPENDIX 19/9: GENERAL REQUIREMENTS

/Note to compiler: This should include: /

- 1 Whether solvents may be used to remove oil or grease */1902.1j*.
- 2 Requirements for cleaning final shop coat if different from the requirements of sub-Clause 1902.10.
- 3 Requirements for:
 - (i) abrasive if different from the requirements of sub-Clause 1903.1;
 - (ii) wet blast cleaning if different from the requirements of sub-Clause 1903.12.
- 4 Requirements for treatment to threaded fasteners if different from the requirements of sub-Clause 1904.2.
- 5 Requirements for metal spray at joints if different from the requirements of sub-Clauses 1904.7 and 1904.8.
- 6 Requirements for stepping back shop paint coats if required at non-friction bolted joints *[1904.16]*.
- 7 Requirements for surface preparation and material for 'restored' coatings if different from the requirements of sub-Clauses 1908.3 (i) and (ii).
- 8 Requirements for procurement of paints if different from the requirements of sub-Clause 1909.5.
- 9 Requirements for provision of samples if different from the requirements of sub-Clause 1910.1.
- 10 Requirements for galvanized coatings if different from the requirements of sub-Clause 1911.1.
- 11 Requirements for:
 - (i) sprayed metal coatings if different from the requirements of sub-Clause 1911.2;
 - (ii) sherardized coatings if different from the requirements of sub-Clause 1911.3;
 - (iii) electroplated coatings if different from the requirements of sub-Clause 1911.4.
- 12 Requirements for stripe coats if different from the requirements of sub-Clause 1914.13.
- 13 Requirements for shop and site procedure trials if different from the requirements of sub-Clause 1915.1.
- 14 Requirements at concrete/steelwork contact areas if different from the requirements of sub-Clauses 1917.1 and 1917.3.
- 15 Requirements for the protection of steel in bridge bearings if different from the requirements of Clause 1920.
- 16 Requirements for the protection of steel lighting columns and bracket arms if different from the requirements of Clause 1921.
- 17 Measures to contain plant, materials, dust and debris *[1901.3]*.

[Cross-reference should be made in Appendix 1/23].

