

## DEFINING QUALITY REQUIREMENTS FOR FUSION WELDING OF STEEL STRUCTURES

David Howse  
 Consultant Welding Engineer  
 TWI Ltd

### INTRODUCTION

Welding is a widely used process in steel fabrication and is also one that can have a great influence the cost, quality and fitness for purpose of a structure. It is, therefore, important that the welding process is properly controlled so that customer expectations are met. One way that the quality requirements for welding can be specified is in the adoption and use of harmonised European standards. It is the intention of this article to provide an overview of how the requirements of BS EN 1090, Execution of steel structures and aluminium structures, are defined and what implications this has in defining the requirements of a quality control system for welding. It should be noted that this is only intended as a guide and for a full understanding of the requirements, the relevant standards should be read in detail.

### BS EN ISO 3834

It is probably best to first consider the scope and requirements of the BS EN ISO 3834 group of standards (parts 1-6). This set of standards entitled “Quality requirements for fusion welding of metallic materials” can be used to specify the requirements for any welded component. Whilst there are many detailed requirements contained in this family of documents, the central idea is that three distinct levels of quality are defined:

- Comprehensive quality requirements: Part 2
- Standard quality requirements: Part 3
- Elementary requirements: Part 4

BS EN ISO 3834 is designed to be used as a generic system for any welded construction, in which case, the choice of quality level is left to the manufacturer and will depend on a number of factors that will include safety criticality, complexity of manufacture, product range etc.

However, BS EN ISO 3834 can also be referred to in other standards where the quality level to be adopted for welding is clearly defined from other requirements. This is the case for BS EN 1090: Execution of steel structures and aluminium structures.

### BS EN 1090 REQUIREMENTS FOR WELDING

In regard to welding requirements, BS EN 1090 gives specific guidance on the quality levels to be adopted for welding and matches these to an execution class (EXC) for a structure. If part 2, technical requirements for the execution of steel structures is considered, it states that:

“Welding shall be undertaken in accordance with the requirements of the relevant part of EN ISO 3834”

And, according to the execution class, the following parts of EN ISO 3834 apply:

- EXC1: Part 4 “Elementary quality requirements”;
- EXC2: Part 3 “Standard quality requirements”;
- EXC3 and EXC4: Part 2 “Comprehensive quality requirements”.

So, in this case the quality requirements for welding are clearly defined and the standard also gives guidance on the selection of execution class as follows reproduced from Table B3:

Consequence classes		CC1		CC2		CC3	
Service categories		SC1	SC2	SC1	SC2	SC1	SC2
Production categories	PC1	EXC1	EXC2	EXC2	EXC3	EXC3 <sup>a</sup>	EXC3 <sup>a</sup>
	PC2	EXC2	EXC2	EXC2	EXC3	EXC3 <sup>a</sup>	EXC4
<sup>a</sup> EXC4 should be applied to special structures or structures with extreme consequences of a structural failure as required by national provisions.							

It can be seen that execution class 1 (EXC1) will only be met where the structure meets the requirements of the following categories:

#### Service Category 1 (SC1)

- Structures and components designed for quasi static actions only (Example: Buildings)
- Structures and components with their connections designed for seismic actions in regions with low seismic activity and in DCL.
- Structures and components designed for fatigue actions from cranes (class S0)

#### Production category 1 (PC1)

- Non welded components manufactured from any steel grade products
- Welded components manufactured from steel grade products below S355

# Member News

## Consequence class (CC1, from BS EN 1990)

Low consequence for loss of human life, and economic, social or environmental consequences small or negligible such as Agricultural buildings where people do not normally enter (e.g. storage buildings), greenhouses.

Higher consequence, production or service categories will produce higher execution classes and therefore higher quality requirements for the quality system for welding.

## REQUIREMENTS FOR QUALITY SYSTEMS MEETING BS EN ISO 3834

As mentioned previously, the quality systems defined in BS EN ISO 3834 exist in three levels and it is probably worth looking at this in more detail based on the requirements of BS EN 1090. Most companies producing agricultural or industrial buildings in the UK will fall within execution class (EXC) 1 or 2 and this will require that a quality system for welding is implemented that will be in accordance with BS EN ISO part 4, elementary, or part 3, standard, respectively. However, it should be noted that there are many significant differences between the requirements for the two levels of quality. Some of these, taken from part 1 of BS EN ISO 3834 are summarised in the following table:

It can be seen that the number of quality requirements needed to meet EXC 2 (BS EN ISO 3834 part 3) are significantly greater than those that will allow EXC 1 (BS EN ISO 3834 part 4) to be met. Unless the structural requirements are quite basic and EXC1 applies, the development, demonstration and proof of use of a quality plan for welding that will pass certification by an external third party will not be a trivial matter.

Element	BS EN 1090 EXC2	BS EN 1090 EXC1
	BS EN ISO 3834 Part 3 Standard	BS EN ISO 3834 Part 4 Elementary
Review of requirements	Record may be required	Record is not required
Technical review	Record may be required	Record is not required
Welders and welding operators	Qualification is required	
Welding co-ordination personnel	Required	No specific requirement
Inspection and testing personnel	Qualification is required	
Equipment maintenance	Records are recommended	No specific requirement
Description of equipment	List is required	No specific requirement
Production planning	Required	No specific requirement
Welding procedure specifications	Required	No specific requirement
Qualification of Welding Procedures	Required	No specific requirement
Inspection and testing before, during and after welding	Required	If required

In particular, it should also be noted that one of the key requirements for meeting EXC2 rather than EXC1 is that the company will need access to a properly qualified and experienced Responsible Welding Co-ordinator (RWC). Whilst it is possible to use a full time member of staff for this role, the RWC may also be sub-contracted on a part time basis.

## CERTIFICATION TO BS EN ISO 3834

A company wishing to apply for certification to BS EN ISO 3834 in the UK can apply through TWI Certification Ltd via its UKAS accredited Welding Fabricator Certification scheme at [www.iso3834.org](http://www.iso3834.org). Once an application is submitted the following tasks are carried out:

Preliminary visit: Approximately half a day at the manufacturing site

Document review: Review of hard copy of all documented procedures required carried out off site.

Final Audit: A full day's visit auditing elements of the agreed welding quality plan incorporating RWC interview, if required.

Recommendation for certification.

Certification is valid for 5 years with yearly surveillance visit required to maintain certification.

## CONCLUDING REMARKS

In order to meet the requirements for a quality plan for welding as described in BS EN 1090 it should be noted that, unless the steel grade being used within a welded construction is less than S355 strength and, the building is designed so that people do not normally enter, then the structure will be classed as, at least, EXC2. In this case, the requirements for the welding quality plan will include many more elements than simple qualification of welders and inspectors. Given that auditing of a quality plan and awarding of certification to part 3 of BS EN ISO 3834 can easily take six months or longer from the point of first application it is important that this process is properly timed to coincide with any future legislative requirements for CE marking that require adoption of harmonised European standards.

Reader Enq. 16