

# Compliance through Competence – Welding coordinator competence assessment for railway vehicle components

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## Abstract

Competence assurance is essential in providing customer confidence in manufacturing operations and engineering service delivery. Customers have the right to expect that products and services are not only delivered fit-for-purpose but are safe to use, and will remain so for their specified lives. Welding is a special process, in that it requires knowledge, skill and experience in planning and executing its application and, because much of the evidence of process control will have been concealed or lost once the weld has been completed, its quality cannot be readily verified after the weld is made. It is the employer's responsibility to ensure that all personnel are competent to discharge their allocated roles and responsibilities prior to authorising them to work, and third-party certification has a significant part to play in ensuring that role-specific competences are validated, and are subject to surveillance to assure continued competence. Welding is an essential process for the joining of materials in manufacture, fabrication and repair of railways vehicles and components; competence assurance of welding personnel is an essential feature in compliance with EN 15085 for quality assurance of those welded products.

## 1 An Increasing Focus on Personnel Competence

The EN 15085 [1] series of standards, "Railway applications – Welding of railway vehicles and components", was introduced to harmonise requirements for welding of metallic materials in the manufacture and maintenance of railway vehicles. The five parts of EN 15085 address the quality, design, production and inspection, testing and documentation requirements for the application of welding to this specific product group. Unusually for a CEN (European Committee for Standardization) European Standard, EN 15085-2, "Railway applications – Welding of railway vehicles and components – Part 2: Quality requirements and certification of welding manufacturer", mandates certification for compliance with the requirements, and defines the certification procedure.

For welding quality requirements, EN 15085-2 makes normative reference to EN ISO 3834 [2], "Quality requirements for fusion welding of metallic materials", a standard that does not mandate certification but is being increasingly specified to provide customer confidence in the quality of welded production across a wide range of industrial sectors and product types. EN 15085-2 defines the relationship between its four certification levels (CL 1, CL 2, CL 3 and CL 4) and the three levels of welding quality set by EN ISO 3834 (Elementary, Standard and Comprehensive) and expects verification of compliance with the relevant part of EN ISO 3834 as part of the audit for certification of railway vehicle and component manufacturers.

EN ISO 3834 adds detail to the human aspects of welding quality requirements by extending the EN ISO 9001 [3] systems approach to competence assurance to personnel involved in the validation and application of welding [4]. Specifically, EN ISO 3834 introduces the requirement for welding coordination personnel and refers to EN ISO 14731 [5], "Welding coordination – Tasks and responsibilities", to identify the essential welding-related responsibilities that require competent welding coordinators. EN 15085-2 refers to EN ISO 14731 for the technical knowledge requirements of

welding coordinators but defines its own three levels of welding coordinator competence (Level A, Level B and Level C) for allocation of railway vehicle welding responsibilities, and sets the limits of their authority relative to the Certification Level of the production.

Because competence is concerned with personal attributes that affect the employability of an individual, it is an emotive subject [6]. The systems approach to personnel competence assurance, which begins in EN ISO 9001 and is focused onto welding and then rail vehicle welding by EN ISO 3834 and EN 15085, enables recognition that a lack of competence means that there is a knowledge, skill, experience or behaviour gap. That competence gap must be closed by one or a combination of formal or informal education, formal or informal training, on-the-job training, or work under supervision before the individual can be authorised to undertake the appointed role. To achieve competence assurance, the manufacturer must understand the competences necessary for each task, and ensure that all personnel undertaking these tasks possess the requisite competences and understand their responsibilities for product quality. For railway vehicle welding, EN 15085-2 sets the experience and knowledge criteria for the Level A, Level B and Level C welding coordinators, and identifies which tasks each may be authorised to undertake.

Welding is one of the most highly regulated manufacturing processes, and the increasing specification of personnel competence requirements in standards relating to welding and welded products is often challenged by practitioners. The introduction of EN 15085-2 describes welding as a "special process", a term that was used in EN ISO 9001:1994 to refer to processes that produce outputs for which the quality cannot be verified before being released to the customer. The term 'special process' was not included in the 2000 version and discussion of special processes has been superseded by ISO 9001:2015 clause 8.5.1 f). The current EN ISO 9001 requirement states that the organization shall implement production and service provision under controlled conditions, which include, "the validation, and periodic revalidation, of the ability to

achieve planned results of the processes for production and service provision“, and sets the requirement that, the organization shall validate any processes for production and service provision, “where the resulting output cannot be verified by subsequent monitoring or measurement.”

The very nature of welding, with many of the process variables unrecorded and lost once the weld has been completed, identifies welding as a special process that requires validation. The need to validate welding is acknowledged in the specification and qualification of welding procedures, where welding trials in accordance with the welding procedure are demonstrated and undergo non-destructive and destructive tests to ensure that the procedure will work in practice and fulfil its intended function. With this view of welding, the requirement to assure the special competences to validate the special process is put beyond question.

The certification procedure defined in EN 15085-2 requires verification of the manufacturer’s compliance with the requirements of the standard during an audit by a manufacturer certification body. Due to the consequence of failure of railway vehicles and components, manufacturer certification bodies engaged in assessment of manufacturers for conformity with EN 15085 requirements have voluntarily formed the European Committee for Welding of Railway Vehicles (ECWRV). The manufacturer certification body is not defined in EN 15085 but the ECWRV Guideline [7] sets requirements for manufacturer certification bodies wishing to become members, including accreditation in accordance with ISO/IEC 17021 [8] or ISO/IEC 17065 [9]. The ECWRV Guideline [10] provides members with guidance on the implementation of the standard and the application of the conformity assessment process.

## **2 Routes to Compliance with Welding Coordinator Requirements**

Welding coordination can be undertaken by one or a number of individuals, and the welding coordination organisation will include all those with allocated responsibility for essential welding-related tasks. The required Level of welding coordinator (Level A, B, or C) for the Certification Level of the manufacturer (CL 1, 2, or 4) is defined in Annex C of EN 15085-2. The number of welding coordinators and the number and level of deputies is dependent upon the extent of the welding production. Clause 5.3 makes it clear that the organisational diagram of the manufacturer shall state the responsibilities, competences, and mutual relationships of all staff who carry out work that influences welding quality. It must be shown that responsible welding coordinators are able to accept their tasks and responsibilities without reservation, and that they have the authority to issue instructions and make decisions independently of manufacturing pressures.

To set out how manufacturers and individuals are required to comply with requirements for welding coordinators for railway vehicles and components, EN 15085 draws on the technical knowledge requirements of EN ISO 14731 clause 6. The fundamental requirement is stated in EN 15085-2 clause 5.1.2 as, “experience of welding supervision for the production of railway vehicles and/or components of at least three years and proof of comprehensive, specific or basic technical knowledge,” for Level A, Level B and Level C welding coordinators, respectively. The railway vehicle welding requirement

then extends the content of the EN ISO 14731 informative Annex A into normative options that may be satisfied with the European or International Welding Engineer, Technologist, and Specialist diplomas [11, 12], or an acceptable national qualification. Although it is not included in the recommendations made in EN ISO 14731, EN 15085 also recognises the European or International Welding Practitioner diploma [11, 12] as an optional element in the route to compliance with the requirements for Level C welding coordinator.

## **3 Assessment of Welding Coordinator Competence**

All accredited manufacturer certification bodies undertaking conformity assessment to EN 15085 requirements will have a scheme document that specifies how compliance is to be evaluated. The accreditation of a manufacturer certification body for a scope including EN 15085 will be based on assessment of that body against the requirements of ISO/IEC 17021 or ISO/IEC 17065, the requirements of EN 15085-2, and the requirements of the body’s own scheme document and management procedures. Additionally, ECWRV members are expected to implement assessments in line with the Guideline.

Through its specification of education requirements, the tasks to be undertaken, the prior experience necessary, and how the individual is required to undertake the role, EN 15085 has set requirements for each element of competence; knowledge, skills, experience and behaviours. Assessment of welding coordinator knowledge is included in the procedure for certification (clause 6), in which EN 15085-2 states that, “welding coordinators shall be interviewed to demonstrate that they have the necessary technical knowledge on welding according to EN ISO 14731 and this series of standards.” The ECWRV Guideline adds to the knowledge assessment process by stating, “Welding coordinators without a qualification according to the relevant IIW/EFW guidelines must demonstrate the necessary technical knowledge of welding during an extended interview as part of the certification audit”. However, assessment of welding coordinator skills, experience and behaviours is not specified in EN 15085-2, and is supported only by compliance with the requirement for prior experience of welding supervision for the production of railway vehicles and/or components. The ECWRV Guideline describes welding coordinator assessment elements that relate to skills, experience and behaviours but sets no assessment criteria or measures.

## **4 Effectiveness of Welding Coordinator Competence Assessment**

Whilst it is recognised that quality of welding may have a direct effect on the safety of railway vehicles and their components, it is very difficult to adopt Community legislation for every product which exists or which may be developed. Additionally, rail vehicle safety is primarily controlled through regulation of operators and service providers. As such, there is no EC Directive or Regulation for market surveillance of welded railway vehicle components. However, effective implementation of certification of manufacturers in accordance with EN 15085-2 should provide product quality control that benefits product safety. Under present requirements, it is possible that certificates in accordance with EN 15085-2 may be issued by manufacturer certification bodies that

are not accredited, or by accredited manufacturer certification bodies that are not members of ECWRV. It is therefore likely that there will be variations in the implementation of the requirements and in the outcomes of the assessments.

The quality of products realised under EN 15085 requirements depends upon welding coordinators applying the required knowledge, skills, experience and behaviours to the execution of their tasks and in discharging their responsibilities. Competence assurance is generally made on a tripwire assessment basis, so any variabilities in determination and evaluation of demonstrable evidence of compliance will result in differences in level of competence. As EN 15085-2 has set specific competence requirements for welding coordinators with responsibility for railway vehicle welding, it follows that variability in competence assurance may lead to variability in realisation of product quality, which could impact confidence in railway vehicle safety.

Table 1 illustrates the increasingly specific competence requirements for responsible welding coordinators, as they move from their roots in EN ISO 3834, through EN ISO 14731, and into EN 15085. The 'what' of these requirements is then complemented by the 'how' of the certification procedure of EN 15085-2 and the guidance provided to ECWRV members. The table assists with analysis of the effectiveness of the welding coordinator competence assurance process required by EN 15085-2.

For the knowledge element of welding coordinator competence, EN 15085-2 places a significant amount of reliance on the IIW and EWF diplomas, and this reliance is encouraged by the ECWRV Guideline, which applies an extended interview requirement to individuals without an E/IWE, E/IWT, E/IWS diploma. Whilst the IIW and EWF diploma guidelines offer an undoubtedly effective syllabus of education in welding processes and their application, there is very little in the syllabus that is specific to railway vehicle components and, inevitably, some syllabus content that has no relevance at all. As with all qualifications, the IIW and EWF diplomas are awarded for life on the basis of examination passes, and it is the consolidation of that learning in practice that ensures that the knowledge is retained. Whilst the certification procedure in EN 15085-2 states that all welding coordinators must demonstrate their knowledge in interview, the ECWRV Guideline suggests that interview is optional for IIW and EWF diploma holders. Neither document sets any requirement for the recency of the diploma award or for any evidence of continuing professional development to maintain and enhance currency of the welding coordinator's technical knowledge.

Whilst stated as an alternative means of compliance with the knowledge requirements, outside of the ECWRV extended interview route, there is no accommodation of "acceptable national qualifications" or any other "proof" of the required level of knowledge in the assessment process.

The skills required by a welding coordinator are firmly related to the tasks that must be executed in delivery of the role. No skills assessment is required in the certification procedure defined in EN 15085-2. However, the ECWRV Guideline encourages review of training undertaken, review of documentation produced in delivery of relevant tasks, and verification of the

performance of the welding coordinator in the supervisory role. As part of the extended interview, the ECWRV also encourages the use of practical tests, which could be used for skills assessment. The table provides the example of the Level C welding coordinator not being authorised for the task of welding procedure qualification. In clause 5.1.2 of EN 15085-2, the only difference between a Level B and a Level C welding coordinator may be an E/IWT diploma rather than an E/IWS diploma. In the IAB-252 Guideline, the IWT candidate receives 12 hours of education on welding procedure qualification, whereas the IWS candidate receives 10 hours, with both allocations including 2 hours of practical exercise. Without any skills assessment, the authorisation of welding coordinators to undertake essential tasks may be unnecessarily restricted, by Annex B of EN 15085-2, entirely on the basis of the knowledge qualification held.

EN 15085-2 sets a minimum requirement for three years' experience of welding supervision for the production of railway vehicles and/or components for Level A, Level B and Level C welding coordinators, except for those holding the E/IWE, E/IWT or E/IWS diplomas, respectively. The standard provides no definition of welding supervision, or the nature and level of the tasks involved. No basis for the three-year tariff is given within the requirement; in an intensive engineering role, with significant technical challenges and high responsibility, three years may well be too high a tariff; in a low intensity engineering role with low complexity and little autonomy, three years may not be sufficient experience to consolidate learning and develop competences. A time-based achievement bar on its own will not deliver confidence in competence assurance. The ECWRV Guideline encourages the length of experience to be reviewed alongside the role and responsibilities but the assessment is still portrayed as more quantitative than qualitative.

The behaviours of a welding coordinator are shown, in the requirements, to be highly important for delivery of the role and effective discharging of the responsibilities. Acceptance of responsibility, exercising of authority and acting independently under pressure are seen as essential features of an effective welding coordinator, in accordance with EN 15085-2, but there are no assessment criteria stated in the certification procedure. The ECWRV Guideline encourages a review of the organisation chart, the responsibilities of the welding coordinator, and their performance in related tasks but these are unlikely to yield demonstrable evidence of the required behaviours

## 5 Conclusions and Recommendations

The specific competence requirements for welding coordinators for railway vehicles and components expressed in EN 15085-2 are unquestionably defined in an attempt to assure the quality of products that may well be safety-critical. However, the increased requirements, over and above those of EN ISO 3834 and EN ISO 14731 are reducing the means of compliance and restricting the authorisation of individuals as welding coordinators without necessarily realising the desired levels of competence assurance and quality control.

The current mandatory and voluntary certification processes are insufficiently specified and inadequately enforced to eliminate variabilities in the implementation

and outcomes of manufacturer certification in accordance with EN 15085-2. Procedures and tools for the assessment of the requisite knowledge, skills, experience and behaviours for execution of the essential welding-related tasks of welding coordinators for railway vehicles and components could yield significant benefits in the harmonisation of evaluation and certification of manufacturers and, thereby, increased consistency in the quality of products.

It is recommended that:

a) The ECWRV provides guidance on the implementation of the IIW and EWF Personnel Certification Scheme [13], to award CE/IWE, CE/IWT and CE/IWS in the relevant scope of application to railway vehicle welding coordinators, with the relevant diploma, on successful completion of welding coordinator assessment. The Personnel Certification Scheme would not only recognise consolidation of learning but the periodic renewal would also bring the certificate holder into a code of conduct and continuing professional development review that would improve confidence in behaviours and currency of knowledge.

b) The ECWRV develops assessment criteria for the knowledge required for coordination of railway vehicle welding relative to the essential tasks and for each level of welding coordinator. Harmonisation of the assessment requirements and assessment guidance, including interview or examination questions, will be instrumental in improving the consistency of welding coordinator competence assessment.

c) The collective experience of ECWRV members is used to identify national qualifications and other evidence of level of technical knowledge that have been successful in supporting assessment of welding coordinator competence. Identification of acceptable routes of development will increase the availability of suitable welding coordinators.

d) Guidance on training needs and skills assessment relative to specific tasks be developed so that authorisation of welding coordinators can be made possible by in-house or third-party training and assessment by the manufacturer certification body, rather than prevented solely on the grounds of level of knowledge or qualification held.

e) The experience requirement is enhanced with clear guidance on time and level of role required, and an assessment of performance in the relevant tasks. The required experience could be related to performance of the essential welding-related tasks for specific components, or for specified combinations of welding process, material, thickness and geometry combinations. In combination with the outcomes of recommendations b) and d), this guidance could enable the three-year tariff to be reduced, or make it possible for suitable welding professionals from other sectors to become welding coordinators for railway vehicles.

f) Guidance on assessment of welding coordinator behaviours, including identification of demonstrable evidence of compliance, is developed for both initial audit and surveillance. It is essential that welding coordinators, in-house as well as sub-contracted, are able to show documentary evidence of their involvement in welding and the effectiveness of their execution of allocated tasks.

## 6 Implementation

Recommendation a) is available through ECWRV members who are EWF or IIW Authorised National Bodies with the Personnel Certification Scheme in their scope of activities, and could be implemented immediately following agreement of the ECWRV members.

Whilst the knowledge assessment criteria developed under recommendation b) should be implemented as an enhancement to harmonisation, it is also possible that such criteria could be implemented by EWF into a railway vehicle specific guideline, similar to the guideline that has been produced for Personnel with the Responsibility for Welding Coordination to comply with EN 1090-2 [14].

A register of national qualifications could be included in the Online Register, based on submissions from ECWRV members. The register would need to be accessible to applicant manufacturers and members.

The skills assessment guidance should be included in the ECWRV Guideline for implementation by member manufacturer certification bodies. EWF and IIW may also be able to implement the training needs into new guidelines. IIW has expressed interest in developing a guideline for inspection personnel in the railway vehicle sector, which may be of interest to ECWRV members.

Whilst the recommendation for additional guidance on evaluating the quality of prior experience is an important one, it is dependent upon the outcomes of recommendations b) and d), and could not be implemented fully without amendment to EN 15085-2. As such, it should be considered by the ECWRV working group that is contributing to revision of the standard.

Guidance on assessment of welding coordinator behaviours could be created from ECWRV member feedback and implemented through the ECWRV Guideline. Consideration may be given to introducing an ECWRV Welding Coordinator Logbook or work diary, to support those individuals who have difficulty in collating suitable documentary evidence.

Recommendations a), b), d), and f) may be implemented through publication in the ECWRV Guideline but this will only increase harmonisation and consistency of results across ECWRV members. EWF has been instrumental in providing clear guidance on the assessment and certification of manufacturers in accordance with EN ISO 3834 through its involvement in creating and revising the European Accreditation (EA) mandatory guidance document EA-6/02 [15]. The publication of a similar document for harmonisation of the audit of railway vehicle welding manufacturers under accreditation by members of the EA, would implement ECWRV guidance across all accredited manufacturer certification bodies with EN 15085-2 in their schedule.

Table 1. The 'what' and the 'how' of railway vehicle welding coordinator competence

Element of Competence	Competence Requirement - The 'What'			Competence Assessment - The 'How'	
	ISO 3834-2/-3	EN ISO 14731	EN 15085-2	EN 15085-2	ECWRV Guideline Part 2
Knowledge	CI 7.1: "The manufacturer shall have at his disposal <b>sufficient and competent personnel</b> for the planning, performing and supervising of the welding production according to specified requirements.	CI 3.3: "person responsible and competent to perform welding coordination" CI 6.1: " <b>General technical knowledge</b> " and " <b>Specialized technical knowledge</b> " "which shall be attained by a combination of <b>theoretical knowledge</b> , training and/or experience." CI 6.2: criteria refers to Specific Knowledge requirements for: <b>Comprehensive</b> - " <b>full technical knowledge</b> " is required, "for the planning, executing, supervising and testing of all tasks and responsibilities." <b>Specific</b> - " <b>needs to be sufficient</b> ", " <b>within a selective or limited technical field</b> ", "for the planning, executing, supervising and testing of all tasks and responsibilities." <b>Basic</b> - " <b>needs to be sufficient</b> ", " <b>involving only simple welded constructions</b> ", "for the planning, executing, supervising and testing of all tasks and responsibilities."	CI 5.1.2: <b>Level A- Comprehensive Technical Knowledge:</b> -IWE or EWE or -IWT or EWT with comprehensive technical knowledge <b>Level B- Specific Technical Knowledge:</b> -IWT or EWT or -IWS or EWS with specific technical knowledge <b>Level C- Basic Technical Knowledge:</b> -IWS or EWS or -IWP or EWP with specific technical knowledge	Interview and evidence of IIW/EWF qualification	CI 3.2: "Generally the welding coordinator assessment is carried out by the MCB as follows: review of technical diploma; review of participation in professional training in welding processes, metallurgy, control methods, etc"  "The auditor may perform a technical assessment of the welding coordinator based on questions concerning the implementation of materials and processes in the workshop. Questions shall be limited to materials and processes used in the workshop and covered by the range of certification requested by the manufacturer."
		CI 5.1.2: Level A - "..... <b>proof of comprehensive technical knowledge ....</b> " Level B - "..... <b>proof of specific technical knowledge ....</b> " Level C - "..... <b>proof of basic technical knowledge ....</b> " "..... <b>acceptable national qualifications</b> may be also considered."	Interview and proof of technical knowledge or evidence of national qualification	<b>Extended Interview:</b> CI 3.2: "must demonstrate the necessary technical knowledge of welding during an extended interview as part of the certification audit."	
Skills	CI 7.3: "The manufacturer shall have at his disposal <b>appropriate</b> welding coordination personnel."	CI 3.3: "person responsible and competent to perform welding coordination" <b>Annex B (normative)</b> CI B.7 "the method and range of qualification shall be considered."	Example from <b>Annex B (normative) line B.7:</b> Qualification of the welding procedures - "method and range of qualification with regard to the qualification of the welding procedures" From the 'Explanations': Level C welding coordinator cannot be authorised to undertake the task. Therefore, a Level C welding coordinator can only work on CL 2 CP D as long as a WPQR is not specified as a contract requirement, as shown in Annex C.		CI 3.2: "Generally the welding coordinator assessment is carried out by the MCB as follows: review of participation in professional training in welding processes, metallurgy, control methods, etc; review of documentation implemented by the welding coordinator (e.g. WPQR, WPS); verification of the efficiency of the welding coordinator supervision (records, remarks, corrective actions)." "..... extended interview, by means of written questionnaire or oral assessment and practical tests (e.g. evaluation of test pieces)"
Experience		CI 3.3: "person responsible and competent to perform welding coordination" CI 6.1: Specialized technical knowledge "....which shall be attained by a combination of theoretical knowledge, training <b>and/or experience</b> ."	CI 5.1.2: "Personnel with experience of welding supervision for the production of railway vehicles and/or components of <b>at least three years</b> ...."	CI 6.1: Verification during assessment. "Welding personnel requirements."	CI 3.2: "Generally the welding coordinator assessment is carried out by the MCB as follows: review of his/her resume that shows the number of years of experience in railway welding; review of the number of years of experience in the manufacturer organisation; position of the coordinator in the manufacturer organisation chart; review of personal datasheet showing his/her responsibilities"
Behaviours	CI 7.3: "Such persons having responsibility for quality activities shall have <b>sufficient authority</b> to enable any necessary action to be taken."	CI 5.3: "the extent of authorization accorded to them to carry out the assigned tasks." CI 3.3: "person responsible and competent to perform welding coordination"	CI 5.3: "Responsible welding coordinators can only be recognised if they are involved in the organization of the welding manufacturer in such a way that they can <b>accept their tasks and responsibility without reservation</b> according to EN ISO 14731 and according to 5.1.2. For this purpose they shall have the <b>authority to issue instructions and make decisions</b> when there are technical problems independent of manufacturing pressures."		CI 3.2: "Generally the welding coordinator assessment is carried out by the MCB as follows: position of the coordinator in the manufacturer organisation chart; review of personal datasheet showing his/her responsibilities and the link to the quality manager; verification of the efficiency of the welding coordinator supervision (records, remarks, corrective actions)."

## 7 References

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- [14] EWF-652r3-14, EWF Guideline, Dedicated Knowledge for Personnel with the Responsibility for Welding Coordination to comply with EN 1090-2.
- [15] EA-6/02 M: 2013, EA Guidelines on the Use of EN 45 011 and ISO/IEC 17021 for Certification to EN ISO 3834. European Accreditation.