PROTECTION OF STEELWORK AGAINST CORROSION

Contents

Protection of Steelwork Against Corrosion

1901 General

1 Surface preparation and protection against corrosion of steelwork shall be carried out in compliance with Clauses 1902 to 1921 and as described in Appendices 19/1, 2, 3 and 4 as appropriate to the design and method of fabrication of the components.

2 Item numbers and descriptions of paints are contained in the 'Manual of Paints for Structural Steelwork' which is included in UK Department of Transport Standard BD 35.

3 Subject and without prejudice to the Conditions of Contract, the Contractor shall comply with any measures to contain people, plant, materials, dust and debris described in Appendix 19/9.

4 Compliance with sub-Clause 3 of this Clause does not confer immunity from relevant legal requirements.

1902 Surface Preparation – General Requirements

Shop and Site Work

1 Before blast cleaning or abrading steel surfaces or before overcoating painted or galvanized surfaces, contamination by oil or grease shall be removed by wet cleaning the affected areas as described in sub-Clause 1903.9. Solvents shall not be used unless otherwise described in Appendix 19/9.

2 Clean water which does not leave harmful residues on the surface shall be used for cleaning and rinsing.

3 Only cleaning agents which do not leave harmful residues on the surface after final rinsing shall be used for cleaning.

4 Surface preparation shall be continued until the standard described in Appendix 19/1, 2, 3 or 4 as appropriate has been achieved.

5 Weld spatter shall be removed from accessible areas which are to be hot dip galvanized or protected by metal spray or paint. Firmly adhering weld spatter in the heat affected zone shall be removed before blast cleaning.

6 After dry surface preparation of internal surfaces and before any wet cleaning, all dust and debris shall be removed from accessible areas by sweeping and vacuum cleaning.

7 Immediately before application of each coat of paint, the Contractor shall ensure that the surfaces:

(i) meet the standard of preparation described in Appendix 19/1, 2, 3 or 4 as appropriate;

(ii) are free from harmful residues, including mortar, concrete, dust, grit and paint degradation products;

(iii) are free from detrimental contamination;

(iv) are free from moisture detrimental to the coating to be applied.

8 Joints, plies and fasteners shall be sealed in compliance with sub-Clauses 1904.27 and 28.

9 Coats of paint shall be free from embedded metallic or other foreign particles including metallic dust. Deposits of adherent matter on metallic coatings or painted surfaces shall be cleaned off immediately they occur. Coatings damaged in the process shall be restored.

10 Unless otherwise described in Appendix 19/9, the final shop coats on external surfaces shall be wet cleaned on site.

1903 Surface Preparation – Materials and Methods

Dry Blast Cleaning in the Shops

1 Unless otherwise described in Appendix 19/9, chilled-iron grit complying with ISO 11124 : Part 2, high carbon cast-steel shot or grit complying with ISO 11124 : Part 3 with a hardness value greater than 650 HV, or aluminium oxide complying with ISO 11126 : Part 7 shall be used.

Grades for metallic abrasives shall comply with the following:

Profile (see sub-Clause 1907.1)	Grade
Fine	G050 or S060
Medium	G070 or S100
Coarse	G100 or S120

2 The particle size of metallic abrasive in plant or equipment shall not exceed the maximum for the relevant grade as specified above.

3 Before the start of blast cleaning and during blast cleaning the Contractor shall ensure that the abrasive is free from matter which could leave detrimental contamination, as defined in sub-Clause 1907.7, on the surfaces to be coated.

Abrading in the Shops or on Site

4 Any encrusted foreign matter or paint which may be difficult to remove by abrading alone shall be dislodged by scraping, aided by hand or power wire-brushing. This work shall be completed before abrading the areas so affected.

5 Abrading shall be carried out using abrasive paper or other material or a flexible abrasive disc mounted on a power driven flexible pad, or a power driven arbor or spindle-mounted flexible abrasive flap wheel. Abrading tools may be used to remove weld spatter. Wet abrading may be employed for the preparation of finishes over sound undercoats, over unsound systems over galvanizing, or galvanizing. Wet abrading shall not be allowed to come into contact with exposed metal spray coatings.

6 All equipment including tools, abrasive sheets, abrasive discs and abrasive wheels shall be of a type, capacity and in a condition appropriate for the work. The use of hard grinding wheels for abrading will not be acceptable.

7 A burnished appearance caused by polishing in of paint, rust or dirt will not be acceptable.

8 Areas of previously corroded steel or unsound metal coatings, except galvanizing, which have been prepared by abrading down to bright steel or bright metal coating, and blast cleaned where appropriate, shall be protected by the primer and next two coats of paint before any cleaning down or preparation of adjacent surfaces.

Wet Cleaning in the Shops or on Site

9 Wet cleaning shall be carried out by scrubbing with a stiff-bristled brush using water and a cleaning agent. Immediately after cleaning, the surfaces shall be thoroughly rinsed.

Dry Cleaning in the Shops or on Site

10 Surfaces shall be cleaned by scrubbing with a dry stiff-bristled brush.

Dry Blast Cleaning on Site

11 Metallic abrasives shall comply with sub-Clauses 1, 2 and 3 of this Clause. Metallic grit or aluminium oxide abrasive shall be used for dry blast cleaning of relatively small areas on site which are to be metal sprayed, such as at site welds, at areas prepared to clean steel or areas where a metal spray is to be restored, as indicated in sub-Clause 1908.3(i). The Contractor shall ensure that the grade and particle shape of non-metallic abrasives are adequate for the purpose intended including sub-Clause 3 of this Clause. Excepting for aluminium oxide non-metallic abrasives shall not be recycled.

Wet Blast Cleaning on Site

12 Unless otherwise specified in Appendix 19/9 a low pressure air/water/ abrasive system shall be used. The air/water pressure at the nozzle shall not exceed 7.0 kgf/cm^2 and shall be fully adjustable below this level. The system shall incorporate a mechanical metering device remote controlled by the operator from the nozzle to enable him to regulate from zero to maximum the quantity of non-metallic abrasive being fed into the air/water mixture. During abrasive cleaning, the air, water and abrasive shall be thoroughly mixed and this mixture shall be projected on to the surface to be cleaned through a single bore nozzle or tube. The use of an inhibitor during wet blast cleaning or washing will not be permitted.

13 Within 60 minutes of wet blast cleaning, the whole of the cleaned surface shall be thoroughly washed using the blast cleaning equipment with air and water. Any further deposits of abrasive on already rinsed surfaces shall be removed in a similar manner also within 60 minutes of being deposited. All accumulated deposits of abrasive and debris on other parts of the structure shall be removed by the same method before the end of the working day. After washing, the surfaces shall be free from all particles of dust and debris. Tests for freedom from detrimental contamination shall be made after the washing.

Combined Wet/Dry Blast Cleaning on Site

14 Wet blast cleaning using the low pressure air/water/abrasive system in compliance with sub-Clauses 12 and 13 of this Clause shall be followed, after an appropriate interval, by dry blast cleaning in compliance with sub-Clause 11 of this Clause, of all the previously wet blast cleaned areas.

15 The specified standard of surface preparation shall have been achieved in full, initially by wet blast cleaning and washing, before any later dry blast cleaning of the same areas to remove flash rusting or to restore the required standard of surface preparation.

Other Requirements

16 When surface preparation is to be carried out by dry blast cleaning and, on adjacent surfaces, by wet cleaning and/or abrading, then unless otherwise necessary, the wet cleaning and any abrading shall be carried out first.

When combined wet/dry blast cleaning has been specified instead of dry blast cleaning only, the above sequence may be reversed. On completion of the wet blast cleaning part of the process, the areas to be abraded shall be cleaned in compliance with sub-Clause 9 of this Clause except that for rinsing, the wet blast cleaning equipment may be used. The dry blast cleaning part of the process, and dry abrading shall be carried out after any wet abrading required and final rinsing. Any prepared dry metal surface shall be protected from the effects of any further wet method of surface preparation by the application of a minimum 75 microns dry film thickness of paint.

Grinding After Surface Preparation in the Shops or on Site

17 Grinding wheels and discs shall be of the size, shape and grade of coarseness appropriate to the particular operation. The speed of revolution shall be appropriate for the work.

1904 Procedures for Treatment at Joints

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

Fasteners, Including Bolts, Nuts and Washers

1 Surfaces of uncoated fasteners shall be free from all but traces of oil or grease before assembly.

2 Unless otherwise described in Appendix 19/9, threaded fasteners at joints in hot dip galvanized steelwork or in hot dip galvanized steelwork which is to be painted, shall be hot dip galvanized. Hot dip galvanized fasteners which are to be painted shall be 'T' Washed before assembly.

3 Metal coatings on surfaces of fasteners which are to be painted shall be:

(i) free from all traces of oil or grease and then 'T' Washed; or

(ii) treated at the same time as the parent material where fasteners are already assembled in compliance with sub-Clause 24 of this Clause.

Fasteners excluding those in (ii) above shall be pressure-rinsed with water and allowed to dry before assembly or packing for delivery at least one hour and not more than four hours after satisfactory application of 'T' Wash.

4 Fasteners which have become difficult to tighten because of corrosion shall be replaced.

Joint Material and Parent Material in Joints

5 The standard of initial blast cleaning of joint material and parent material in joints shall be at least equal to that for the parent material. Before a joint is made on site, contact surfaces shall be restored to clean steel, 2nd Quality or to sound metal coating.

At Joints Made with HSFG Bolts

6 In steelwork painted only overall:

The blast primer applied to the parent material shall be taken 10 mm to 15 mm inside the perimeter of the joints. The outer surfaces and edges of site joint material may, at the option of the Contractor, also be given a coat of the blast primer.

7 In steelwork metal sprayed at joints only, and painted overall:

Unless otherwise described in Appendix 19/9, the metal spray shall be applied to the contact surfaces of the joints and to the outer surfaces and edges of joint material. The metal spray on the contact surfaces of the parent material shall be taken 10 mm to 15 mm outside the perimeter of the joints. The blast primer applied to the parent material shall be taken 10 mm to 15 mm inside the perimeter of the joints. The metal spray on the outer surfaces and edges of site joint material shall be given a coat of aluminium epoxy sealer (2 pack).

8 In steelwork metal sprayed overall and sealed only or painted overall:

Unless otherwise described in Appendix 19/9, the metal spray shall be applied to the contact surfaces of the joints and to the outer surfaces and edges of joint material. The sealer applied to the parent material shall be taken 10 mm to

15 mm inside the perimeter of the joints. The metal spray on outer surfaces and edges of site joint material shall also be given a coat of sealer.

9 In steelwork hot dip galvanized only or hot dip galvanized and painted overall:

All material at joints shall be hot dip galvanized. When 'T' Wash and a first undercoat are applied before a joint is made they shall be taken 10 mm to 15 mm inside the perimeter of the joint; these coats shall also be applied to edges and outer surfaces of the joint material.

10 The thickness of a protective paint coat applied to the outer surfaces of joint material prior to assembly of any high strength friction grip (HSFG) bolted joint shall not exceed 20 microns dry film thickness (dft).

At Non Friction Bolted Joints

11 At shop joints in all steelwork other than in hot dip galvanized steelwork the blast primer alone or metal spray plus sealer shall be applied initially to parent and joint material. Immediately before assembly of a joint which is to be painted the first undercoat shall be applied to the contact surfaces and the joint made while the paint is wet.

12 At site joints in all steelwork other than in galvanized steelwork unless otherwise described in Appendix 19/1, 2, 3 or 4 as appropriate, all surfaces except those of fasteners, shall receive in the shops the shop protective system which is applied to the parent material.

13 At shop and site joints in galvanized steelwork 'T' Wash and shop coats may be applied to the joint material before or after shop joints are made. When galvanized steelwork is painted on site 'T' Wash and paint shall be applied to joint material after the joint has been made.

At Welded Joints

14 At shop and site joints in all steelwork, surfaces to be welded shall be restored to clean steel, 2nd Quality or to bright steel and shall be free of any protective or other coating immediately prior to welding.

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

At HSFG Bolted Joints

15 The paint coats, with the exception of the primer or first coat of paint, shall be stepped back at 30 mm intervals commencing 10 mm from the perimeter of the joints.

At Non Friction Bolted Joints

16 Unless otherwise described in Appendix 19/9, shop paint coats are not required to be stepped back.

At Welded Joints

17 Metal spray coating shall be kept clear of the weld by a distance of at least 15 times the thickness of the steel in the area to be welded, with a maximum of 300 mm from the joint. The restricted area shall be masked during metal spraying. Galvanizing shall be removed a minimum of 5 mm back from the edges of weld areas. Paint coats shall be stepped back at 30 mm intervals commencing at least 100 mm from the joint, or from the edge of the metal spray, starting with the 2nd coat of paint.

At Completed Joints

18 Within 14 days of a joint being completed, exposed surfaces of parent and joint material shall be prepared in compliance with sub-Clauses 19 to 23 of this Clause and fasteners in compliance with sub-Clauses 24 to 26 of this Clause.

At Bolted Joints

19 In steelwork painted only overall, blast cleaned only or primed surfaces shall be prepared by dry blast cleaning to restore or provide the standard of surface preparation, for shop or site work as appropriate, described in Appendix 19/1, 2, 3 or 4.

20 In steelwork metal sprayed at joints only, and painted overall, primed or sealed metal sprayed coatings shall be prepared by dry blast cleaning to restore the surfaces to the standard described in Appendix 19/1, 2, 3 or 4 as appropriate.

21 In steelwork metal sprayed overall, and sealed only or painted overall, metal spray coatings shall be prepared as described in sub-Clause 20 of this Clause.

22 In steelwork galvanized only or galvanized and painted overall the surfaces shall be free from contamination detrimental to paint coats by wet cleaning.

At Welded Joints

23 In all steelwork, welds shall be prepared by the methods and to the standards described in Appendix 19/1, 2, 3 or 4 for shop or site work as appropriate. Surfaces of areas adjacent to the weld shall be similarly prepared. For site welds in galvanized steelwork, surfaces shall be treated in accordance with sub-Clause 1905.9.

Surfaces of Fasteners

24 Uncoated and temporarily coated fasteners shall be free from all but traces of oil and grease and blast cleaned to clean steel, 2nd Quality, Medium profile, before painting.

25 Metal coated fasteners which have been 'T' Washed before assembly shall be dry cleaned after final surface preparation of the joint and then painted.

26 Fasteners which are to be metal sprayed after assembly shall be blast cleaned to clean steel, 1st Quality, medium profile, with chilled iron grit, cast steel grit or aluminium oxide.

Sealing at Joints or Plies

27 Bolted joints or built-up sections shall be free from any water which has penetrated the plies.

When drying out has been completed or when surfaces are dry after surface preparation, fine gaps around the perimeter of joints or along plies shall be sealed by successive application of undercoat paint. All wider gaps shall be sealed with a proprietary sealant compatible with the paint system.

Sealing of Gaps at Nibs of Load Indicating Fasteners or Washers

28 Gaps shall be sealed by brush application of primer and successive undercoats, of the types used on adjacent areas.

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

1 Score marks and indentations in the surface of a steel substrate or of a metal coating shall be treated by abrading or grinding to bright steel or bright metal coating, to produce a surface without sharp edges or abrupt change in contour. Damage to unprepared surfaces shall be treated before blast cleaning. A blast cleaning profile shall be restored on areas to be metal sprayed but not necessarily areas to be painted only. Other surface defects in the steel substrate, including fissures caused by the removal of 'hackles' or inclusions described in sub-Clause 1907.3, shall be similarly treated.

2 In the case of damage to paint coatings only, surface preparation shall be by blast cleaning or abrading. The paint coatings shall then be restored.

3 When a two-pack Epoxy paint system is restored over a steel substrate prepared by abrading, the Contractor shall check that the adhesion of the first paint coat to the substrate is satisfactory before overcoating with the next coat in the system. At the option of the Contractor , Item 111 as the first coat may be replaced with a two-pack surface tolerant primer over abraded surfaces.

4 When an area of metal spray is to be restored after surface preparation by abrading or grinding, any affected metal spray or exposed steel substrate shall be dry blast cleaned immediately before further application of metal spray.

5 In the shops, a damaged metal spray coating, together with any damaged sealer or paint coats, shall be restored.

6 On site, with the exception of the small areas permitted under sub-Clause 7 of this Clause, a damaged metal spray coating, together with any damaged sealer or paint coats shall be restored but with a minimum thickness of 150 microns of metal spray.

7 On site, small areas of isolated damage in a metal spray coating plus paint system, need not be restored; after surface preparation in compliance with sub-Clause 1 of this Clause, the metal spray shall be replaced by 100 microns of the first undercoats, omitting the sealer. Adjacent paint coats, excluding the sealer shall then be restored over the repaired area.

8 In the shops, in the case of hot dip galvanizing only, small isolated areas of up to 40mm², and not exceeding 0.5% of the total surface area of the component, whichever is the lesser, may after surface preparation, be repaired with low melting point zinc alloy, providing that the total area of any damage on a component does not exceed 0.5% of the total surface area of the component. Components with damaged areas greater than the above limits shall be regalvanized.

Isolated areas of damage larger than 40mm² in galvanizing which is to be painted later or which has already been painted may be repaired with low melting point zinc alloy after surface preparation. Alternatively the whole of the affected area including exposed steel substrate shall, after surface preparation, be given a coat of 'T' Wash which, when wet cleaned in accordance with sub-Clause 1903.9 and finally dry, shall be overcoated with two coats of Item 118 MIO Epoxy Primer, medium grey, two pack, to a total minimum dry film thickness (mdft) of 150 microns. The 'T' Wash and Epoxy paint shall not be applied over existing paints.

9 On site, surfaces of galvanized components found to have minor damage shall be prepared in accordance with sub-Clause 8 of this Clause and coated with zinc-rich primer of 100 microns mdft, complying with BS 4652. Alternatively, the components shall be regalvanized.

10 In all cases where paint coats only are to be restored, or metal spray coats replaced or restored, or galvanizing is to be replaced by paint, the edges of paint coatings or metal coating adjacent to the affected area shall be bevelled back into sound paint or metal coating. This work shall be carried out before any final blast cleaning described in sub-Clause 4 of this Clause.

11 'T' Wash applied outside the areas to be overcoated shall be removed immediately by wet cleaning.

12 In the shops exposure and overcoating times shall not exceed those specified in Clause 1914.

On site overcoating shall be started immediately after surface preparation of the affected area and before any deterioration in the standard of the prepared surface occurs, and continued as soon as each coat is dry enough for overcoating.

1906 Procedures for Treatment of Local Failure in Protective Coatings

1 In the shops, failed paint coatings and failed metal spray coatings shall be restored. Abrading down to sound paint only, is permissible. If a metal spray coating is damaged or reduced to less than 80% of the specified minimum thickness during abrading, it shall be restored.

2 On site, failed paint coatings and metal spray coatings shall be restored except that:

(i) abrading down to sound paint or to bright steel, or

(ii) blast cleaning to clean steel, 2nd Quality,

are permissible methods of surface preparation when restoring paint systems over a steel substrate.

3 In the shops and on site, galvanized components showing signs of failure of the coating shall be regalvanized.

4 In the shops and on site, failed paint coatings over galvanizing shall be restored. Surface preparation of affected areas shall be by abrading. Areas of sound galvanizing exposed through a paint system shall be abraded only as necessary to ensure satisfactory application of 'T' Wash and paint. If the galvanizing is damaged or reduced to less than 80% of the specified minimum thickness during abrading, the component shall be regalvanized.

5 Sub-Clauses 1905.3, 4, 10, 11 and 12 shall be complied with.

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

1 The surface profile to be achieved by blast cleaning, either 'Fine' 'Medium' or 'Coarse', as described in Appendix 19/1, 2, 3 or 4 as appropriate, shall be within the limits set by the Surface Profile Comparator for the Assessment of Abrasive Blast Cleaned Surfaces, conforming to ISO 8503 : Part 1.

2 Blast cleaned surfaces shall be virtually free from sharp spikes of parent metal defined as 'rogue peaks' formed by the impact of abrasive

particles and which project above the blast cleaning profile. Any 'rogue peaks' which would be detrimental to the protective system shall be removed.

3 'Hackles' and inclusions caused by the rolling process, visible after blast cleaning, which would be detrimental to the protective system, shall be removed. Affected surfaces shall be prepared by grinding or abrading to bright steel in compliance with sub-Clause 1905.1 where appropriate. Sharp edges shall be rounded. If metal spray is to be applied the surfaces shall then be blast cleaned.

4 Steel surfaces to be prepared by any of the methods described in the Contract shall be such that after surface preparation the surfaces are free from detrimental contamination.

5 Surface preparation by blast cleaning shall be to one or more of the following standards of visual cleanliness:

(i) 'Clean steel' 1st Quality

Appearance:
There shall be a blast cleaning pattern overall. The surface profile shall be free from mill scale, rust and foreign matter when viewed through a X10 illuminated magnifying glass.

(ii) 'Clean steel' 2nd Quality

Appearance:
There shall be a blast cleaning pattern overall. The surface profile shall be free from mill scale, rust and foreign matter when viewed by normal vision.

(iii) 'Bare steel' (blast cleaned or abraded)

Appearance:
The surface shall be free from all rust scale, loose rust and loose mill scale.

6 After surface preparation by blast cleaning to 1st or 2nd Quality the surface profile shall be virtually free from embedded abrasive particles when viewed through a X10 illuminated magnifying glass. Surfaces assessed as unsatisfactory in this respect shall be blast cleaned again with fresh abrasive. Another abrasive complying with the Specification may be used if necessary.

7 'Harmful residues' or 'detrimental contamination':

Surfaces shall be deemed to be free from 'harmful residues' or 'detrimental contamination' after surface preparation when any such remaining matter will not reduce the required durability of the specified protective system.

8 'Bright steel':

Surfaces free from defects or prepared to this standard by grinding or abrading shall have an overall bright appearance.

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

1 Before overcoating, surfaces shall be free from:

(i) any visible gloss which may prevent adequate adhesion of the next coat

(ii) any unsound paint down to sound paint

(iii) any unsound paint down to clean steel

(iv) any unsound paint down to bright steel

(v) any unsound paint down to sound metal coating

(vi) any unsound paint down to bright metal coating

(vii) any unsound metal coating down to sound metal coating

(viii) any unsound metal coating down to bright metal coating

(ix) any unsound metal coating down to clean steel

(x) any unsound metal coating down to bright steel

(xi) detrimental contamination.

2 Definitions of terms used in describing the above standards of workmanship are as follows:

(i) 'clean steel', as in sub-Clause 1907.5

(ii) 'bright steel', as in sub-Clause 1907.8

(iii) 'free from detrimental contamination', as in sub-Clause 1907.7

(iv) 'bright metal coating' resulting from abrading, a metal coating whose surfaces are free from all corrosion products and of bright appearance overall

(v) 'unsound metal coating', a metal coating showing signs of disruption, inadequate adhesion or penetration by rust or other corrosion products

(vi) 'sound metal coating', a metal coating which complies with sub-Clause 1911.2 including such a metal coating which has been blast cleaned but which has a reduced thickness in accordance with sub-Clause 1906.1

(vii) 'unsound paint', paint showing signs of disruption, rusting through, having inadequate adhesion or covering rust scale, loose rust, loose mill scale or other detrimental products

(viii) 'sound paint', paint which is sound down to a metal substrate.

3 Definitions of terms used in Clauses 1904, 1905 and 1906 are as follows:

(i) 'restored' coatings. Unless otherwise described in Appendix 19/9, when paint or similar coatings or metal spray coatings are to be restored, the standard of surface preparation and coating material shall comply with the original standard. Damaged or failed paint systems over metal spray shall be restored using dry blast cleaning. The thickness of any underlying metal spray or paint coating which may have been reduced in thickness during surface preparation shall be brought up to specification

(ii) 'restored' surface preparation. Unless otherwise described in Appendix 19/9 the original standard shall be obtained. When further metal spray coating is to be applied, the surface of the existing metal spray coating shall be restored by dry blast cleaning with metallic grit abrasive or aluminium oxide to sound metal coating

(iii) 'local failure'. An isolated breakdown of a protective coating or system due to extraneous causes excluding mechanical damage.

4 Permitted residual metal sprayed aluminium and zinc:

When clean steel is exposed through a metal coating during remedial surface preparation, remnants of sound aluminium metal spray coating may be retained within the blast clean profile; also unreacted traces of zinc metal, which will not be detrimental to restored coatings, may remain occluded within the blast clean profile after the removal of a zinc metal coating.

1909 Paint and Similar Protective Coatings

1 The term paint shall be deemed to refer also to similar protective coatings including specialist coatings such as grease paints.

2 All paints incorporated in the Permanent Works shall conform with the formulations which have been registered by the manufacturer with the Coatings Section, Materials Technology Department, Enterprise Ireland on or before the date entered at Part 2 of Appendix 19/5, Form BE/P2 (New Works) Paint System Sheet.

The procedure for registration of paint formulations is detailed in U.K. Department of Transport Advice Note BA 27 except that paints shall be registered with the Coatings Section, Materials Technology Department, Enterprise Ireland, Glasnevin, Dublin 9. The functions and duties of the Coatings Section, Materials Technology Department, Enterprise Ireland; shall be those of 'QSCE Division' as specified in U.K. Department of Transport Standard BA 27. Details of the quality assurance scheme for paints and similar protective coatings are given in U.K. Department of Transport Standard BD 35 which also includes the Manual of Paints for Structural Steelwork.

3 All paints shall be supplied in sealed containers of not more than 25 litres capacity and these shall be used in order of delivery. Each container shall be of the completely removable lid type and be clearly marked on the side to show the name of the manufacturer, registered description of the material (including purpose, e.g. whether primer, undercoat or finish), colour, Item No, paint manufacturer's reference number, batch number and date of manufacture. Where date of manufacture is coded, the Contractor shall provide the code key.

4 The Contractor shall ensure that the properties of the paints he has selected are suitable for the conditions in the shops and on site, including temperature and humidity, and that he is able to apply the paints satisfactorily to all parts of the structure in these conditions.

5 Unless otherwise described in Appendix 19/9 all paints forming any one protective system or overlapping systems, shall be obtained from the same manufacturer, as named by the Contractor in Appendix 19/5 submitted by the Contractor.

1910 Testing of Paints

Provision of Samples

1 Unless otherwise described in Appendix 19/9, the Contractor shall provide unopened samples, known as 'A' samples, for quality assurance purposes, of each type of paint to be used for the Permanent Works in accordance with sub-Clauses 2 and 4 of this Clause. In addition the Contractor shall supply 500 ml samples, known as 'B' samples, for application control purposes.

'A' Samples

2 'A' samples are required in all cases where more than 1000 litres of any one coat of paint is to be applied to road-bridge and gantry steelwork. 'A' samples are not required for footbridge steelwork or lighting columns.

3 The first 'A' samples shall be taken from the first representative batch of each type of paint delivered to the fabricator's shop or to site. First batches of paint of less than 200 litres shall be discarded as not being representative and shall not be used in the Permanent Works.

4 Additional 'A' samples of the paints subject to testing under sub-Clause 2 of this Clause shall be provided by the Contractor depending on the weight of structural steelwork in the Permanent Works in accordance with the following:

(i) 500 tonnes to 1000 tonnes: one set of samples;

(ii) over 1000 tonnes: a further set of samples for each part of or whole 1000 tonnes.

The Contractor shall also provide an 'A' sample:

(iii) of any replacement batch of paint subject to testing under sub-Clause 2 of this Clause;

(iv) returned paint described in sub-Clause 1913.4;

(v) when the paint is showing unsatisfactory application characteristics under Clause 1914.

5 Immediately after selection, the 'A' samples shall be despatched by the Contractor to the testing authority.

6 Paint shall be supplied in sufficient time to allow for sampling and testing before the start of application.

7 Except for procedure trials, painting shall not start until the first 'A' samples are confirmed as satisfactory.

'B' Samples

8 The Contractor shall take 'B' samples from painters' kettles or from nozzles of airless spray guns directly into clean, new 500 ml tins which shall be filled and then sealed prior to despatch to the testing authority.

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

9 The Contractor shall provide 500 ml tins with lids and lid clips, for 'B' samples at the start of painting or before any procedure trials required by Clause 1915. The quantity supplied shall be sufficient to avoid any delay in taking 'B' samples throughout the work.

10 The Contractor shall ensure that the lids of all tins of sample paint are securely clipped down when they are despatched for testing.

11 The Contractor shall be responsible for handling, packing as necessary, prompt despatch and transit of 'A' and 'B' samples.

1911 Metal Coatings

Galvanized Coatings

1 Galvanized coatings shall, unless otherwise described in Appendix 19/9, comply with EN ISO 1461 and with the following:

(i) Inhibited hydrochloric acid with a strength not exceeding 18% and within a temperature range of 15°C to 25°C or inhibited sulphuric acid with a strength not exceeding 18% and within a temperature range of 60°C to 80°C shall be used for pickling.

(ii) Components shall not be immersed in the pickling acid longer than is necessary for cleaning the surfaces prior to galvanizing.

(iii) The surfaces of components to be galvanized shall be dried before immersion in the molten zinc.

(iv) When an aqueous flux is to be used, all traces of acid shall be washed off immediately after pickling.

(v) Hot dip galvanized coatings shall be relatively smooth, continuous and free from flux staining.

(vi) Detrimental surface contamination of galvanized coatings which are to be painted shall be removed by wet cleaning in compliance with sub-Clause 1903.9.

Surfaces to be painted shall not receive chromate passivation treatment.

(vii) Vent holes drilled in hollow sections prior to galvanizing shall be plugged after galvanizing and before any painting.

Sprayed Metal Coatings

2 Sprayed metal coatings shall, unless otherwise described in Appendix 19/9, comply with ISO 2063 and with the following:

(i) Aluminium coating shall be of a material with minimum quality in accordance with type A1 99.5 (1050A) of ISO 209 : Part 1. Zinc coating shall have a composition in accordance with type Zn 99.99 of ISO 752.

(ii) The thickness of the coating shall be not less than 100 microns.

(iii) The strength of adhesion of metal spray coatings shall not be less than the following:

Aluminium	50 kgf/cm^2
Zinc	50 kgf/cm^2.

(iv) Metal spray coatings shall be applied continuously over each 0.5 m^2 per gun or the area of the component whichever is the lesser until the specified thickness has been achieved.

(v) The application of metal spray in separate layers will not be permitted.

(vi) All surfaces to be metal sprayed, including that of the reference panel having equivalent hardness to that of the parent material, shall be blast cleaned with chilled iron grit or high carbon cast-steel grit with a hardness value grater than 650 Hv, or aluminium oxide with a hardness value greater than 9 Mohs, and the standard shall be clean steel, 1st Quality, medium profile.

Sherardized Coatings

3 Sherardized coatings shall, unless otherwise described in Appendix 19/9, comply with Class 1, Table 1 of BS 4921.

Electroplated Coatings

4 Electroplated coatings shall, unless otherwise specified in Appendix 19/9, comply with BS 3382 : Part 2. Additionally BS 3382 : Part 2 shall be deemed to cover the electroplating of components up to and including 36 mm in diameter. Electroplated surfaces which are to be painted shall not receive chromate passivation treatment.

Other Requirements

5 When a metal coating is required on only part of a component it shall be applied before the rest of the component receives paint.

1912 Testing of Metal Spray Coatings

1 At the start of the Works, and subsequently at intervals scheduled in Appendix 1/5 (with the exception of coatings on steel in bearings, curved surfaces, repairs to mechanical damage, local failure of metal spray at site joints or areas restored on site), the Contractor shall demonstrate by means of a tensile test in accordance with ISO 2063, that the minimum adhesion requirement is being attained as detailed in sub-Clause 1911.2 (iii). In the excepted areas, the Contractor shall demonstrate that the adhesion is satisfactory by means of grid tests in accordance with ISO 2063. Areas affected by the tests shall be restored.

2 The tensile tests shall be carried out initially on panels 150 mm x 150 mm x 6 mm which are of the same grade of steel as the parent material and which before blast cleaning had the same surface condition. The panels shall be blast cleaned and metal sprayed together with the parent material to the same standard and using the same technique.

3 The Contractor shall ensure that adhesion tests have been carried out satisfactorily before any further work continues.

4 If the adhesion requirement on any test panel is not met, the Contractor shall carry out a further test on the parent material adjacent to the panel position. In the case of adhesion failure on the steelwork itself by either method of test, unsound metal spray coating shall be restored and the tests repeated.

5 If more than two local areas of faulty adhesion occur on any one component, the whole of the metal spray coating on the component shall be considered as having failed, and it shall be restored. Sub-Clause 1908.4 is not applicable in the case of adhesion failure.

1913 Storage Requirements and Keeping Periods for Paints

1 On delivery to the shops or site, paint shall be unloaded directly into one or more secure paint stores which shall be located approximately within 100 metres of the painting area. Insulation and means of heating and ventilating shall be provided as necessary to maintain the temperature of paint stores between 5°C and 27°C.

If at any time or place paint in tins, painters' kettles or airless spray containers is allowed to reach temperatures outside the 5°C and 27°C limits or the paint manufacturer's recommended storage temperature, the paint shall be discarded and not used in the Permanent Works. The Contractor shall also implement any additional storage restrictions recommended by the paint manufacturer.

2 Unless excepted in accordance with sub-Clause 4 of this Clause, paint which has not been used within the shelf life recommended by the manufacturer or within 18 months of the date of manufacture, whichever is the lesser, shall be discarded and not used in the Permanent Works.

3 Chemically or moisture cured paints shall not be used after the expiry of the pot life stipulated by the paint manufacturer. They shall be discarded on expiry of the pot life or at the end of each working day/night whichever is the less. All other paints in opened tins or open containers including painters' kettles shall be returned to store and kept in sealed containers with not more than 10% ullage.

4 Exceptionally, Oleo-resinous undercoats and finishes, Acrylated Rubber paints and components of Polyamide-cured Epoxy paints may have their keeping period extended to 24 months provided that the Contractor returns the paints to the paint manufacturer and ascertains that the manufacturer examines the contents of each tin and reconstitutes the paints as necessary so that such paints are equal in all respects to the paints described in the Contract.

5 Each tin of reconstituted paint returned to the shops or site by the manufacturer shall have an additional label affixed stating 'Extended Keeping Period to (date)'. The previous date marking shall remain and not be obscured. Testing in compliance with Clause 1910 shall apply to reconstituted paints.

1914 Application of Paint

1 Paint shall be supplied from the Contractor's paint store to the painters ready for application, the only adjustment of formulation permitted being as described in sub-Clause 1915.4. Any addition of solvent shall be made in the store and shall not exceed 5% by volume of the paint.

2 Paint shall be applied only to surfaces which have been prepared and cleaned as described in this Series.

3 Unless otherwise described in Appendix 19/1, 2, 3 or 4 a coat of paint in a system shall be applied by one of the following methods:

(i) brush (B)

(ii) airless spray (AS)

(iii) air pressure spray.

4 Paint shall not be applied under the following conditions:

(i) when the ambient temperature falls below 5°C or the relative humidity rises above 80% in an enclosed workshop or 90% on site;

(ii) during rain, snow, fog, mist or in a dust laden atmosphere;

(iii) when the amount of moisture likely to be deposited on the surface by condensation or rain before or after painting, may have a harmful effect on the paint;

(iv) when wind-borne dust may have a harmful effect on the paint.

5 All shop painting of steelwork shall be carried out in a fully enclosed workshop.

6 Before starting the procedure trials described in Clause 1915, the Contractor shall make available details of the overall wet film thickness for each coat he proposes to apply. He shall also make available information as to the total amount of paint he expects to use for each coat of each system for which procedure trials are required. The calculation of the amount of paint to be used shall be based on the volume solids plus an allowance for waste.

7 The following requirements on paint film thicknesses shall apply:

(i) Wet film thickness gauges shall be used where practicable to check that the wet film thickness is not less than:

$$\frac{\text{minimum dry film thickness (mdft)} \times 100}{\text{volume solids \%}}$$

(ii) During the application of a paint system the Contractor shall ensure that the progressive total thickness of the applied coats will allow the specified minimum total dft of the system to be attained without exceeding, overall, the proposed wet film thicknesses referred to in sub-Clause 6 of this Clause by more than 20%.

(iii) In no case shall the total dry film thickness of a paint system or the mdft of the last undercoat and finish be less than that specified in Appendix 19/5 Form BE/P2 (New Works) Paint System Sheet.

(iv) The local dry film thickness for any primer shall not exceed the specified mdft by more than 30% and for other paints by more than 75%.

8 Each coat of paint of a specified system shall have satisfactory adhesion.

9 Each coat of paint of a specified system at whatever thickness applied shall be virtually free from surface defects, particularly cratering, pin-holing, blistering, rivelling, sagging, bittiness, dry spray and cissing. The finished system shall have an even and uniform appearance and the finishing paint in visually sensitive areas shall be from the same batch.

10 The degree of gloss of a finishing coat shall be established before the procedure trials. A painted tin plate reference panel, 150 mm x 100 mm, shall be provided by the Contractor for this purpose.

11 All successive coats in a system including the stripe coats shall be in contrasting colours to aid identification.

12 Two pack chemically cured paints shall not be applied when the steel or ambient temperatures are below those advised by the paint manufacturer, nor shall such paints be applied when the temperature is likely to fall below the advised temperatures during the curing period.

Stripe Coats

13 Stripe coats shall be applied to all welds and all fasteners including washers and to all external corners except those of RHS. The first stripe coat, using second undercoat paint, shall be applied over the primer, sealer or 'T' Wash. When a second stripe coat is specified, it shall be separated from the first stripe coat by an undercoat. The first stripe coat on 'T' Washed fasteners shall be applied by brush; other stripe coats may be applied by brush or airless spray as appropriate.

A solvent shall be used to remove final traces of grease from 'T' Washed fasteners.

The Contractor shall enter the details of the stripe coats he has selected in Appendix 19/5 giving the Item No., colour and method of application.

14 Square solid infill bars shall, after the second undercoat has been applied, be given an extra coat of first undercoat in lieu of stripe coats.

Exposure Times for Prepared Steel Surfaces and for Metal Coatings.
Exposure Times and Treatment of 'T' Wash and Overcoating Times for Paints

15 Clean steel prepared by dry blast cleaning or bright steel prepared by abrading or by grinding shall be primed within four hours.

16 Clean steel prepared by wet blast cleaning only, shall be primed within four hours of being dry enough for painting.

17 Clean steel prepared by combined wet/dry blast cleaning shall be primed within four hours of dry blast cleaning.

18 Steel or steelwork blast primed at the mills or in the shops shall be overcoated within eight weeks. The primed surfaces shall only be exposed outside for a maximum of two weeks of the eight week period. Prepared surfaces affected by detrimental contamination or corrosion shall be restored before overcoating.

19 Shop steelwork which has been metal sprayed shall be primed and sealed within four hours. The next coat shall be applied within 72 hours.

20 Shop prepared steel surfaces, unsealed metal spray coatings and undercoats, except final shop undercoat, shall not be exposed outside.

21 All 'T' Washed surfaces, except those of fasteners which have been treated in compliance with sub-Clause 1904.3, shall, after initial drying, be wet cleaned in compliance with sub-Clause 1903.9, taking care not to remove adhering 'T' Wash, and allowed to dry before overcoating. The first coat of paint shall be applied within 48 hours of the 'T' Washed surfaces being first dry enough for painting over.

22 When galvanized steel is to be protected by a paint system, 'T' Wash shall be applied not later than 14 days after delivery to site.

23 When galvanized steelwork is to be erected in a Marine environment and is to be protected by a paint system, 'T' Wash and the shop coats shall be applied within seven days after galvanizing.

24 A first shop undercoat shall be overcoated within 72 hours. Further shop coats shall be applied within 72-hour intervals per coat.

25 The application of sealant in gaps, in compliance with sub-Clause 1904.27, may be carried out either before or after application, as appropriate, of the first coat of paint to be applied to the completed joints or assembled plies.

26 Prepared steel surfaces and sprayed metal coatings which have been restored, also paint coats and galvanizing which have been prepared after surface damage or deterioration shall be overcoated with the sealer primer or first undercoat as appropriate before the surfaces have been affected by moisture and in any case within four hours.

27 On site, steel surfaces and metal spray coatings shall be primed or sealed within four hours and shall have the following coat applied within 72 hours. The next coat shall be applied within a further 72 hours.

1915 Procedure Trials

1 Unless otherwise described in Appendix 19/9, the Contractor shall carry out shop and site procedure trials of the protective system when more than 50 litres of any coat of paint are to be applied to 'Difficult Access' road-bridge and gantry steelwork.

Procedure trials are not required for footbridges.

Procedure trials are not required for systems applied to joints or for galvanizing only. The procedure trials shall be completed at least ten days before the start of application of the systems on the main steelwork. The trials shall be carried out with the labour and equipment to be used for the work.

2 The Contractor shall provide for the shop trials, samples of steel from $2m^2$ to $10m^2$ representing the main steelwork, galvanized when necessary. The Contractor shall demonstrate his ability to carry out surface preparation by blast cleaning and by using power assisted tools, to apply metal spray coatings described in Appendix 19/1, 2, 3 or 4 and the paints he has selected. He shall provide sufficient paint for the trials.

3 Metal spray application and painting of the main steelwork shall not be started in the shops or on site until procedure trials have been completed satisfactorily.

4 Any adjustment to the registered paint formulations shown to be required by the trials, other than an adjustment to the solvent shall be agreed with the National Roads Authority and made at the paint manufacturer's works.

5 The Contractor shall carry out further procedure trials whenever he employs replacement skilled labour or proposes to use equipment of a different type.

1916 Storage and Transport of Steel and Fabricated Steelwork

1 Steel awaiting fabrication for the Permanent Works and uncoated steelwork shall be adequately protected from contaminants liable to cause heavy rusting and possibly pitting of the surfaces.

2 Steelwork shall not be loaded for transport until the paint system is sufficiently hard for handling.

3 During storage, steelwork shall be kept clear of the ground and shall be laid out or stacked so as to prevent water or dirt accumulating on or against any of the surfaces. Suitable packings shall be placed between layers of stacked steelwork. When cover is provided it shall be ventilated sufficiently to keep condensation to a minimum.

4 Components weighing less than one tonne shall be kept in a storage area away from their erection point in order to minimise damage to protective coatings.

5 Lengths of parapet and individual lighting columns shall be supported on timber, and precautions taken to prevent damage to their protective coatings and ingress of water. They shall only be positioned adjacent to their erection point immediately before erection. If the planned erection time is delayed by more than 72 hours the components shall be returned to the storage area.

6 Hot dip galvanized components shall be transported and stored under dry and well ventilated conditions, to avoid wet storage staining. If stored outdoors, close contact of surfaces of components shall be avoided, and suitable packing shall be placed between

components, and to keep the components clear of the ground. Components should be stored wherever possible at a slight angle to allow water run off. When cover is provided it shall be ventilated sufficiently to keep condensation to a minimum.

7 If damage to coatings is excessive, or may be difficult to deal with satisfactorily after erection, the Contractor shall restore the coatings before erection.

1917 Surfaces in Contact with Concrete

1 Unless otherwise described in Appendix 19/9, metal spray coatings and all shop paint coats shall be returned 25 mm into the concrete/steelwork contact area.

2 Where aluminium metal spray, which has been sealed only, is returned into the contact area, it shall be given a coat of two-pack Epoxy Undercoat or Acrylated Rubber Undercoat of 40 microns mdft, not later than 48 hours before concreting. Application of the paint outside the contact area shall be prevented, by masking if necessary.

3 Hot dip galvanized coatings shall be applied overall. Unless otherwise described in Appendix 19/9, concrete may come into direct contact with the hot dip galvanized surfaces.

1918 Form BE/P2 (New Works) Paint System Sheet (Appendix 19/5) Form BE/P5 Paint Data Sheet (Appendix 19/8)

1 As soon as the Contract has been awarded the Contractor shall prepare and make available a copy of Form BE/P2 (New Works) Paint System Sheet (Appendix 19/5), of which he will have completed Parts 5, 6, 7, 8 and 9 for each paint system specified in Appendices 19/1 to 19/4 together with relevant copies of Form BE/P5 Paint Data Sheet (Appendix 19/8).

2 Following any relevant approvals in accordance with the Contract, the Appendices 19/5, Forms BE/P2 (New Works) Paint System Sheet shall be adopted for the Permanent Works.

1919 Access and Lighting

1 Without prejudice to the Conditions of Contract, access for inspection shall be provided and erected by the Contractor. The access shall be adequate in all respects for inspection purposes.

2 Manual surface preparation and coating application work shall not be carried out when light intensity at the workface is less than 500 lux. When the natural light intensity falls below this level the Contractor shall install and maintain temporary lighting which shall provide a minimum light intensity of 500 lux over at least 1.0 m^2 at the workface during the work and also for inspection when required.

1920 Additional Requirements for the Protection of Steel in Bridge Bearings

Applicable Clauses

1 Unless otherwise described in Appendix 19/9, the work described in this Clause shall be carried out in compliance with Appendix 19/2 and with Clauses 1901 to 1919, excepting sub-Clauses 1910.1 to 1910.7, and the following:

Supply of Coatings

2 Information, including the name of the paint manufacturer, required for completing Appendix 19/5 Form BE/P2 (New Works) Paint System Sheet, for the bearings, shall be obtained by the Contractor from the bearing manufacturer.

3 'T' Wash and MIO Epoxy paints when required for application on site shall be obtained from the manufacturer of the shop applied coats. Paint applied to the bearings on site to match the bridge steelwork paint system shall be obtained from the manufacturer of that system.

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

Applicable Clauses

1 Unless otherwise described in Appendix 19/9, the work described in this Clause shall be carried out in compliance with Appendix 19/3 and with Clauses 1901 to 1919 and the following:

Surface Preparation

2 In the shops, any steel lighting column or component material, the surfaces of which show rust pitting when viewed by normal vision after surface preparation, shall be discarded and not used for the Works.

3 On site, any lighting column or component material, the internal surfaces of which show rust pitting when viewed by normal vision after surface preparation, shall be discarded and not used for the Works.

Stripe Coats

4 For lighting columns, only one stripe coat in undercoat paint is required. For basic system Types A2a and G2a, the stripe coat shall be applied before the last undercoat of the total system, in the shops or on site as appropriate. For basic system Types A2b (Alternative) and G2b (Alternative), the stripe coat shall be in the first coat of paint applied before the final coat.

Adhesion Strength of Aluminium Metal Spray

5 For aluminium metal-sprayed lighting columns, the strength of adhesion of metal spray coating to the steel shall not be less than 35 kgf/cm^2 when tested by means of a tensile test in accordance with ISO 2063.