Steel Bridge Group

Guidance Note

The inspection of surface preparation and coating treatments

No. 8.06

Scope

This Guidance Note describes the fundamental requirements relating to the inspection of surface preparation and coating treatments applied to steel bridges. It is intended to provide an appreciation of the need for total inspection throughout all of the stages associated with application of surface treatments for durability and appearance.

General

Most new steel bridges in the UK are protected in accordance with specifications contained in the Highways Agency Specification for Highway Works, 1900 Series or the Railtrack Code of Practice RT/CE/C/002 documents (Refs 1 and 2). Sometimes, client-designed specifications may be required instead, but whichever is to be followed, the basic principles for adequate surface preparation and the correct application of the protective coatings should be common.

The employment of an appropriately experienced and/or qualified paint and coating inspector is essential to monitor for compliance with any specification, to record essential data and to advise where any non-conformances are found.

One recognised qualification scheme currently available is that certified by the Institute of Corrosion. This international scheme is available for the qualification and certification of industrial painting and coating inspectors and operates in accordance with BS EN ISO/IEC 17024 (Ref 3).

The inspector should have recourse to a wide range of equipment for testing and measuring plus the relevant standards for reference.

The absence of a properly conducted inspection regime at the preparation and application stages can account for a significant number of the premature coating failures experienced in service. The costs associated with remedial treatment for coating systems that fail prematurely are well in excess of the costs for proper inspection.

Definition and requirements

The term 'inspection' is defined in BS EN 45020 (Ref 4) as the "evaluation for conformity by observing, testing or gauging the relevant characteristics"

Additionally, the evaluation for conformity is defined as "systematic examination of the extent to which a product, process or service fulfils the specified requirements".

Surface preparation

The performance of a coating is significantly influenced by a number of characteristics of the substrate surface including: its condition before treatment; its post-treatment state of cleanliness and surface profile and surface imperfections on welds and cut edges. All of these directly affect the adhesion of the protective coatings. See GN 8.01 for further guidance.

Surface preparation is the essential and most important first stage treatment of a substrate. There is little point in continuing with the application of the coating(s) if there is failure to achieve a satisfactory surface condition.

The importance of checking that surfaces are adequately cleaned and profiled to receive the subsequent coating cannot be overstated.

Conditions at application of coating(s)

A basic requirement of all specifications is that the conditions of temperature and humidity are favourable for the application of the coating.

Normal practice is to measure the steel temperature with a contact thermometer and the humidity by using a whirling hygrometer. The dew point may be calculated from the readings obtained. It is usually specified that the steel temperature should be maintained at least 3°C above the dew point (except for moisture-cured paints).

Records of all parameters should be kept along with dates, times and signature of the inspector.

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These records may be used as a basis for future maintenance programmes and are also essential to provide data in the event of premature coating failure.

Inspection and testing of metal coatings
The inspection of metal coatings is usually straightforward. A visual check is made on the condition of the surface and measurements are taken of the coating thickness.

For thermally sprayed coatings, the inspector should check that the surface is uniform in texture without coarse, lumpy or powdery deposits. Any damage to the coating should be noted and further checks made on repairs, which should be made by an agreed method (see GN 8.04).

For hot dip galvanized coatings, the inspector should check that the surface is uniform in appearance and reasonably smooth. Variations in colour and texture are acceptable, because these vary according to the steel chemistry and processing. The appearance of uncoated areas, flux and ash inclusions, distortion and damage may be causes for rejection. Any defects that are repairable should be noted and further checks made on the repairs. (For guidance on repair of galvanized coating, see GN 8.03.)

Metal coating thickness measurement
The thickness of metal coatings is measured using standard non-destructive methods (e.g. an electromagnetic induction paint thickness gauge). There may also be a specified requirement for adhesion testing for thermal sprayed coatings. More information can be found in BS EN 22063 (thermal sprayed coatings) and ISO 1461 (hot dip galvanized coatings).

Inspection and testing of paint coatings
Paint coating systems are usually multi-coat systems and it is important to make checks at each coating stage. Visual checks should be made for obvious coating imperfections and defects. Measurements of coating thickness should be made on both wet and dry film thicknesses during and after the paint application process. In addition, there is sometimes a requirement to undertake other tests such as for adhesion and porosity or pinholes.

Measurement of paint coating thickness
Wet film thickness
Wet film thickness (wft) checks are usually required during the application of the coating to check that a subsequent satisfactory dry film thickness will be achieved. The most common instrument is the wet film comb. Disposable plastic types can be used once only, to speed measuring.

Dry film thickness
An important factor in the inspection of the coating system is the measurement of the dry film thickness (dft). Dry film thickness is generally measured on the complete paint system, although individual films may be required to be checked separately as application progresses (minimum values for each coat are usually stated in specifications).

One common method of measuring dft is to use a calibrated digital electromagnetic induction paint gauge. The accuracy of the gauge should be checked periodically during use against calibrated thickness shims. It should be realised that there are several ways of calibrating this type of instrument depending largely on whether or not the steel beneath the coating has been blast cleaned.

If an electromagnetic gauge is used on a coating over a blast cleaned substrate, the dry film reading will not take into account the profile of the blast cleaned substrate. One widely used method to compensate for this is first to obtain an average of the peak-to-trough height of the surface after surface preparation and before coating, and then subtract this value from the reading shown on the display of the gauge. Other methods require the use of smooth surface shims that are coated at the same time as the work piece. No surface profile then needs to be deducted.

A significant number of measurements are required to determine whether the target thickness has been achieved. To avoid erroneous readings, measurements should not be taken within 12 mm of edges or holes etc.

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As well as measuring the dft, the inspector should check that excessive film thickness is not applied. The 'over application' of paints can result in the formation of high stresses and may cause premature failure of the system.

Other checks on paint coatings

The requirement for testing of high build glass flake epoxy/polyester paint coatings to check for pinholes or discontinuities has recently been introduced by the Highways Agency as part of a (draft) item sheet for glass flake and polyester in all steel structures. This is to ensure that a satisfactory continuous cover has been achieved.

It should be noted that the test parameters selected for the high voltage holiday testing must take into consideration the coating dielectric strength as well as the coating thickness. Serious damage can be caused to an otherwise sound coating if the coating is subjected to an inappropriate test voltage.

References

1. Manual of Contract Documents For Highway Works Specification for Highway Works, Series 1900: Protection of Steelwork against Corrosion. 2005.
2. Railtrack Company Code of Practice. RT/CE/C/002: Application and Reapplication of Protective Treatment to Railtrack Infrastructure. Issue 4, 2002.
3. BS EN ISO/IEC 17024:2003 Conformity Assessment. General requirements for bodies operating certification of persons
4. BS EN 45020:1998 Standardization and related activities. General vocabulary. (Partially replaced by BS EN ISO/IEC 17000:2004.)

Other relevant Standards and further reading

BS EN ISO 8501-1:2001, BS 7079-A1:1989 Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings

BS EN ISO 8503-1:1995, BS 7079-C1:1989. Preparation of steel substrates before application of paints and related products. Surface roughness characteristics of blast-cleaned steel substrates. Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast-cleaned surfaces.

BS EN ISO 2808:2001, BS 3900-C5:1997. Paints and varnishes. Determination of film thickness.

Corrosion Protection of Steel Bridges, Corus, 2002.

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