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# **Steel Bridge Group: Model Project Specification For the Execution of Steelwork in Bridge Structures**

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# FOREWORD

## Foreword to Revised Issue, 2012

This document has been revised in line with changes made in Amendment 1 to EN 1090-2, published in August 2011. Only a small number of changes were needed - the clauses concerned are highlighted in Appendices B and C. Changes have also been made in the comment column to a few of the references to PD 6705-2; in some cases additional guidance in the PD that had been anticipated was not provided when that document was published. An additional tolerance requirement has been included in 11.201. Revised text is indicated by a marginal bar.

The membership of the Steel Bridge Group, at the time of this revision, was as follows:

Mr C R Hendy (chairman)	Atkins	Mr T Harris	Parsons Brinckerhoff
Mr E Atherton	Cass Hayward LLP	Mr I E Hunter	I E Hunter Associates
Mr S Bhattacharya	URS/Scott Wilson	Mr D C Iles	SCI
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## Foreword to First Issue

CEN Standard EN 1090-2, issued in the UK as BS EN 1090-2, gives technical requirements for the execution of steel structures. The Standard is referenced by EN 1993, Eurocode 3, and in the UK effectively replaces BS 5400-6, which was the Standard for bridge steelwork designed in accordance with BS 5400-3. EN 1090-2 covers all forms of steel construction but, because of its universal coverage, it has many instances where an execution specification needs to give additional requirements or to choose optional requirements, to suit the particular structure. These additional and optional requirement choices are especially necessary for bridge steelwork, where high quality products and workmanship are needed.

To address the need to provide bridge-related requirements in an execution specification, the members of the Steel Bridge Group have compiled, in this publication, a set of additional requirements that would reflect current best practice in the UK. The requirements are in the form of a series of clauses that may be inserted into a project's execution specification and which will be compatible with EN 1090-2. The publication, simply referred to as the *Model Project Specification* (MPS) presents numbered clauses, each with an accompanying commentary. The text of the clauses is also made available separately, as a Word document that may be downloaded from Steelbiz, to facilitate compilation of contract documents.

The Steel Bridge Group is a technical forum that has been established to consider matters of high-priority interest to the steel bridge construction industry in the UK and to suggest strategies for improving the use of steel in bridgework. As a result of the representation of diverse interests in the Group, the publication may be considered to be a guide to good, accepted practice in this field. It should not, however, be taken to be suitable, complete and applicable contractually to every project. The Steel Construction Institute and the members of the Group assume no responsibility for the adequacy of the advice given, or for the legal, contractual or financial consequences of its use.

Thanks are expressed to Tata Steel Europe for financial support during the preparation of this publication. Thanks are also expressed to Mr A Sollis of Atkins for contributions during the drafting of the publication.

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## SUMMARY

This document provides a set of clauses that may be used in drawing up execution specifications for bridge steelwork, in conjunction with BS EN 1090-2, for individual projects in the UK. The clauses represent an industry ‘best practice’ view of how the general requirements of BS EN 1090-2 may be modified and supplemented, where permitted by that Standard, to achieve the quality and reliability to be expected for bridges in the UK, designed in accordance with the Structural Eurocodes.

The clauses are grouped under headings which generally correspond to those of the principal headings in BS EN 1090-2 and are presented in a two column format. The left-hand column presents the model clauses and the right-hand column presents a commentary, giving background or reference to further advice.

An appendix lists all the clauses in BS EN 1090-2 where further information is required or where options may be specified and indicates which of these have corresponding model clauses in the main body of the document.

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# 1 USE OF THIS MODEL PROJECT SPECIFICATION

## 1.1 Scope and format of this document

The execution of steelwork for bridges in the UK will generally be specified to be in accordance with BS EN 1090-2. That Standard, which covers technical requirements for a wide range of steel structures, including bridges, includes clauses where the execution specification for the works is required to give additional information or where it has the option to specify other requirements.

The execution specification is defined in BS EN 1090-2 as the “set of documents covering technical data and requirements for a particular steel structure including those specified to supplement and quantify the rules of this European Standard”. The present publication offers a set of clauses that may be used for individual bridge projects to supplement and quantify those rules and describes itself, for brevity, as a Model Project Specification (MPS). In the document, clauses are grouped under headings that generally correspond to those of the principal headings in BS EN 1090-2. Reference numbers for these model clauses are given for ease of use and cross reference; when used in a project, an alternative numbering system may be chosen to suit the project documentation. Reference to clauses within BS EN 1090-2 is made simply by quoting the clause number.

The clauses are arranged in a two-column format. The left column contains the proposed clauses. The right column gives a commentary to each clause, for the information of the person drawing up project documents; those commentaries are not intended to be included within the execution specification. In the commentaries, references are made to ‘Guidance Notes’. These are a series of 60 separate topics that are published as *Steel Bridge Group: Guidance Notes on Best Practice in Steel Bridge Construction* (SCI P185). The Notes offer extensive, though still relatively concise, advice on practical aspects related to structural steelwork for bridges. References are also made to PD 6705-2 (see Section 2), which offers background information about BS EN 1090-2.

Only clauses for ‘normal’ bridge steelwork are included: clauses related to stainless steels and to thin gauge steel are excluded, as are any building-specific clauses. The MPS is intended to cover both highway and railway bridges but relates principally to conventional construction using constituent products to the standards referenced in BS EN 1090-2. If more complex forms of construction are involved or other products are used, designers need to consider any modifications that might be needed to the execution specification to ensure that the desired quality and/or functionality are achieved.

Clauses noted as “optional clause” are included for completeness but will rarely be required for highway bridges and may be omitted in most project specifications.

It is emphasised that this model document is intended to clarify and assist the production of an execution specification that expresses clearly what the designer requires for a particular project. This should be of benefit in pricing and execution of the work and should lead to improvements in economy and quality of the finished structure.

## 1.2 Reference to the designer during execution

For most steel bridge structures, and especially for major structures, there is a need to maintain involvement of the designer of the permanent works, or at least someone who takes over full responsibility for the design of the permanent works, during construction.

There should be a means to refer matters of non-conformance with the execution specification to the designer, if acceptance of the non-conformance were to be considered. Also, if the constructor’s erection method (see 9.3.2) deviates from the design basis method of erection (see 9.3.1) the designer needs to be satisfied that the change will not be detrimental to the performance

of the permanent works. The latter requirement is introduced in 9.304 of this MPS. The assignment and definition of the role of the designer should be part of the contractual arrangements for the project and is outside the scope of this document.

### **1.3 Involvement of the constructor during design development**

It is good practice to seek the advice of a constructor during the design development of any steel bridge. For modest structures, that advice can take place before, and be outside of, any contractual arrangements for execution. However, it should be recognised that the design of major long-span bridges invariably requires the input of the chosen constructor during final design development, after contractual arrangements for execution have been initiated. The involvement of the constructor in this role is outside the scope of this document.

### **1.4 Competence of the designer and the constructor**

Attention is drawn to two of the general assumptions in EN 1990, 1.3, that the design of the structure is made by appropriately qualified and experienced personnel and that the execution is carried out by personnel having the appropriate skill and experience. Structural details in bridgework can be complex, and constrained access to the details, particularly for welding, may add to the difficulty of achieving the necessary quality. Designers and specifiers need to have the appropriate experience to recognise difficulties and to set practically achievable requirements. The appointed constructor needs to have personnel who have experience of the type of work needed for the execution of the steelwork.

## 2 REFERENCE DOCUMENTS

In addition to the normative references in BS EN 1090-2, the following documents are referred to in the model clauses or in the commentaries to the clauses.

NHSS 19A	National Highways Sector Schemes for Quality Management in Highway Works, 19A, For corrosion protection of ferrous materials by industrial coatings, UKAS, 2006
NHSS 20	National Highways Sector Schemes for Quality Management in Highway Works, 20, The execution of steelwork in transportation infrastructure assets, UKAS, 2008
ASTM A325	ASTM A325 - 07a Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength, ASTM, 2007
EN ISO 8501-1:2007	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.

The following parts of the Manual of Contract Documents for Highways Works are referenced:

Specification for Highway Works (SHW), Series 1900 Protection of steelwork against corrosion

Notes for Guidance on the Specification for Highway Works, Series NG 1900

Several Parts of the Eurocodes are also referenced; in each case, the relevant UK National Annex should be consulted.

The following BSI document is referred in the commentaries to some clauses. It provides background to some of the clauses in EN 1090-2 and in places offers advice on drafting more sophisticated requirements, where that might be appropriate for a specific project.

PD 6705-2:2010, Structural use of steel and aluminium. Recommendations for the execution of steel bridges to BS EN 1090-2

Reference is also made to individual Guidance Notes (e.g. to GN 3.01) within the publication:

Steel Bridge Group: *Guidance Notes on Best Practice in Steel Bridge Construction* (P185), published by SCI (5<sup>th</sup> issue, 2010).

## 3 TERMS AND DEFINITIONS

No terms additional to those in BS EN 1090-2 are defined in this document.

## 4 SPECIFICATIONS AND DOCUMENTATION

### 4.1 Execution Specification

#### 4.1.1 General

- 4.101 The requirements for the execution of structural steelwork for the project are given in the following documents:  
*(Insert list)*
- Insert a list of the relevant drawings and other documents, including reference to EN 1090-2*

#### 4.1.2 Execution classes

- 4.102 For bridge structures, EXC3 shall generally apply, except where specified otherwise on the drawings.
- The use of EXC3 as the default class will provide adequate reliability for most elements of ordinary highway bridges. For some structures, a greater scope of inspection and testing and/or higher quality level acceptance criteria may be required, either generally or for particular details. Particular details where this is required, such as where special inspection and testing is required, according to BS EN 1993-1-9, NA.2.1.2, should be indicated on the drawings. See 7.603, 12.4.2.2 and 12.401. Guidance on selecting greater or lesser quality criteria based on fitness for purpose, considering individual details within a structure, is given in PD 6705-2. Note, however, that it is unlikely to be economic to include such relaxations from a general requirement for EXC3 unless they are extensive.*

### 4.2 Constructor's documentation

#### 4.2.2 Quality plan

- 4.201 A quality plan for the execution of the works, in accordance with ...., shall be provided and maintained.
- A quality plan should normally be required. The general requirements for the particular plan should be agreed with the client by the designer and specified in this clause. Note that HA requires certification for structural steelwork to NHSS 20: NHSS 20 requires a quality plan in accordance with its Appendix A. Similarly, for corrosion protection, HA requires a quality plan in accordance with Appendix A of NHSS 19A.*

## 5 CONSTITUENT STEEL PRODUCTS

### 5.1 General

- 5.101 *(Optional clause)* Properties for ... shall comply with the requirements given in ... *Insert details for any constituent product not covered by the standards listed in 5. Not normally required for bridgework.*

### 5.2 Identification, inspection documents and traceability

- 5.201 A record shall be maintained of the source of, and test certificates for, main structural steel elements in order to provide traceability for each product. Traceability shall be by piece, by type or by stock certificate, as follows: *If appropriate, include other items. Traceability to a particular piece is not essential for items such as intermediate web stiffeners. Traceability to a particular batch for items such as welding consumables is not practical.*
- a) For flanges, webs and diaphragms in main girders, the records shall be maintained for each individual piece. A unique item mark shall be made on each piece.
  - b) For stiffeners, splice plates, bracing members, and fasteners, the records shall be maintained for each item type, of which there can be many individual pieces. Products of one type may come from more than one source and be installed in more than one location.
  - c) For welding consumables and shear connectors, the records shall be maintained according to stock certification, which shall show that the stock material meets the project requirements.

### 5.3 Constituent steel products

#### 5.3.1 General

- 5.301 The grade and quality of structural steel shall be as specified on the drawings. *The drawings are the best place to specify the grade and quality; the extent of each particular grade and quality can be clearly indicated. See GN 3.01 for guidance on grade selection.*

#### 5.3.2 Thickness tolerances

- 5.302 For structural steel plates thickness class A in accordance with EN 10029 shall be used. *Class A is usually sufficient, even where EXC4 is specified, but if class C is required by the technical authority or for other reasons, that class should be specified instead.*

### 5.3.3 Surface conditions

- 5.303 The surface condition shall comply with Class A3 (for flat products) or Class C3 (for sections) to BS EN 10163.

*Classes A & C limit removal of minor surface defects by grinding. Sub-class 3 prohibits repair by welding. Sub-class 2, which allows repair by welding subject to the agreement of the purchaser, should not normally be used. These classes are higher than the default values and no additional statement about repair is needed. In some cases the technical authority may require the use of classes B3/D3.*

- 5.304 The surface of the steel material, before surface preparation and protective treatment, shall comply with rust grades A or B according to EN ISO 8501-1. Material which is pitted, i.e. rust grades C or D, shall not be used.

*Avoid the use of grades C and D, because it is almost impossible to remove the corrosion products from the deepest pits; such residues often lead to premature breakdown of the protective treatment. If there are any other non-structural requirements related to surface condition, these should also be specified but that is not usual for bridge steelwork.*

### 5.3.4 Special properties

- 5.305 The locations where internal discontinuity quality class S1 is required are specified on the relevant drawings.

*Class S1 should be specified on the drawings for the joints and areas referred to in 5.3.4. In exceptionally complex details, designers might wish to identify other locations where a particular quality class should be specified - for example class E<sub>1</sub> should be specified on the relevant drawings for the edges of plates where corner welds will be made on to the surface of such plates.*

- 5.306 Areas where material shall comply with requirements for improved deformation properties perpendicular to the surface according to EN 10164 are specified on the drawings.

*Consideration should be given to specifying such material for cruciform, T and corner joints. Should only be invoked where necessary; specify only those parts of the structure which need these properties. See PD 6695-1-10 for advice on class.*

- 5.307 *(Optional clause)*  
Where constituent products are to be processed before delivery, the processing shall comply with the following requirements:  
*(Insert details)*

*Not normally required for bridgework. Might be needed for bending of open and hollow sections - seek specialist advice.*

## 5.5 Welding consumables

- 5.501 Welding process 136 is permitted, using one of the options for process 135, for steels according to EN 10025-5.

*Process 136 (Tubular-cored arc welding with active gas shield) is included as a permitted process in 7.3 and is commonly used in positional fillet and butt welding.*



## 5.6 Mechanical fasteners

### 5.6.3 Structural bolting assemblies for non-preloaded applications

- 5.601 The property classes of non-preloaded bolts and nuts, and surface finishes, shall be as specified on the drawings
- The NA to BS EN 1993-1-8 restricts design to the use of bolt property classes 4.6, 5.6, 8.8 and 10.9. Non-preloaded bolts are used only for non-structural applications in bridges (see EN 1993-2, 2.1.3.3); only property class 8.8 is commonly available in the UK.*

### 5.6.4 Structural bolting assemblies for preloading

- 5.602 The property classes of preloaded bolts and nuts, and surface finishes, shall be as specified on the drawings.
- Property class 8.8 HR bolts will normally be specified; they are the nearest equivalent to HSFG bolts to BS 4395-1, which have been most commonly specified for bridges.*
- Property class 10.9 HRC bolts will also be commonly specified; they are the equivalent to TCB grade S10T bolts.*
- Property class 10.9 HR bolts or HV bolts (only available in property class 10.9) should be allowed if proposed as an alternative by the constructor but HV bolts are sensitive to over-tightening, so they require a greater level of site control and the NA to BS EN 1993-1-8 applies a larger value of  $\gamma_{M7}$  to the preload value .*
- It is not advisable to use both HR and HV assemblies on the same project.*
- Property class 8.8 HR bolts can be tightened by the part-turn method (see 8.501).*

### 5.6.6 Weather resistant assemblies

- 5.603 The chemical composition of weather resistant assemblies shall comply with the requirements for Type 3 fasteners to ASTM standard A325, Grade A, or equivalent.
- It is necessary to specify the requirement explicitly.*

### 5.6.7 Foundation bolts

- 5.604 Reinforcing steels shall not be used for foundation bolts.
- Reinforcing bars are not appropriate for bridgework foundation bolts.*

### 5.6.8 Locking devices

- 5.605 For non-preloaded assemblies, locking devices shall be provided.
- Ancillary items are often attached using non-preloaded bolts; locking devices are necessary to prevent the nuts from working loose due to vibration.*

- 5.606 *(Optional clause)*  
Where locking devices are specified on the drawings, they shall comply with the relevant standard in 5.6.8 and additionally ...  
*(Insert any particular requirements for locking devices)*
- The products listed in the standard are suitable for use as locking devices. Insert any project-specific requirements for type of device etc.*
- 5.7 Studs and stud connectors**
- 5.701 Stud shear connections shall be type SD1 in accordance with EN ISO 13918.
- Two types of carbon steel stud connector are given in EN ISO 13918. This clause confirms that the stronger of the two is to be used.*
- 5.8 Grouting materials**
- 5.801 Grouting materials to be used shall be as specified on the relevant drawings.
- It is necessary to specify what materials are to be used. The drawings are a convenient means to do so.*
- 5.9 Expansion joints for bridges**
- 5.901 *(Optional clause)*  
Requirements for the type and characteristics of expansion joints shall be as specified on the relevant drawings.
- If expansion joints are needed, general requirements should be given on the drawings, with reference to an appropriate specification and expansion schedule. See Annex B of EN 1993-2.*
- 5.10 High strength cables, rods and terminations**
- 5.1001 *(Optional clause)*  
The tensile strength grade and coating class for wires for high strength cables shall be as specified on the relevant drawings.
- Refer to EN 1993-1-11 for guidance on specification of cables.*
- 5.1002 *(Optional clause)*  
The designation and class of strands for high strength cables shall be as specified on the relevant drawings.
- Refer to EN 1993-1-11 for guidance on specification of strands.*
- 5.1003 *(Optional clause)*  
The minimum breaking load, diameter and corrosion protection requirements for steel wire ropes shall be as specified on the relevant drawings.
- Refer to EN 1993-1-11 for guidance on specification of wire ropes*
- 5.1004 *(Optional clause)*  
The filling material for the sockets shall be as specified on the drawings.
- Filling material for sockets can be either molten metal or resin in accordance with EN 13411-4. Design of sockets is a specialist activity and the specification of filling material should be undertaken in conjunction with the manufacturer of the socket system taking into account the constructor's method statement and procedure(s) for the socketing activities.*



## 6 PREPARATION AND ASSEMBLY

### 6.2 Identification

- |       |  |  |
|-------|--|--|
| 6.201 | Hard stamping shall only be used in the areas marked on the drawings. Punched or drilled marks may be used for steels up to and including grade S355.  | <i>This clause is only required on fatigue-sensitive structures where hard stamping would reduce the fatigue life. Hard stamping is the best way of marking, but ordinary stamps produce a detail category typically of 56 or 63 (depending on the letter and its size). Soft or low stress stamps give a better detail category. Punched or drilled marks are acceptable. See GN 5.05</i> |
| 6.202 | Soft or low stress stamps may be used except in any areas specified on the drawings.   | <i>Soft or low stress stamp marks can easily be obliterated by the protective system. The fabricator will usually mask the stamped area after application of primer and complete the coating locally after erection. Note that soft or low stress stamps are effectively detail category 100, for fatigue assessment purposes.</i>   |
| 6.203 | <i>(Optional clause)</i><br>Areas where identification marks are not permitted or shall not be visible after completion are specified on the drawings. | <i>Not normally required in bridgework. Marks are small and therefore not visually intrusive.</i>  |

## 6.4 Cutting

### 6.4.4 Hardness of free edge surface

- 6.401 For carbon steels, hardness of plasma-cut free edge surfaces shall be in accordance with Table 10, except where all the following apply:
- there is no geometrical discontinuity on the surface;
  - the surface is not subsequently subject to cold forming; and
  - the element of which the surface is a part is not in an area exposed to accidental impact from vehicles.
- Elements in areas exposed to vehicle impact are identified on the drawings

*See Appendix C: for suggested note on drawings about areas exposed to impact. The hardness limits in Table 10 are taken from EN 15614-1 for welded joints; they are not the result of direct research related to cut surfaces.*

*Hardness of less than 380 HV10 can be achieved in flame-cut surfaces by controlling the process, but that cannot be done with plasma cutting. Typical hardness values for S355 steels cut by plasma lie between 400 and 600 HV10 and in bridgework this process is routinely used for cutting webs, cover plates, stiffeners and flanges in thicknesses of 30 mm and below. Tests on plasma cut surfaces indicate that they have a slightly reduced fracture resistance, but this would not be detrimental to the performance of bridge steelwork unless the surface contains a geometrical discontinuity such as a change of cross-section causing a stress concentration, or is subject to shock loading such as that due to vehicle impact or the edge is subsequently cold formed. Surfaces exposed to impact loading would typically be on outer girders with headroom under 5.7 m, and include edges of bottom flanges, bottom flange cover plates and stiffeners.*

- 6.402 Where a hardness limit specified in Table 10 is applicable, the processes that are likely to produce local hardness (thermal cutting, shearing, punching) shall have their capability checked. The check of the capability of the processes shall be as specified in 6.4.4.

*The procedures for checking the capability of the processes should observe a similar discipline of drafting, testing and certification as for welding procedure specifications.*

## 6.5 Shaping

### 6.5.4 Cold forming

#### 6.501 *(Optional clause)*

The bending of circular tubes by cold forming shall comply with the following requirements:

*(Insert details)*

*Insert a clause if it is considered that there is a need to change the conditions in 6.5.4.*

*A lesser d/t ratio or bend radius should not be specified without either advice from a specialist bending contractor or appropriate pre-production testing to ensure that bending does not cause mechanical damage.*

*Note that the implications of curvature on the choice of buckling curve and the consequences on toughness requirements of cold forming need to be considered by the designer*

## 6.6 Holing

### 6.6.1 Dimensions of holes

#### 6.601 *(Optional clause)*

Where specified on the drawings, holes with special dimensions shall be provided for connections for movement joints.

*Only needed for special cases such as for mechanically operated bridges. Design of such joints is a specialist activity; the specialist designer should give the requirements.*

#### 6.602 *(Optional clause)*

For hot rivets the nominal diameter of holes shall be 2 mm larger than the nominal diameter of the cold rivet as manufactured.

*Only needed for riveted construction, which is very rarely used for structural purposes.*

6.603 For countersunk bolts or hot rivets the nominal dimensions of the countersinking shall be such that after installation the bolt or rivet will be flush with the outer face of the outer ply.

*The use of countersunk bolts or hot rivets should be shown on the drawings. (Reference to rivets may be omitted if they are not used.) Avoid the specific dimensioning of countersinking - the requirement for a flush surface is sufficient.*

### 6.6.2 Tolerances on hole diameter for bolts and pins

#### 6.604 *(Optional clause)*

Tolerances on hole diameters shall be as specified on the drawings.

*Special tolerances would only be needed in exceptional conditions. No clause is needed for normal bridgework. If pins are used, tolerances should be specified for both holes and pins. See EN ISO 286-2 for guidance on classes of fit.*

**6.6.3 Execution of holing**

6.605 Holes for fasteners shall be formed by drilling or by punching followed by reaming.

*Thermal cutting is not normally practicable or acceptable (it would have a lower fatigue category) for execution of holing bridgework but it is not explicitly excluded by 6.6.3. Clause 6.6.3 requires that punching be at least 2 mm undersize for EXC3 and EXC4.*

6.606 *(Optional clause)*  
Long slotted holes shall be executed as specified on the drawings.

*This option is only needed for special cases, such as slotted holes for pins in movement joints. Details must then be given on the drawings.*

**6.7 Cut-outs**

6.701 Punched cut-outs are not permitted

*For bridges, cut outs should be considered as requiring class EXC4.*

**6.8 Full contact bearing surfaces**

6.801 Where full contact bearing is specified, other than at the ends of stiffeners, the fit between two surfaces shall be such that two surfaces mate to give a maximum 0.5 mm gap; the fit may be achieved by machining or grinding.

Where ends of stiffeners are specified on the drawings as required to be fitted, they shall be ground, where necessary, so that the maximum gap over 60% of the contact area does not exceed 0.25 mm.

*This fit is closer than that in Table D.2.7 (No. 5). This clause allows fitting by grinding because it is often difficult to machine large items of steelwork, such as plate girders. Bearing stiffeners are usually required to be fitted to the flange to give full contact bearing where the flange is subject to a concentrated load (this requirement must be indicated on the drawings). Note that it is impracticable to achieve full contact bearing between the web and the flange at this location, and so fitting the web to the flange should not be specified.*

**6.9 Assembly**

6.901 The acceptability of the addition of any welded temporary attachments and the making of any butt welds additional to those specified on the drawings shall be verified according to the design rules.

A record of the details of such attachments and butt welds shall be provided as part of the constructor's execution documentation. Areas where temporary attachments have been made shall be made good. If weld repairs are necessary these shall be carried out in accordance with the requirements of the appropriate Standard.

*If there are any restrictions on positioning of temporary attachments, they should be specified on the drawings. In general, temporary welded attachments are not acceptable within 25 mm of the edges of flange plates. See 7.504.*

## 6.10 Assembly check

- 6.1001 *(Optional clause)*  
Trial erection shall comply with the following requirements:  
*(Insert details)*

*For most bridges, it should not be necessary to carry out a full trial erection. A trial erection may be necessary for reasons such as:*

- a) When it is important that the steel fits together on site without any undue delay and/or remedial work (e.g. when erecting during a possession or in a remote location). See GN 7.04.*
- b) When a deviation from nominal geometry would have a significant effect on internal forces and moments.*
- c) When there are functional constraints – such as cross-fall and longitudinal vertical curve for clearance or drainage.*
- d) When required to check the alignment of visually critical elements, e.g. fascias. (Requirements for a), c) and d) should be given as functional tolerances; requirements for b) should be given as essential tolerances.)*

## 7 WELDING

### 7.4 Qualification of welding procedures and welding personnel

#### 7.4.1 Qualification of welding procedures

##### 7.4.1.1 General

- 7.401 In general tack welds should be made to the same welding procedure specification as the permanent weld. If special deposition conditions for tack welds are required, they shall be included in the welding procedure specification.
- In some cases, for instance if the tack weld will not be completely re-melted by the subsequent welding, it might be necessary to use a different preheat. This should be investigated during welding procedure approval.*

##### 7.4.1.2 Qualification of welding procedures for processes 111,113,12,13 and 14

- 7.402 *(Optional clause)*  
For particular joints, as specified on the drawings, pre-production welding tests, qualified in accordance with EN ISO 15613, shall be carried out.
- This clause may be used where the designer recognises that a particular joint or configuration is structurally critical and likely to be unusually difficult to perform successfully. Examples of such situations are where there is difficult or limited access or unusual orientation. Joints that are difficult to weld are also likely to be difficult to inspect and even more difficult to repair, so the designer should seek the help of an experienced steelwork contractor to investigate alternative solutions.*

##### 7.4.1.4 Validity of a welding procedure qualification

- 7.403 For stud shear connectors, in addition to validation of a welding procedure, production tests shall be carried out in accordance with 12.403 and 12.404.

### 7.5 Preparation and execution of welding

#### 7.5.4 Assembly for welding

- 7.501 *(Optional clause)*  
The assembly of hollow sections shall comply with the following requirements:  
*(Insert details)*
- Insert a clause if the assembly of hollow sections to be welded is other than in accordance with Annex E.  
Advice from a specialist hollow section steelwork contractor should be followed.*

#### 7.5.6 Temporary attachments

- 7.502 In general, temporary welded attachments shall not be attached within 25 mm of the edges of flange plates.
- If there are any other restrictions on positioning of temporary attachments, they should be specified, either in this clause or on the drawings.*

7.503 The use of temporary attachments is permitted, except in areas specified on the drawings, subject to the constraints on their removal given in 7.504.

*Where the designer requires a fatigue life corresponding to detail category 112 or higher, temporary attachments should be prohibited.*

*The steelwork contractor would normally select the position of temporary attachments and, in so doing, would take account of potential clashes with permanent formwork and reinforcement.*

7.504 Any temporary welded attachments shall be completely removed. Attachments may be removed by flame cutting not less than 3 mm above the connection on condition that the welded area is subsequently ground flush and checked for cracks using Magnetic Particle Inspection.

Any welded attachments provided for temporary works during construction that can, with the agreement of the designer, be left in position, such as lifting cleats on top flanges that are subsequently cast into reinforced concrete, shall be considered as permanent works and be subjected to appropriate testing and inspection.

### 7.5.9 Butt welds

#### 7.5.9.1 General

7.505 The location of butt welds used as splices to accommodate available lengths of constituent products is permitted, except in areas specified on the drawings. The locations of all such splices shall be shown on the drawings.

*The location of all butt welds should be consistent with the design of the structure. The designer may exclude locations where a butt weld would not be consistent with the design. The locations of all butt welds should be shown on the final contract drawings.*

#### 7.5.9.2 Single sided welds

7.506 *(Insert one of these alternative clauses)*

*Either:*

Permanent backing material shall not be used for single sided welds.

*Or:*

Permanent backing material for single sided welds may only be used where indicated on the drawings and when the following requirements are included in the WPS:

*(Give requirements to be included in the WPS).*

*Steel backing bars might be needed if there is no access for removal of ceramic bars (for example where there are butt welds in a small box girder).*

*Note that the detail category for stresses in the direction of the backing bar is 36 where the bar is not continuous.*

*In all cases, the WPS should specify that the permanent backing material shall be closely fitted and firmly located only by tack welds in the root of the permanent weld.*



- 7.507 *(Optional clause)*  
Where flush grinding of welds in joints between hollow sections without backing is permitted, grinding shall comply with the following requirements:  
*(Insert details)*
- Insert a clause if flush grinding is to be allowed and show on the drawings where this is permitted.*  
*Not normally required in bridgework. Advice from a specialist hollow section steelwork contractor should be followed, if grinding is to be allowed.*

#### 7.5.10 Welds on steels with improved atmospheric corrosion resistance

- 7.508 For welds on steels with improved atmospheric resistance, C-Mn consumables may be used for single run fillet welds up to 8 mm leg length using welding processes 121 to 125, 135 and 136, and for butt welds formed by a single run from each side.
- Refers to MAG and SAW weld processes. This will ensure that the welds have weather resistance at least equivalent to that of the parent metal. See Guidance Note 1.07*

#### 7.5.13 Slot and plug welds

- 7.509 *(Optional clause)*  
Dimensions for slot and plug welds shall be as specified on the drawings.
- This option allows the designer to specify dimensions for these welded connections (normally based on the dimensions suggested in 7.5.13 a) and b) ). If the constructor wishes to modify the specified dimensions, the adequacy of the connection should be verified to the satisfaction of the designer.*
- 7.510 Plug welds shall not be made without previous slot welding.
- Plug welds without previous slot welding are not appropriate for bridgework. Fillet welds in the slot can be visually checked but MPI and dye penetrant testing would not always be possible because part of the weld would be flooded by the ink or dye.*

#### 7.5.15 Other weld types

- 7.511 *(Optional clause)*  
Other weld types shall comply with the following requirements:  
*(Insert details)*
- Any special requirements for other types of weld should be specified and the relevant welds indicated on the drawings.*

#### 7.5.17 Execution of welding

- 7.512 Butt welds shall be ground flush only where specified on the drawings.
- Grinding flush should only be required in specific circumstances such as enhanced fatigue classification, or where weld caps can interfere with the sealing of formwork or precast units. The grinding of external weld caps could make the joint more noticeable because it tends to produce a wider feature and should not normally be specified for appearance reasons.*



## 7.6 Acceptance criteria

- 7.601 The acceptance criteria for “Excessive throat thickness” (5214) shall be quality level D.
- The limits on throat thickness for fillet welds in EN ISO 5817 are too onerous for normal production. In normal bridge fabrication where excessive throat thickness is not detrimental, the acceptance level can be lowered to Quality Level D (Unlimited).*
- 7.602 *(Optional clause)*  
Where specified on the drawings, the weld geometry and weld profile shall comply with the following additional requirements:  
*(Insert details)*
- It should not be necessary to specify any additional requirements except in structures that are particularly sensitive to fatigue loading. See further comment below.*
- 7.603 *(Optional clause)*  
Where specified on the drawings, internal weld imperfections shall comply with the following additional requirements:  
*(Insert details)*
- Generally, the requirements in Table 17 for quality level B+ (which applies to EXC4) are not practically achievable in routine production. If a higher quality level (than EXC3) is required this should be specified for each relevant joint detail. As noted in 7.6, the evaluation of non-conformity should then be judged individually for each detail and criteria set based on the function of the component. PD 6705-2 provides fitness-for-purpose acceptance criteria related to functional classifications of fatigue details.*

## 8 MECHANICAL FASTENING

### 8.2 Use of bolt assemblies

#### 8.2.1 General

- 8.201 Non-preloaded assemblies shall be provided with locking devices. Preloaded assemblies shall not be provided with additional locking devices.
- Locking devices are required to prevent secondary components fastened with non-preloaded bolts vibrating loose. Locking devices are not required for preloaded bolts and should not be used other than in exceptional circumstances.*

#### 8.2.2 Bolts

- 8.202 Bolt sizes for structural bolting shall be as specified on the drawings.
- State all bolt sizes on the drawings. Bolts smaller than M20 are rare for structural applications in bridges.*
- 8.203 *(Optional clause)*  
Where the structure has been designed to utilise the shear resistance of the unthreaded shank of bolts, this is specified on the drawings and the dimensions of the bolts are given.
- The locations and dimensions must be given on the drawings. Reliance on the resistance of the unthreaded shank, rather than the threaded part, is inadvisable because it requires a higher level of control on bolt supply and installation to ensure that only unthreaded parts exist in the part of the connection where the resistance to shear is required.*

#### 8.2.4 Washers

- 8.204 *(Optional clause)*  
Washers shall be provided under the nut or the bolt head of non-preloaded bolts, whichever is rotated.
- Non-preloaded bolts are not used in structural connections for bridgework (see EN 1993-2, 2.1.3.3).  
If they are used in non-structural connections, washers should be specified, to prevent damage to a protective coating during tightening*
- 8.205 The dimensions and steel grades of plate washers shall be as specified on the drawings.
- If plate washers are required, their thickness and steel grade should be such that they are adequate for the design forces in the bolts, taking account of the geometry of the connection.*

### 8.4 Preparation of contact surfaces in slip resistant connections

- 8.401 The area of contact surfaces in preloaded connections where a particular friction class is required shall be as specified on the drawings.

- 8.402 The class of friction surface shall be as specified on the drawings. After preparation of the surface, including the application of any coating in accordance with F.401, the treated surfaces shall be adequately protected until they are brought together.
- Note that when the contact surfaces (faying surfaces) are metal sprayed, any light 'browning' which occurs before the splice is assembled is not harmful and should not be a reason to re-blast the faying surface. See GN 7.05.*

## 8.5 Tightening of preloaded bolts

### 8.5.1 General

- 8.501 In addition to the tightening methods in 8.5, the part turn method described in 8.505 may be used.
- The part-turn method described in 8.505 has been validated for property class 8.8 HR bolts.*

### 8.5.4 Combined method

- 8.502 For the combined method, when using the value  $M_{r,1}$  for the first tightening step, the simplified expression in 8.5.4 may be used.
- This confirms the use of the simplified expression.*

- 8.503 For the combined method, values other than those given Table 21 shall not be used unless calibrated in accordance with Annex H.
- In bridgework it would be unusual to use values other than those given in Table 21 for the combined method.*

### 8.5.5 HRC method

- 8.504 For the HRC method, the first tightening step shall be repeated as necessary if the pre-tightening is relaxed by the subsequent tightening of the remainder of the bolts in the connection.
- In bridgework it would be unusual to repeat the pre-tightening step more than once.*

**8.5.106 Part turn method**

*This clause number is additional to those in EN 1090-2.*

*The part turn method is essentially a modified form of the combined method but it does not require the use of K1 or K2 class bolts and the method is traditionally known in the UK as the part turn method.*

8.505 Before commencement of preloading, the connected components shall be fitted together and the bolts in a bolt group shall be tightened in accordance with 8.3 but the residual gap at the edges shall be limited to 2 mm with the necessary corrective action on steel components.

*This clause is based on the requirements in BS 4604 and the SHW.*

*The requirement to tighten to the method in 8.3 and the limit on residual gap are stated in 8.5 and are repeated here to confirm that the requirement also applies to the part turn method.*

Tightening by the part-turn method comprises two steps:

- a) a first tightening step, using a torque wrench. The wrench shall be set to a torque value in accordance with Table 8.1. This first step shall be completed for all bolts in one connection prior to commencement of the second step;
- b) a second final tightening step in which a specified part turn is applied to the turned part of the assembly. The position of the nut relative to the bolt threads shall be marked permanently after the first step, so that the final rotation of the nut relative to the thread in this second step can be easily determined.

The second step shall be in accordance with the values given Table 8.2

TABLE 8.1 First step tightening of nuts

Nominal dia. mm	Bedding torque of bolt $\pm 10\%$ Nm
24	270 Nm
30	460 Nm

*The values in Table 8.2 have been validated by tests for property class 8.8 HR bolts to EN 14399-3, for sizes M24 and M30, for nominal thickness) up to 160 mm.*

TABLE 8.2 Final tightening of nuts

Total nominal thickness "t" of parts to be connected (including all packs and washers)	Further angle of rotation to be applied, during the second step of tightening	
	Degrees	Part turn
$t \leq 160$ mm	180	$\frac{1}{2}$

- 8.506 Where the part turn method of tightening is adopted, the as-delivered lubrication of high strength bolts for preloading may be modified.
- This clause implements for the part turn method the permission to vary the lubrication that is given in 8.5.1 for the DTI method and for when the procedure in Annex H is adopted.*  
*Part turn tightening is predominantly a strain-control method that takes the bolt beyond its yield point. Consequently, the final preload developed is not sensitive to a change in lubrication such as that caused by T-washing or by the application of tallow.*

## 8.6 Fit bolts

- 8.601 *(Optional clause)*  
 Where permitted on the drawings the length of the threaded portion of the shank of a fit bolt may exceed 1/3 of the thickness of the plate, subject to the following requirements: *(Insert details)*
- Insert a clause if such permission is to be given and specify on the drawings for which bolts the longer thread length is permitted.*  
*Fit bolts are rarely used in bridgework in the UK.*

## 8.7 Hot riveting

### 8.7.2 Installation of rivets

- 8.701 *(Optional clause)*  
 Where specified on the drawings, countersunk rivets shall have a flush surface
- Rivets are not normally used in bridgework in the UK.*

### 8.7.3 Acceptance criteria

- 8.702 *(Optional clause)*  
 Where specified on the drawings, outer faces of plies shall be free of indentation by the riveting machine.
- Rivets are not normally used in bridgework in the UK.*

## 8.9 Use of special fasteners and fastening methods

- 8.901 *(Optional clause)*  
 Where the use of special fasteners and fastening methods in non-preloaded or preloaded applications is specified, the following procedure tests shall be carried out:  
*(Insert details)*
- Special fasteners are not normally used in bridgework.*
- 8.902 *(Optional clause)*  
 Where the use of hexagon injection bolts is specified, the use shall comply with the following requirements:  
*(Insert details)*
- Hexagon injection bolts would only be used in exceptional circumstances.*

## 9 ERECTION

NOTE: See Sections 1.2 and 1.3 for additional comment on the relationship between the design basis method of erection and the constructor's erection method.

### 9.3 Erection method statement

- 9.301 The design is based on the construction method and/or sequences given in the following documents:  
*(Insert list)*
- 9.302 Requirements for temporary bracing compatible with the construction method and/or sequences are specified on the following drawings:  
*(Insert list)*
- 9.303 The allowances for permanent deformation and other associated dimensions specified on the drawings allow for the quasi-permanent effects of the following actions, using the design basis method of erection:
- i) after steelwork erection:  
Self weight of structural steelwork
  - ii) after completion of structure:  
Self weight of structural steelwork  
Self weight of structural concrete  
Self weight of non-structural parts  
The effects of shrinkage modified by creep
- Insert list of relevant drawings and other documents. Information should include, amongst other things, allowances for permanent deformations (precamber - see also 9.303), settlement of supports, assumptions for temporary stability and assumptions about propped/unpropped conditions in staged construction. The designer has a duty to ensure that the permanent works can be built safely. The drawings will show a construction method and/or sequence and will show either in detail or indicatively the nature and positions of temporary bracings compatible with that sequence. These temporary bracings will normally be those required to provide stability in the 'bare steel' and 'wet concrete' conditions. The elements of the temporary bracing would normally be designed by the permanent works designer; if that is not the case it should be stated in the contract documents (preferably on the drawings) that the design of them is the constructor's responsibility. See GN 1.03*
- It is the designer's responsibility to determine the allowances (i.e. the addition to the nominal profile) required to offset the effects of permanent actions, including shrinkage effects. These allowances have often been termed, somewhat loosely, 'precamber'. See GN 4.03 for further advice. The provision of information about deflection of the bare steelwork will facilitate the checking of the accuracy of fabrication. Note that the characteristic value of self weight of surfacing and ballast includes allowances for deviation from nominal dimensions (see EN 1991-1-1).*



**9.3.2 Constructor's erection method**

- 9.304 If the constructor proposes to adopt an alternative construction method and/or sequence to that referred to in 9.301 the constructor shall verify in accordance with the design rules that the alternative method and/or sequence can be used without detriment to the permanent works. The constructor shall allow a period of at least ... (insert number) weeks for the verification of the erection method in accordance with the design rules, to the satisfaction of the permanent works designer.

*For major bridge structures the design basis method of erection will normally be produced through a close working between designer and a constructor because the method of erection will often dictate aspects of the design. Even for lesser or minor bridges the fundamental issue is that the constructor's erection method must be compatible with the design basis method of erection or, if it is different, for whatever reason, the design of the permanent works must be re-verified, for that erection method.*

**9.4 Survey****9.4.1 Reference system**

- 9.401 The steelwork dimensions on the drawings are specified for a reference temperature of (Insert reference temperature, °C)

*The steelwork contractor will make adjustments to suit the calibration temperature of his measuring equipment.*

**9.5 Supports, anchors and bearings****9.5.3 Maintaining suitability of supports**

- 9.501 Compensation for settlement of supports shall be made by the constructor if such settlement differs from the design assumptions.

*The designer should state the range of settlement of the supports (including temporary supports) that was considered in the design, as part of the information provided under 9.301.*

**9.5.4 Temporary supports**

- 9.502 The finished cover to steel packings (comprising a total thickness of grout and any concrete) shall comply with the cover requirements of EN 1992.
- 9.503 Packings and levelling nuts may be left in position provided that it can be verified in accordance with the design rules that there is no detriment to the permanent works.

*It is normal practice to remove steel packings. Softer packings are left in place but see further comment below.*

*The implications of introducing a hard spot into the bearing area should be checked with respect to both steel and concrete elements.*

**9.5.5 Grouting and sealing**

- 9.504 The treatment of steelwork, bearings and concrete surfaces before grouting shall be as specified on the drawings.
- 9.505 Areas where the edges of the base plate are to be sealed, without grouting, are specified on the drawings.

*For surfaces in contact with concrete, see also 10.7 and 10.701.*

*If grouting is not specified in bearing areas, the perimeter of base plates should be sealed. The locations for sealing must be shown on the drawings.*

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- 9.506 Requirements for tamping and ramming against properly fixed supports are specified on the drawings. *Alternatively, general requirements can be given in this clause.*

## **9.6 Erection and work at site**

### **9.6.5 Erection methods**

#### 9.6.5.3 Fit-up and alignment

- 9.601 If shims are provided in slip resistant connections, the class of contact surface and surface treatment of the shims shall be the same as for the contact surfaces of the primary components. *(No comment)*



## 10 SURFACE TREATMENT

### 10.1 General

#### 10.101 *(Optional clause)*

Where surfaces are to be coated with *(insert the particular coating system)* they shall comply with the following additional requirements:  
*(Insert details)*

*(Insert any requirements to suit the particular coating system, additional to those already covered in this Section and other project specific clauses.)*  
*Guidance on preparation of surfaces for coating is given in the Corus brochure Corrosion protection of steel bridges and in GN 8.01*

### 10.2 Preparation of steel substrates

10.201 All exposed edges that are prepared for coating shall be rounded to a minimum radius of 2 mm.

*See comment below.*

10.202 Preparation grade P2 shall apply.

*For bridge steelwork it is unlikely that preparation grade P3 will be required, except on edges, where rounding to a minimum radius of 2 mm is recommended to maximise the durability of the coating. See GN 8.01 (see 10.201).*  
*Grade P3 should be specified for surfaces exposed to corrosivity category C4 and above (an additional clause will be needed, giving requirements and stating which surfaces are to receive the higher preparation grade).*  
*Generally, preparation grades should be compatible with the corrosion protection specified under Annex F.*

### 10.3 Weather resistant steels

10.301 External surfaces of weather resistant steel shall be blast cleaned to grade Sa2 to BS EN ISO 8501-1 to ensure uniform weathering.

Weather resistant steel shall be kept free of contamination such as oil, grease, paint, concrete and asphalt.

*Usually all weather resistant steel elements will be blast cleaned immediately prior to leaving the place of fabrication. Thus all elements experience similar exposure allowing the erected steelwork to weather uniformly. Contaminants must be cleaned off - guidance on avoidance of contamination is given in the Tata Steel brochure Steel bridges - Material matters - Weathering steel and in GN 1.07.*

## 10.5 Galvanizing

### 10.501 *(Optional clause)*

Where fabricated components that contain enclosed spaces are to be galvanized internally, these enclosed spaces shall be sealed after galvanizing. The material and method of sealing shall comply with the following requirements:  
*(Insert details)*

*Galvanizing is not commonly used for plated members in bridgework. Galvanizing is more common where hollow sections are used (e.g. in trusses, bracing and ancillary members) as it is impracticable to apply a paint based corrosion protection system to the interior surfaces. Insert this clause if internal spaces are to be sealed.*

## 10.6 Sealing of spaces

### 10.601 *(Optional clause)*

Where the drawings specify that enclosed spaces are to be provided with an internal treatment system, the internal treatment system shall comply with the following requirements:  
*(Insert specification for treatment system)*

*The NA to BS EN 1993-2 recommends that box girders should not be sealed and should be provided with additional sacrificial thickness, rather than internal treatment. It also recommends that structural hollow sections either be sealed (and designed for pressure differences) or be provided with additional sacrificial thickness.*

### 10.602 *(Optional clause)*

Where spaces are to be fully enclosed by seal welds to prevent the ingress of moisture, weld imperfections otherwise permitted under the welding specification shall be sealed by application of suitable filler material.

*Cracks in welds which are not detectable by visual inspection will allow water to penetrate the sealed space and should be sealed. The phenomenon where water vapour in the air is drawn in through micro-cracks and subsequently condenses inside the closed member when the ambient temperature falls is often termed breathing.*

### 10.603 *(Optional clause)*

Where mechanical fasteners penetrate the wall of sealed enclosed spaces, the penetrations shall be sealed to prevent the ingress of water.  
*(Insert specification for sealing)*

*A performance specification is preferable to a method specification.*

## 10.7 Surfaces in contact with concrete

10.701 Surfaces that are to be in contact with concrete, including parts of the undersides of baseplates, shall be coated with the protective treatment applied to the steelwork, excluding any cosmetic finishing coat, for a distance from the exposed edge. Where concrete is cast against the surface, this distance shall be at least 25 mm. Where permanent formwork bears on the surface, the distance from the exposed edge shall be at least 100 mm, or a greater distance as specified on the drawings.

Uncoated surfaces shall be blast cleaned or wire-brushed to remove loose mill scale and cleaned to remove dust, oil and grease. Immediately before concreting, any loose rust, dust and other loose debris shall be removed by cleaning.

*A minimum return of the coating system is needed to allow in situ concrete to bond to the coated steelwork. A distance of 25 mm is adequate when the concrete is cast directly against the surface. Where the ends of permanent formwork bear on the surface there will be no bond and the coating should extend at least 25 mm beyond the end of the permanent formwork. The value of 100 mm allows for 50 mm nominal bearing length for permanent formwork, 25 mm cumulative tolerances on the formwork length, its positioning and the steelwork spacing, and the required 25 mm distance for bonding. Where the sum of nominal bearing length and tolerances is greater than 80 mm an increased minimum distance should be shown on the drawings.*

## 10.8 Inaccessible surfaces

10.801 *(Optional clause)*  
In non-preloaded bolted connections, contact surfaces and surfaces beneath washers may be treated ... *(insert requirements).*

*In bridgework it is normal practice to use slip resistant connections and 10.8 applies. Other forms of connection would only be used for non-structural ancillary members - insert a clause for such connections only if it is considered that contact surfaces and surfaces beneath washers may be treated with other than a maximum of a primer and undercoat.*

10.802 *(Optional clause)*  
Where specified on the drawings, bolted connections including the perimeter around such connections may be treated as follows:  
*(Insert requirements)*

*In bridgework it is normal practice to treat bolted connections with the full corrosion protection system specified for the remainder of the steelwork. Insert a clause only in exceptional circumstances.*

## 10.9 Repairs after cutting or welding

10.901 *(Optional clause)*  
After cutting, cut edges and adjacent surfaces shall be ... *(insert requirements)*, where specified on the drawings.

*For EXC3, plates and sections cut with equipment calibrated to meet Range 4 should not require any further preparation of the surface (other than the normal blast cleaning) prior to application of the protective treatment, nor should any additional protective treatment be required if the edges are rounded. (See also the comment on 10.201.)*

- 10.902 Where precoated constituent products are welded, all coatings affected by the welding process shall be made good to the original standard. *It is unusual to use precoated constituent products in bridgework.*

# 11 GEOMETRICAL TOLERANCES

## 11.1 Tolerance types

11.101 Requirements for special tolerances are given in 11.201 and 11.302.

*This clause is included because the option to add requirements is given in 11.1, rather than in 11.2 or 11.3.*

## 11.2 Essential tolerances

11.201 The tolerance on steelwork dimensions and levels at completion is as follows:

- i) on level, relative to that specified:
  - at the supports: 5 mm.
  - at midspan: span/1000, up to a maximum of 35 mm.
- ii) on level, of one main girder relative to another, adjacent, main girder: 20 mm.
- iii) on level, of one ladder deck cross girder relative to another, adjacent, cross girder: 20 mm.
- iv) on plan position of steelwork at bearings (structure at datum temperature):
  - Transverse position of bearing top and bottom plates relative to substructure:  $\pm 15$  mm
  - Longitudinal position of bearing top plate relative to bottom plate:  $\pm (10 \text{ mm} + L_s/10000)$
  - Longitudinal position of bearing bottom plate relative to substructure:  $\pm 10$  mm

Where  $L_s$  is distance from the fixed point.

- v) on verticality of main girder webs at supports:
  - Depth/300 or 3 mm, whichever is greater
- v) on spacing of top flanges where permanent formwork is to be used:  $\pm 10$  mm.

If the steelwork is not within tolerance, it shall be reported to the designer of the permanent works and shall be adjusted, if necessary, to maintain the structural adequacy in accordance with the design rules.

*The final profile of the steelwork depends on work not covered by the specification for the steelwork. Nevertheless, the constructor is responsible for the lines and levels in the completed condition. If the level of the bridge soffit at midspan is close to a clearance gauge, the specified profile should include an allowance for adverse variation that is at least the construction tolerance allowed under this clause. In some cases, it might be preferable to specify tolerance on level at positions other than midspan. It is essential to ensure that the bearing location relative to the steelwork matches the location as designed, and that the bearing is located on the support within the design requirements for it. Adjustability should be provided wherever possible between the three elements. The tolerance in verticality of main girders applies to the completed (usually composite) structure. Measures may need to be taken to ensure that adequate conformity is maintained throughout the construction. The tolerance on relative level of cross girders needs to be considered in the determination of destabilizing force due to compressive force in the deck slab. See GN 7.03 and AD318 (available on [www.steelbiz.com](http://www.steelbiz.com)).*

## 11.3 Functional tolerances

### 11.3.1 General

- 11.301 The tabulated values in D.2 shall apply and the tolerance class shall be class 1. *This confirms the default requirement.*
- 11.302 In addition to the requirements in D.2, the following functional tolerances apply: *Where there are particular requirements, such as the achievement of a visually good alignment of fascias, these should be specified.*  
(insert requirements)

# 12 INSPECTION, TESTING AND CORRECTION

## 12.2 Constituent products and components

### 12.2.1 Constituent products

- 12.201 *(Optional clause)* Specific testing of ... *(Insert relevant constituent product)* shall comply with the following requirements:  
*(Insert details)*
- Insert any special requirements, or refer to the drawings, if they are specified there.*

## 12.3 Manufacturing: geometrical dimensions of manufactured components

- 12.301 Repair by welding on cover plates is not permitted.
- If deviations exceed the limits, the structural performance will be impaired, particularly in compression. If a cover plate is attached by welding, the fatigue performance will be impaired. Such repairs are not normally acceptable in bridgework.*

## 12.4 Welding

### 12.4.2 Inspection after welding

#### 12.4.2.2 Scope of inspection

- 12.401 Where a requirement for special testing and inspection is specified on the drawings, the extent of supplementary NDT shall be as follows:  
*(Insert details)*
- The extent of supplementary NDT for EXC3 is given in Table 24. If the extent of supplementary NDT is increased above that specified for EXC3, then the extent should be appropriate to the particular details and particular fatigue classification, and should take account of any additional acceptance requirements in 7.603. The frequency for EXC4 may be taken as a guide for specifying the extent of supplementary NDT.*

#### 12.4.4 Production tests on welding

- 12.402 The frequency of the production tests of the penetration of deep penetration fillet welds shall be defined in the Inspection Plan.
- These production tests should always be specified, either in the execution specification or on the drawings.*
- 12.403 Weld production tests shall be carried out on stud shear connectors, as follows:
- Each stud shall be tested by striking the side of the head of the stud with a 2 kg hammer. The weld shall be considered acceptable if there is a clear ring tone due to the striking.
  - Selected studs shall be bent by striking the side of the head of the stud with a 6 kg hammer until its head is displaced
- The selection of studs for 2) is left to the steelwork contractor, which is normal practice.*

laterally a distance of approximately 0.25 times the height of the stud from its original position. The stud shall not show any signs of cracking or lack of fusion. Satisfactory studs shall not be bent back again.

- 12.404 The studs to be tested in accordance with 12.403 2) shall be selected at a rate of approximately 1 in 50 studs on each girder or piece of steelwork, with a minimum of 2 per piece. The direction of test shall be such as not to interfere with the fixing of reinforcement.

Additionally, before the start of each day's welding, three studs shall be welded to a plate of the same thickness as the flange plate and tested in accordance with 2). If any of these studs fail, further sets of three studs shall be welded and tested until satisfactory results are obtained, before any studs are welded to the girders.

Studs whose welds have failed either of these tests shall be replaced, according to an approved welding repair procedure.

## 12.5 Mechanical fastening

### 12.5.2 Inspection after tightening

#### 12.5.2.3 Inspection during and after tightening

- 12.501 The inspection shall be carried out in accordance with the procedure given in 12.5.2.3.

#### 12.5.2.4 Torque method

- 12.502 For the torque method, the torque may be applied to the head, if access to apply torque to the nut is not possible.

*Applying a torque to the head might be necessary if the clearance restricts the insertion and tightening of the bolt.*



12.5.2.108 Part turn method

*This clause number is additional to those in EN 1090-2*

- 12.503 For the part turn method, the first step shall be controlled by use of a calibrated torque wrench.  
 Before the second step starts, the markings of all the nuts relative to the bolt threads shall be visually inspected. Any missing mark shall be corrected.  
 After the second step, the marks shall be inspected with the following requirements:
- a) if the angle of the second step rotation is more than 15° below the specified value, this angle shall be corrected;
  - b) if the angle is more than 30° over the specified angle, or the bolt or the nut has failed, the bolt assembly shall be replaced by a new one.

*A tolerance on torque value of ± 10% is stated in Table 8.1.*

**12.5.5 Special fasteners and fastening methods**

12.5.5.1 General

- 12.504 *(Optional clause)*  
 Where the use of special fasteners and fastening methods in non-preloaded or preloaded applications is specified, requirements for inspection shall be as follows:  
*(Insert details)*

*Special fasteners and methods are not normally used for bridge steelwork.*

**12.7 Erection**

**12.7.1 Inspection of trial erection**

- 12.701 *(Optional clause)*  
 Where trial erection is specified, the inspection shall comply with the following requirements:  
*(Insert details)*

*See guidance in GN 7.04. Insert any requirements that are specific to the trial erection.*

**12.7.3 Survey of geometrical position of connection nodes**

12.7.3.1 Survey methods and accuracy

- 12.702 All records shall become part of the record of the as-built structure, as required by 4.2.4.

12.7.3.4 Location and frequency

- 12.703 Measurements shall be taken on completion of steelwork erection of the position of main girders at site connections, mid-span, at supports and at any additional locations specified on the drawings.

*The locations listed should be sufficient to check that the overall shape of the erected steelwork and the headroom clearances are satisfactory.*

12.704 *(Optional clause)*  
The following additional measurements shall be taken at specified locations and stages of loading:  
*(Insert details; locations may be specified on the drawings)*

*Additional measurements will be needed to monitor stages of the more complex construction methods. For instance: deflections should be checked during launching operations; levels should be recorded at intermediate stages if concrete is placed on the structure before steelwork erection is complete.*

12.705 The positional accuracy of the erected steelwork shall be measured under self weight of steelwork.

#### 12.7.3.6 Definition of nonconformity

12.706 *(Optional clause)*  
The envelope of permissible positions shall be as specified on the drawings.

*Specify an envelope of permissible positions for the steelwork if significant movement of the structure is anticipated that could affect dimensional checking.*

#### 12.7.4 Other acceptance tests

12.707 *(Optional clause)*  
Where components of the structure are to be erected such that a specific internal force in a component is to be achieved, rather than to a specific geometry, the tolerance range shall be as specified on the drawings.

*Acceptance criteria should be given in tension structures, for example, when a certain load in a tensile member is specified.*

## ANNEX F (OF EN 1090-2) CORROSION PROTECTION

### F.1.2 Performance specification

- F.101 The corrosion protection shall comply with the following performance requirements:  
(insert details)
- For highway structures the requirements are expressed in terms of the environment, accessibility and required durability - see Series NG 1900 of the Specification for Highway Works (SHW). These requirements are written into the appropriate Paint System Sheet by the constructor, as required by Clause 1918 of the SHW.*
- Note that F.1.2 allows a preference for painting, thermal spraying or galvanizing to be expressed. If there is a preference for colour, it should also be given in these details.*
- For railway structures, consult Network Rail for their requirements.*

### F.1.3 Prescriptive requirements

- F.102 The prescriptive requirements for the corrosion protection system are specified in:  
(insert details - see commentary)
- F.1.3 states that either prescriptive requirements should be developed (by the constructor) to comply with the performance specification or the execution specification may define the prescriptive requirements.*
- For highway structures, prescriptive requirements are given in Series 1900 of the SHW and these can be invoked by this clause.*
- For railway structures, consult Network Rail for their requirements.*
- Prescriptive requirements might alternatively refer to manufacturers' data sheets.*

### F.2.2 Surface preparation of carbon steels prior to galvanizing

- F.201 (For highway structures)
- In addition to the requirements of F.2.2, the surface preparation of carbon steels prior to galvanizing shall comply with:  
(insert details - see commentary)
- For highway structures, additional requirements are given in Clause 1909 of the Specification for Highway Works.*
- For railway structures, consult Network Rail for any additional requirements.*

**F.4 Surfaces in preloaded connections**

- F.401 The area of contact surfaces in preloaded connections where the friction class is specified shall be protected as follows:  
*(insert details)*
- The contact surfaces outside these areas shall be protected as follows:  
*(insert details)*

*Only coatings that are compatible with the required friction class should be specified or permitted - see Class B in Table 18 of BS EN 1090-2.*

*It is normal to apply the full coating system, other than the final coat, to the periphery of contact surfaces, where moisture can accumulate through capillary action.*

**F.6.3 Galvanizing**

- F.601 *(Optional clause)*  
Where specified on the drawings, components shall be galvanized after manufacture. The procedure qualification of the dipping process for these components shall comply with the following requirements:  
*(Insert details)*

*If galvanizing after manufacture is required, specify which components are to be galvanized at that stage and give requirements for procedure qualification of the dipping process.*

*Seek specialist advice, e.g. from the Galvanizers Association.*

- F.602 The preparation of components shall be checked by the galvanizer before overcoating to ensure that the surfaces are free from contamination.

*There are no national or international standards that give specific requirements for preparation. If the preparation is not adequate the surfaces will not galvanize properly and it will be immediately apparent that the requirements of EN ISO 1461 are not met. Seek specialist advice, e.g. from the Galvanizers Association.*

**F.7.1 General**

- F.701 Inspection and surveillance of the protective treatment operation shall be carried out in accordance with the quality plan.

*The quality plan specified in 4.201 should cover the corrosion protection and, as noted in the commentary to 4.201, the quality plan for corrosion protection for HA contracts should be written in accordance with NHSS 19A. If application and inspection is carried out by a company that has been audited and certified in line with the requirements set down in NHSS 19A then no additional requirements need to be specified.*

*If application and inspection is carried out by an uncertified company then its compliance with the requirements set out in NHSS 19A will need to be reviewed and additional independent inspection should be required.*

### **F.7.3 Reference areas**

#### **F.702** *(Optional clause)*

The reference areas to be used to establish the minimum acceptable standard for the work shall be as specified on the drawings.

*When procedure trials in accordance with Clause 1915 of the SHW are required, this clause is not needed and should not be specified.*

### **F.7.4 Galvanized components**

**F.703** All galvanized components shall be 100% visually inspected prior to the application of subsequent coatings.

Any areas where liquid metal assisted cracking is suspected during the visual examination shall be subjected to magnetic particle inspection to confirm whether a defect is present.

*For further guidance on LMAC, see GN 8.03 and its references.*

## APPENDIX A: Clauses in EN 1090-2 where additional information is required or options may be specified

Annex A of BS EN 1090-2 includes two tables, one listing the clauses where information is required and one where options may be specified. The following table lists all those clauses, with relevant extracts of clause texts and gives reference to the model clauses in the main body of this document. In the Table, 'A.1' refers to Table A.1 of BS EN 1090-2, which lists the clauses where information is required and 'A.2' refers to Table A.2, which lists where options may be specified. Only those clauses that relate to matters within the scope of this document are listed. (Notably, requirements related to stainless steel and cold formed thin gauge members are excluded.)

Clause	Statement in clause	A.1	A.2	Model clause
4.1.2	If no execution class is specified EXC2 shall apply.	<i>(Not listed but merits a clause in the MPS)</i>		4.102
4.2.2	It shall be specified if a quality plan for execution of the works is required.		✓	4.201 (optional)
5.1	If constituent products that are not covered by the standards listed are to be used, their properties shall be specified.	✓		5.101 (optional)
5.2	This traceability may be based on documentary records for ... unless traceability for each product is specified.		✓	5.201
5.3.1	Structural steel products shall conform to the requirements of the relevant European product standards as listed in ... unless otherwise specified.	✓	✓	5.301
5.3.2	Thickness tolerances for structural steel plates shall be as follows ... unless otherwise specified:		✓	5.302
5.3.3	b) ... Execution specifications shall specify if discontinuities such as cracks, shell and seams shall be repaired.		✓	Higher requirement specified in 5.303
5.3.3	If more stringent surface conditions are required for plates in EXC3 and EXC4, they shall be specified.		✓	5.303
5.3.3	Additional requirements related to the following items ... shall be specified.	✓		5.304 (limitation of rust grade)
5.3.4	It shall be specified whether areas close to bearing diaphragms or stiffeners should be checked for the existence of internal discontinuities.		✓	5.305
5.3.4	In addition, requirements related to the following items shall be specified if relevant:			
	a) testing on constituent products, ... to identify internal discontinuities or cracks in zones to be welded;	✓		(covered by 5.305)

Clause	Statement in clause	A.1	A.2	Model clause
	b) improved deformation properties perpendicular to the surface of constituent products ...;	✓		5.306
	d) processing conditions if constituent products are to be processed before delivery.	✓		5.307 (optional)
5.5	Unless otherwise specified, one of the options given in Table 6 shall be used.		✓	5.501
5.6.3	Property classes of bolts and nuts and, if appropriate, surface finishes shall be specified ...	✓		5.601
5.6.4	Property classes of bolts and nuts and, if appropriate, surface finishes shall be specified ...	✓		5.602
5.6.6	Weather resistant assemblies shall be made of ... the chemical composition of which shall be specified.	✓		5.603
5.6.7	If specified, reinforcing steels may be used. In this case ... the steel grade shall be specified.		✓	5.604
5.6.8	If required the locking devices ... shall be specified.		✓	5.605
5.6.8	Unless otherwise specified, products from ... may be used.		✓	5.606
5.7	Studs for arc stud welding including shear connectors for steel/composite construction shall comply with the requirements of EN ISO 13918.	<i>(Not listed but merits a clause in the MPS)</i>		5.701
5.8	The grouting materials to be used shall be specified.	✓		5.801
5.9	Requirements for type and characteristics of expansion joints shall be specified.	✓		5.901 (optional)
5.10	The tensile strength grade and, if appropriate, coating class according to EN 10244-2 shall be specified.	✓		5.1001 (optional)
5.10	The designation and class of the strand shall be specified.	✓		5.1002 (optional)
5.10	The minimum breaking load and diameter of the steel wire rope and, if appropriate, requirements related to corrosion protection shall be specified.	✓		5.1003 (optional)
5.10	It shall be selected taking into account service temperature and actions such that continued creeping of the loaded strand through the socket is prevented.	<i>(Not listed but merits a clause in the MPS)</i>		5.1004 (optional)
6.2	The following requirements apply to hard stamped, punched or drilled marks ... unless otherwise specified:	✓	✓	6.201
6.2	If the use of hard stamps, punched or drilled marks is not permitted, it shall be specified whether soft or low stress stamps may be used.		✓	6.202

Clause	Statement in clause	A.1	A.2	Model clause
6.2	Any zones where identification marks are not permitted or shall not be visible after completion shall be specified.	✓		6.203 (optional)
6.4.4	For carbon steels, if specified, hardness of free edge surfaces shall be in accordance with Table 10. In this case processes ... shall have their capability checked.		✓	6.401
6.4.4	Unless otherwise specified, the check of the capability of the processes shall be as follows:		✓	6.402
6.5.4 c)	It shall be specified if constituent products require protective membranes to be applied before forming.	✓		Protective membranes are not normally required for bridgework.
6.5.4 d)	For circular tubes bending by cold forming shall comply with the following three conditions, unless otherwise specified:		✓	6.501 (optional)
6.6.1	Special dimensions should be specified for movement joints.	✓		6.601 (optional)
6.6.1	For hot rivets the nominal hole diameter shall be specified.	✓		6.602(optional)
6.6.1	The dimensions of the countersinking shall be specified accordingly.	✓		6.603
6.6.2	Unless otherwise specified, hole diameters shall comply with the following:		✓	6.604 (optional)
6.6.3	For EXC1 and EXC2, holes may be formed by punching without reaming unless otherwise specified.		✓	Bridgework will not normally be EXC1 or EXC2. Reaming of punched holes would always be required for bridgework and is specified for EXC3 and EXC4 (6.605)
6.6.3	Long slotted holes shall be ... unless otherwise specified.		✓	6.606
6.8	If full contact bearing surfaces are specified, the ... shall comply with the tolerances specified in 11.		✓	6.801
6.9	All connections for temporary components provided for manufacturing purposes shall meet ... and any special requirements including those related to fatigue which shall be specified.	✓		6.901
6.10	Requirements for whether, and to what extent, trial assembly is to be used shall be specified.		✓	6.1001 (optional)
7.3	Other welding processes shall only be used if explicitly specified.		✓	No need to add other processes.
7.4.1.1	If specified, special deposition conditions for tack welds shall be included in the WPS.		✓	7.401



Clause	Statement in clause	A.1	A.2	Model clause
7.4.1.2b	b) If EN ISO 15613 or EN ISO 15614-1 qualification procedures are used, the following conditions apply:		✓	Use of these procedures is invoked by specifying EXC3 or EXC4. There is no option to add further conditions to those in 7.4.1.2b. However, optional clause 7.402 is given, to require pre-production tests.
7.4.1.4	If specified, welding production tests have to be carried out in accordance with the relevant standard of qualification, e.g. EN ISO 14555.		✓	7.403
7.5.4	Assembly of hollow section components to be welded should be in accordance with the guidance given in Annex E, unless otherwise specified.		✓	7.501
7.5.6	Any areas where welding of temporary attachments is not permitted shall be specified.	✓		7.502
7.5.6	The use of temporary attachments for EXC3 and EXC4 shall be specified.	✓		7.503
7.5.6	Cutting and chipping are not permitted for EXC3 and EXC4, unless otherwise specified.		✓	7.504
7.5.9.1	The execution specification shall specify the location of butt welds used as splices to accommodate available lengths of constituent products.	✓		7.505
7.5.9.1	For EXC3 and EXC4, and for EXC2 if specified, run-on/run-off pieces shall be used ...		✓	There is no option here for EXC3 and EXC4. EXC2 is not relevant for bridges.
7.5.9.1	If a flush surface is required, the excess weld metal shall be removed to satisfy the quality requirements.		✓	There is no option here
7.5.9.2	Unless otherwise specified, permanent steel backing material may be used.		✓	7.506
7.5.9.2	Flush grinding of single-sided butt welds in joints between hollow sections executed without backing is not permitted, unless otherwise specified...		✓	7.507 (optional)
7.5.10	As a further option, C-Mn consumables may be used for the body of a multi-run fillet or butt weld provided the capping runs are made using suitable consumables.	<i>(Not listed but merits a clause in the MPS)</i>		7.508
7.5.13	Dimensions shall be specified.	✓		7.509 (optional)
7.5.13	Plug welds performed without previous slot welding are not permitted unless otherwise specified.		✓	7.510.
7.5.15	The requirements for other weld types, e.g. seal welds, shall be specified ....	✓		7.511 (optional)
7.5.17	Any requirements for grinding and dressing of the surface of completed welds shall be specified.	✓		7.511

Clause	Statement in clause	A.1	A.2	Model clause
7.6	Any additional requirements specified for weld geometry and profile shall be taken into account.	✓		7.601 7.602 (optional) 7.603 (optional)
8.2.1	It shall be specified if, in addition to tightening, other measures or means are to be used to secure the nuts.		✓	8.201
8.2.1	Preloaded assemblies shall not be used with additional locking devices, unless otherwise specified.		✓	8.201
8.2.1	Bolts and nuts shall not be welded, unless otherwise specified.		✓	Bolts and nuts would only be welded in exceptional circumstances and would require special consideration. If unauthorised unfastening has to be prevented, appropriate security fastenings should be used.
8.2.2	The nominal fastener diameter used for structural bolting shall be ... unless otherwise specified ....		✓	8.202
8.2.2	If it is intended ... then the dimensions of the bolts shall be specified to allow for the tolerances on the length of the unthreaded portion.	<i>(Not listed but merits a clause in the MPS)</i>		8.203 (optional)
8.2.4	If required, it shall be specified whether washers are to be placed under the nut or the bolt head, whichever is rotated, or both.		✓	8.204 (optional)
8.2.4	Dimensions and steel grades of plate washers shall be specified. They shall not be thinner than 4 mm.	✓		8.205
8.3	For constituent products with $t \geq 4$ mm for plates and sheeting and $t \geq 8$ mm for sections, unless full contact bearing is specified, residual gaps of up to 4 mm may be left ....		✓	This clause relates to the tightening of non-preloaded bolts in structural connections. Non-preloaded bolts would only be used for connections in primary structural members in exceptional circumstances.
8.4	The area of contact surfaces in preloaded connections shall be specified.	✓		8.401
8.4	<i>(Friction class required is not specified)</i>	<i>(Not listed but merits clause in the MPS)</i>		8.402
8.5.1	Unless otherwise specified the nominal minimum preloading force $F_{p,C}$ shall be taken as ...		✓	In bridgework it would be unusual for a lower level of preload to be specified.
8.5.1	Any of the tightening methods given in Table 20 may be used unless restrictions on their use are specified.		✓	8.501 Part turn method, 8.505, 8.506

Clause	Statement in clause	A.1	A.2	Model clause
8.5.1	As an alternative, calibration to Annex H may be used, except for the torque method unless this is permitted in the execution specification.		✓	Option not needed
8.5.1	<i>(related to potential loss of preloading force)</i> In the case of thick surface coatings it shall be specified if measures shall be taken to offset possible subsequent loss of preloading force.		✓	Preloaded bolts would not be used where there are thick coatings in bridge structures
8.5.4	When using $M_{r,1}$ , for simplification ... may be used unless otherwise specified.		✓	8.502
8.5.4	The second step shall be in accordance with the values given Table 21 unless otherwise specified.		✓	8.503
8.5.5	If specified this first step is repeated as often as required.		✓	8.504
8.6	The length of the threaded portion of the shank of the fit bolt ... should not exceed 1/3 of the thickness of the plate unless otherwise specified ....		✓	8.601 (optional)
8.7.2	If a flush surface of countersunk rivets is specified protruding rivet metal shall be chipped or ground off.		✓	8.701 (optional)
8.7.3	Outer faces of plies free of indentation by the riveting machine may be specified.		✓	8.702 (optional)
8.9	Such methods shall be used only where specified. Any procedure tests required ... shall be specified.	✓		8.901 (optional)
8.9	Requirements for use of hexagon injection bolts shall be specified.	✓		8.902 (optional)
9.3.1	Design basis for the erection method. If the structural stability in the part-erected condition is not evident, a safe method of erection on which the design was based shall be provided. <i>(Note that the list of information in 9.3.1 includes drawings.)</i>		<i>(Not listed but merits clauses in the MPS)</i>	9.301, 9.302, 9.303
9.3.2	Constructor's erection method A method statement describing the constructor's erection method shall be prepared ...		<i>(Not listed but merits a clause in the MPS)</i>	9.304
9.4.1	The reference temperature for setting out and measuring the steelwork shall be specified.	✓		9.401
9.5.3	Compensation for settlement of supports is acceptable unless otherwise specified.		✓	9.501
9.5.4	If packings are subsequently to be grouted, they shall be placed so that ... unless otherwise specified.		✓	9.502
9.5.4	For bridges, packings shall not be left in position, unless otherwise specified.		✓	9.503
9.5.4	If adjustment to the position of the base is achieved using levelling nuts ... these may be left in position unless otherwise specified.		✓	9.503

Clause	Statement in clause	A.1	A.2	Model clause
9.5.5	c) tamping and ramming against properly fixed supports shall be used if specified and/or recommended by the grout manufacturer;		✓	9.504
9.5.5	If treatment of steelwork, bearings and concrete surfaces is required before grouting, it shall be specified.		✓	9.505
9.5.5	If no grouting is needed ... the method shall be specified.	✓		9.506
9.6.5.3	Shims shall be made of flat steel unless otherwise specified.		✓	The use of steel shims is current practice.
9.6.5.3	If shims are used ... the shims shall be protected in a similar manner to provide the specified durability unless the shims are required to meet a specified friction classification.	<i>(Not listed but merits a clause in the MPS)</i>		9.601
10.1	The requirements to take account of the particular coating system to be applied shall be specified.	✓		10.101 (optional)
10.1	If painting is specified for aesthetic reasons Table 22 together with Annex F are applicable.		✓	No optional requirement. Painting for aesthetic reasons only is unlikely for bridges.
10.2	If the expected life of the corrosion protection and corrosivity category are specified, the preparation grade shall be in accordance with Table 22. Unless otherwise specified, P1 shall apply for EXC2, EXC3 and EXC4.	✓	✓	10.201, 10.202
10.2	<i>(Table 22, row 4)</i> P2 or P3 as specified		✓	10.202
10.3	If necessary, procedures to ensure that the surface of uncoated weather resistant steels is acceptable visually after weathering shall be specified ...	✓		10.301
10.3	The treatment necessary for surfaces of non-weather resistant steels if these are in contact with uncoated weather resistant steels shall be specified.	✓		There are no additional requirements for treatment of non-weather resistant steels when in contact with weather resistant steel. The two types of steel have similar electrochemical reactivity so galvanic coupling should not occur when the two are in contact.
10.5	The enclosed space shall generally be galvanized internally and if not it shall be specified ...		✓	10.501
10.6	If enclosed spaces are to be sealed ... the internal treatment system shall be specified.	✓		10.601 (optional)
10.6	If spaces are to be fully enclosed by welds, it shall be specified ... to prevent the ingress of moisture. ... If required, further inspection shall be specified.		✓ ✓	10.602 (optional)

Clause	Statement in clause	A.1	A.2	Model clause
10.6	If mechanical fasteners penetrate the wall of sealed enclosed spaces, the method to be used for sealing the interface shall be specified.	✓		10.603 (optional)
10.7	Surfaces that are to be in contact with concrete ... unless otherwise specified and the remaining surfaces ... unless specified.		✓	10.701
10.8	As a maximum, faying surfaces and surfaces beneath washers shall be treated with a primer and undercoat unless specified otherwise ....		✓	10.801 (optional)
10.8	Unless specified otherwise, bolted connections including the perimeter around such connections shall be treated with ...		✓	10.802 (optional)
10.9	It shall be specified if repair, or additional protective treatment, is required to cut edges and adjacent surfaces after cutting.		✓	10.901 (optional)
10.9	If precoated constituent products are to be welded, the methods and extent of repair necessary to the coating shall be specified.	✓		10.902
11.1	In addition, special tolerances may be specified ...	✓		11.101
11.3.1	Functional tolerances in terms of accepted geometrical deviations shall be in accordance with one of the following two options:	✓		11.301 <i>(But 11.3.1 only provides for either Table D.2 or the classes specified in 11.3.3)</i>
11.3.3	If specified, the following alternative criteria may be applied:		✓	11.302 <i>(Does not refer to the classes but provides scope for criteria additional to D.2)</i>
12.2.1	There are no requirements for specific testing of products unless otherwise specified.		✓	12.201 (optional)
12.3	The location and frequency of measurements shall be specified in the inspection plan.	✓		Clause not needed - information must be given in the inspection plan.
12.3	If the gap exceeds the permitted deviation, repairs may be executed by ... unless otherwise specified.		✓	12.301
12.4.2.2	For EXC2, EXC3 and EXC4 welds the extent of supplementary NDT is as specified below.		✓	EXC1 will not apply to bridges.
12.4.2.2	The execution specification may identify specific joints for inspection together with the extent and method of testing.		✓	12.401
12.4.4	If specified, for EXC3 and EXC4, production tests shall be carried out as follows:		✓	12.402. 12.403. 12.404
12.5.2.3	d) Unless otherwise specified, the inspection shall be carried out using ...		✓	12.501

Clause	Statement in clause	A.1	A.2	Model clause
12.5.2.3	f) For final tightening inspection the same bolt assembly shall be used for checking both under-tightening and, if specified, over-tightening.		✓	There isn't an option here.
12.5.2.4	The inspection of a bolt assembly shall be carried out ... by the application of a torque to the nut (or to the bolt head if specified) ...	<i>(Not listed but merits a clause in the MPS)</i>		12.502
12.5.5.1	Requirements for inspection of connections using special fasteners or special fastening methods in accordance with 8.9 shall be specified.	✓		12.504 (optional)
12.7.1	Requirements for inspection of any trial erection to 9.6.4 shall be specified	✓		12.701 (optional)
12.7.3.1	For EXC3 and EXC4 this survey shall be recorded; if there is a requirement to record dimensional checks at acceptance of the structure, this shall be specified.		✓	12.702
12.7.3.4	Measurements will only be taken of ... unless otherwise specified. The location and frequency of measurements shall be specified in the inspection plan.	✓	✓	12.703 12.704 (optional)
12.7.3.4	The positional accuracy of the erected steelwork should be measured ... unless otherwise specified. The conditions under which the measurements shall take place shall then be specified ....		✓	12.705
12.7.3.6	If significant movement of a structure is anticipated that could affect dimensional checking (e.g. for tension structures) an envelope of permissible positions shall be specified.	<i>(Not listed but merits a clause in the MPS)</i>		12.706
12.7.4	If components of a structure are to be erected to a specific load rather than position, detailed requirements ... shall be specified.	✓		12.707
F.1.2	The performance specification may also state a preference for painting, thermal spraying or galvanizing.	✓		F.101
F.1.3	If the durability range and corrosivity category are specified, .... Otherwise, the execution specification shall define the prescriptive requirements ...	✓		F.102
F.2.2	Surfaces shall be prepared in accordance with ... unless otherwise specified.		✓	F.201
F.4	For slip resistant connections, the execution specification shall specify requirements for friction surfaces and class of treatment or tests required.	✓		F.401
F.4	For preloaded connections that are not required to be slip resistant, the extent of surfaces that are affected by the preloaded bolts shall be specified.	✓		Not normally appropriate for bridge work

[Discuss me ...](#)

Clause	Statement in clause	A.1	A.2	Model clause
F.5	The remaining surfaces of the steel are to be left untreated unless otherwise specified ...		✓	No need to specify otherwise
F.6.3	If hot dip galvanizing after manufacture is specified, it shall be undertaken in accordance with ... and requirements for ... shall be specified.	✓		F.601 (optional)
F.6.3	Requirements for the inspection, checking or qualification of the preparation ... shall be specified.	✓		F.602
F.7.1	The execution specification shall specify any requirements for additional inspection and testing.	<i>(Not listed but merits a clause in the MPS)</i>		F.701
F.7.3	the execution specification shall define any reference areas to be used to establish the minimum acceptable standard for the work. Unless otherwise specified, reference areas shall be specified ...	✓	✓	F.702 (optional)
F.7.4	Unless otherwise specified, ..., galvanized components shall be subjected to post-galvanizing inspection.		✓	F.703
F7.4	a) The component specification shall specify the following ...			All components should be inspected post galvanizing.  No additional NDT specified.

## APPENDIX B: Items not included in Appendix A

The following items are included in Tables A.1 and A.2 of BS EN 1090-2 but are not within the scope of this model project specification for bridge steelwork.

Clause	A.1	A.2	Guidance/Commentary
5.3.2		✓	Other products, steels and stainless
5.3.3	✓		Surface finish
5.3.3		✓	Surface finish
5.3.4	✓		Stainless
5.4	✓	✓	Steel casings
5.6.3	✓		Large bolting assemblies
5.6.3	✓	✓	Fasteners for stainless steels
5.6.4		✓	Stainless steel bolts
5.6.11	✓		Fasteners for stressed skin applications
5.6.12	✓		Special fasteners not covered by Standards
6.2		✓	Stamps for stainless steel
6.5.4 b)		✓	Bending of stainless steel
6.5.4 b)	✓		Bending of stainless steel
6.6.1, table 11		✓	Reduced holes sizes for towers and masts
6.7	✓		Thin gauge components
7.5.14.1		✓	Stainless steel
7.5.14.1	✓		Spot welds
7.7.2	✓	✓	Stainless steel
8.2.2	✓		Thin gauge components
8.4	✓		Stainless steel
8.8.2		✓	Thin gauge components
8.8.4	✓		Thin gauge components
9.6.5.2		✓	Buildings
10.2		✓	Stainless steel
10.10.2	✓		Stainless steel
11.2.3.5		✓	Bolted splices in buildings
12.5.1	✓		Stainless steel
12.5.2.1	✓		Stainless steel



## APPENDIX C: Notes on drawings

The execution specification is only part of the contract documentation and is to be read in conjunction with, amongst other documents, the contract drawings. Clearly the two should be harmonised, with no duplications or omissions. The following list of notes is suggested as ‘model’ notes that would be compatible with BS EN 1090-2 and the MPS. The Notes should be used and extended as necessary.

However, the practice of attempting to repeat standard notes on all drawings is prone to mistakes and/or omissions. It is preferable to have a title page listing all the contract drawings and relevant execution, material and component specifications and all the things included in the execution specification clauses that refer to “as specified on the drawings”.

Generally, all notes should comply with the following principles:

- Be free from ambiguity or duplication of matters specified elsewhere.
- Refer only to matters shown on the drawings containing the notes (cross-reference to other drawings should be minimised).
- (Be necessary for the execution of the works (define units, conventions (e.g. weld symbols), material grades, repetition details (e.g. all bolts shall be ...)).
- Use sentences following the convention specified in BS 7373 clause 2.3.3. (Use “shall” for directions and “are” or “have been” for information).
- Notes should be few, concise, and simple and generally should not restate matters that are more correctly Specification issues.

The following notes are examples; they are not an exhaustive list. Use alternative sizes, grades, bolt types, etc as required. Unusual requirements (e.g. suitability for hot dip galvanizing) are not included.

1. For general notes, refer to drawing number ....
2. All dimensions are in millimetres and all levels are in metres above Ordnance Datum.
3. All steel material shall be S355J2+N to BS EN 10025-2:2004 unless otherwise noted.
4. The steelwork manufacturing dimensions shown are specified for a mean temperature of ...°C.
5. Temporary welded attachments shall not be made on the areas specified.
6. Weld symbols are in accordance with BS EN 22553.
7. All fillet welds shall be 6 mm leg length and continuous unless noted otherwise.
8. All bolting assemblies shall be to BS EN 14399 unless noted otherwise. Bolts shall be M24 property class 8.8, system HR, in 26 mm diameter holes, unless noted otherwise.
9. Cope holes and re-entrant corners shall have a radius of at least 40 mm or 1.25 times the plate thickness, unless noted otherwise.
10. In areas marked as subject to possible impact loading and in any areas where cold bending or forming is required, any plasma-cut free edge surfaces shall be ground to ensure that the hardness limits in Table 10 are met.