Guideline of the European Committee for Welding of Railway Vehicles ECWRV Part 2 (09.05.2024)

Technical Interpretation of EN 15085 (new version)

Content

0. Introduction

Part 2 of this guideline provides a technical interpretation of the EN 15085 series of standards. It is comprised of a series of remarks and additional information which aid the comprehension and correct implementation of the standards.

The explanations that are given in this guideline have been taken into consideration by members of the European Committee for Welding of Railway Vehicles (ECWRV) from their knowledge and experience of past audits. Future ECWRV guideline working groups may develop this guideline.

1. Interpretation of EN 15085-1

EN 15085-1 does not include technical information, therefore no interpretation is given in this guideline. Additional information due to wording and translation mistakes is useful.

1.1 Terms and definitions

“Shall” indicates a requirement,
“Should” indicates a recommendation,
“May” indicates a permission,
“Can” indicates a possibility or a capability.

Spare part - welded (EN 13306): Item intended to replace a corresponding item to retain or maintain the original required function of the item.
Spare parts, according to this guideline are parts which must be exchanged periodically during maintenance, e.g. wear parts.
Replacement part – welded (EN 13306): In English, any item that is dedicated and/or exchangeable for a specific item is often referred to as a replacement item (part or component), e.g. in case of an accident or damage of welds.
The different versions of EN 15085-2 (English / German) mix these terms.

Work instruction: An instruction that describes how to work, e.g. NDT-instructions for VT based on the principles of EN ISO 17637.

Record: A report about a specific action, e.g. NDT-record with detailed values.

Traceability (EN 15085-5): Link between a certificate, e.g. 3.1 and an item with an identification number, e.g. heat number.

Maintenance (EN 15085-6 and EN 13306): Includes maintenance itself, repair, overhauling, inspection.

Safety relevance: Safety relevance assessment refers to the part or component and shall be developed and documented in accordance with EN 50126 series, if parts / components are not specified in EN 15085-2, table 1.

Safety category: Safety category assessment refers to the weld and shall be developed and documented according to EN 15085-3, annex G.

2. Interpretation of EN 15085-2

2.1 Classification levels and activities of manufacturers

The introduction of this part of the standards refers to ISO 3834 - Quality requirements for fusion welding of metallic materials.
ISO 14554 - Quality requirements for welding, resistance welding of metallic materials- as a general requirement can be taken into consideration for resistance welding.
EN 15085-2, table B.1 - Minimum requirements for manufacturers - show which part is necessary for each classification level. The contents of both ISO standards are comparable, it is sufficient to comply with one of these quality systems. The special circumstances regarding WPQR shall be adapted, e.g. acc. ISO 15614-12 - Specification and qualification of welding procedures for metallic materials, welding procedure test, part 12: Spot, seam and projection welding.

The management of those quality-related activities shall be described in the relevant documentation e.g. written procedures, records, work instructions and checklists.
Review of requirements and technical review (contract and design review) shall be completed according to the applicable part of ISO 3834 or ISO 14554, see Annex B of EN 15085-2.
The manufacturer shall manage the calibration and/or verification of welding equipment, devices, gauges, jigs and fixtures which have an impact on the quality of the product according to the existing applicable standards.
Calibration, verification and validation shall be done according EN ISO 17662.

Review of welding related documents and records should be organized / supervised by the WC periodically e.g. Welding Procedure Specifications (WPSs), visual inspection (VT) records to demonstrate state of the art practices.
Certification according to ISO 3834 or ISO 14554 are only required if contractual requirements stipulate either standard.

Certification is a tool for conformity assessment according to EN ISO / IEC 17000 which is considered to be a third-party conformity assessment activity completed by an EN 15085 – accredited MCB which takes part in the online register, see ECWRV guideline part I.

Each location of the manufacturer shall be qualified with a certificate.
Exceptions are possible only for M and D, if all types of activity are under control of one manufacturer’s organization.

2.2 Classification level

Welding on additive manufactured metallic components within the scope of the EN 15085 series shall meet the requirements of the highest classification level, where this part is integrated.
Classification level for stud welding according to EN ISO 14555 shall be equal to the component classification level.

2.3 Types of activities of the manufacturer

Types of activities which are to be recorded in the certificate are as follows:

D: If the manufacturer (or design office) is responsible for selection of materials, tolerances, thickness and diameter of parts/components as well as welds (shape, length and thickness). This activity includes calculations and issuing of drawings, part lists and other relevant documents.
MCBs should always make a reference to a design company in the certificate as follows:

Design is valid for new production or
Design is valid for maintenance or
Design is valid for new production and maintenance.

Note: Designers should be trained by WC`s about process and material dedicated problems.

P: If the manufacturer welds new parts and / or components in his own workshop. Also included is repair work under warranty conditions (which can also take place for a limited period see 2.4. in other facilities as long as the manufacturer is responsible for personnel and the documentation).

M: If the manufacturer repairs welded railway vehicles and components by welding (including testing). This covers inspections, repairs, overhauling and refurbishment.
Buying and assembling of spare parts is allowed, as long as the manufacturer of these welded parts is qualified for P and the assembling manufacturer is qualified for M and performs incoming inspections of these parts, like required for S (see also 6.1).

S: If the manufacturer is responsible for purchase and supply of welded parts / components for new fabrication or maintenance activities without conducting welding operations by himself for these sub supplied parts / components.
S related welding activities take place under exclusive responsibility of the sub supplier qualified for P and/or M and can take place in customers or sub suppliers workshops.
S can also cover a repair operation in the field of “M” in the workshop of a customer.
In this case the sub supplier qualified for M is fully responsible for every welding activity.

For dealing with welded spare parts or replacement parts S is mandatory.
S is not required if “D” activities are subcontracted.

Note: If S includes purchasing of welded parts / components, the WC according to Annex A and B of EN 15085-2 should train the involved persons.

2.4 Requirements for the manufacturer, general

The requirements for welding manufacturers based on the EN 15085 series of standards are described in this clause.
For temporary welding work outside the manufacturer's site, e.g. in case of warranty:
The manufacturer shall only perform welding work for a limited period in a different workshop on the rail vehicles or components that they weld themselves, subject to the same personnel competence*,* technical ability and quality requirements specified for the welding manufacturer. Details on the procedure at this site shall be agreed between the parties. The manufacturer shall inform the MCB immediately. This limited period welding in a workshop does not have to be included in the certificate. A limited period should not be longer than 3 months.

2.5 Welding coordination WC

The welding manufacturer shall demonstrate compliance with the requirements according to EN 15085-2, clause 5.3.1.

Annex B of EN 15085-2 describes the minimum requirements for WC`s. The required number of WC`s depends on the size of the welding manufacturer as well as the scope of welding production and the number of sub suppliers.

The requirements for the technical knowledge of WC`s are documented in EN 15085-2, Annex D.
When selecting a WC, their professional experience shall be considered base on EN 15085-2, clause 5.3.5 Welding coordination organization and Annex D.
The WC`s shall be integrated in the welding manufacturer's organization in a way that allows them to attend to their tasks in their area of competence pursuant to EN ISO 14731 and EN 15085-2, Annex A, without any restrictions.
For this purpose, they shall have the required authority to instruct and have their own decision-making power.
This shall be documented by organization charts, matrix acc. EN ISO 14731
(job description acc. EN 15085-2, Annex A) and nomination / appointment.
The independence of the WC`s from production shall be clearly shown in an organization chart.
The tasks and areas of responsibility shall be laid down in writing for each WC (e.g. with an appointment / nomination). If the areas of competence are separated (e.g. for production, subcontracting and design), this shall be indicated in the organization chart and the appointment (e.g. supplemented by a matrix).
If the areas of competence are separated, the WC`s in charge shall be defined in accordance with EN 15085-2, annex A and shall have sufficient knowledge for the type of activity.

WC`s without an IIW /EWF qualification are an exception.
Level A, B and C can be accepted, if such qualifications cannot be achieved.
In this case the following procedure takes place:

WC`s without a qualification according to the relevant IIW/EWF guidelines shall be recognized through a documented extended interview base on EN 15085-2, Annex D requirements.
This recognition applies only to the relevant welding manufacturer.
For the extended interviews complementary rules apply:
1. For level A and B according to EN 15085-2:
a) For level A qualification as technologist or graduate engineer is mandatory.
b) The extended interview shall be executed by an examination board of the manufacturer certification body: the board shall consist of two technical members nominated by the manufacturer certification body and shall be performed and reported separately not as part of the audit.
2. For level C according to EN 15085-2:
The extended interview can be executed by the auditor during the audit.

Level A, B or C without IIW/EWF training cannot be accepted as subcontracted (external) WC`s.

Continuing training is necessary, e.g. regarding new processes, materials, standards and guidelines to ensure continued professional development and recency of competency.

2.6 Subcontracted welding coordinators

The "subcontracted WC" constitutes an exception.
In the online register subcontracted and external have the same meaning, based on historic definitions.
WC`s who are not employed directly (on site) by the welding manufacturer are "subcontracted welding coordinators", see EN 15085-2, clause 5.3.6 "Subcontracted welding coordinator".
A maximum of one WC (RWC, Deputy Welding Coordinator (DWC) or other Deputy with IIW/EWF training shall be subcontracted (external) for each workshop.
Level A, B or C without IIW/EWF training cannot be accepted as subcontracted (external) WC`s.

MCB auditors shall not act as subcontracted WC!

For subcontracted WC`s, the following shall be observed:

- The working hours of the WC`s shall be contractually agreed so that they can perform their tasks as defined in EN 15085-2, Annex A, evidenced in a work log.

- For finishing-welding of castings, the required presence on base of the matrix according to EN ISO 14731 depends on the extent of the welding production within the scope of the relevant standard.

- Subcontracted WC activities for P and M should be limited to maximum 3 manufacturers or locations (one internal and 2 external) in case, all welding related activities are limited.

  In special situations the validity of a certificate can be reduced.

If the total workload of the companies is low, e.g.:

- P with single purpose production (i.e. automated welding of one product)
- M with only a few welding tasks per year
- D or S, where most tasks can be performed from another site

the MCB can accept a subcontracted WC for more than 3 manufacturers or locations but it is necessary to prove to the MCB that all involved manufacturers are informed, and the subcontracted WC is authorized to be in charge with more manufacturers.

The MCB has to assess the specific situation of the manufacturer and decide on a case by case basis.

Remark:
A subcontracted WC is a person that belongs to another manufacturer and is tied contractually to the manufacturer where welding activities take place (external).
A WC that belongs to the manufacturer and is nominated to perform welding related activities in other locations of the manufacturer is not a subcontracted WC. A contract is not necessary. A clear description of tasks and responsibilities shall be available, also a DWC in the various locations (depending on the type of activity) is required. The quality system shall cover all locations.

WC`s with central authority in one manufacturer's organization and proven competence can be accepted for different workshops / locations of the same manufacturer as long as these manufacturer's organization work according to the same quality system.

2.7 Technical requirements

The production workplaces, including workplaces for assembly, shall be sufficient in size and nature to allow correct and reproducible welding work.
The requirements of EN 15085-2, clause 5.5 shall be met.

If a manufacturer uses several types of materials (i.e. carbon steel, stainless steel, aluminum) in the same workshop, the following should be checked:

- The storage areas for materials should be organized in such a way that metal to metal contact between different material types is avoided.
- Grinding and cutting operations that produce dust or particles shall be avoided near or in the storage area.
- Bending and cutting tools and fixtures should be cleaned (usually the manufacturer of the machine offers cleaning products).

- The tools and fixtures for these machines should, in general, be insensitive to ferritic contamination.
- Cleaning using compressed air systems (dust scattering) should be avoided.
- If different materials are used simultaneously in close proximity (e.g. in contiguous workshops), a physical separation of 2 m, minimum, above the working height is necessary
- If different materials are used simultaneously in the same area, a distance of 5 m, minimum, shall be maintained between them.
- Grinding or sharpening (e.g. TIG electrodes for welding) shall not be conducted in the welding area or where base materials can be contaminated.
- Each type of material shall have dedicated small tools (brushes, flex discs...).
- The workbench shall be protected to prevent contact between incompatible materials.
- The workshops shall be equipped with air extractors.

A cleaning procedure shall be available.

External testing laboratories, used for NDT or DT shall work in accordance with EN ISO/IEC 17025 and this shall be verified through a valid national accreditation or a specific assessment.

2.8 Manufacturers declaration

A valid and current certificate issued by an MCB includes all items required in EN 15085-2, clause 6. If there is a change to any item of EN 15085-2, clause 6, the manufacturer shall inform the MCB immediately.

2.9 Supervision of subcontracting

No remarks

2.10 Annex A

No remarks

2.11 Annex B

- Small welding manufacturer

Annex C to EN 15085-2 contains a guideline for evaluating the size of the welding manufacturer, which should be considered for the "small manufacturer".
For the "small manufacturer" classification with types of activity P or M and multiple welding applications (e.g. rail vehicle construction, steel structures, pressure equipment directive, defense technology), all applications should be taken into account if there is only one welding coordination team available (e.g. the number of welders and welding operators in all applications).
A final decision shall be done by the MCB.

2.12 Annex C

The informative Annex C gives a formula to check, whether a manufacturer is small or big.

$WM = a \cdot b \cdot c \cdot d \cdot e \cdot f$

The question of a manufacturer’s size was just relevant to CL 1 manufacturers in the past.
In the recent version of EN 15085-2 it also references CL2 and CL 3.

2.13 Annex D

The informative Annex D gives guidance for the evaluation of the technical knowledge of welding coordinators.

In case, technical knowledge of welding coordinators has to be checked, e.g.

proof of competence according to EN ISO 14731, Annex A or as a technical discussion in the field of EN 15085, a written document about the competence evaluation shall be made available, particularly when welding coordinators do not hold an IIW / EWF qualification.

The technical assessment of the welding coordinator is 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.

3. Interpretation of EN 15085-3

3.1 Design requirements

The assessment of design includes:
- Verification of procedures applicable for calculation and design
- Verification of the design review parameters
- Verification of the implementation of EN 15085-3 in the design (in particular the performance of the joints in relation to the stress levels and the possibility to perform the visual examination during the life of the component)
- Verification of the skills of the person in charge of design (diploma, experience)
- Verification of the design verification method before manufacturing begins (method of design validation)
- Verification of the tools (software) used for the design, for commercial tools, verification of software updates (licenses and subscription); for in-house tools, verification of the validation
- Verification that the content of the drawings complies with EN15085-3 clause 8
- Verification of design updates (transmission of new drawings and documents and the withdrawal of obsolete drawings and documents)
- Verification of the documentation (e.g. standards, technical requirements) at the disposal of the designer and the document management system (e.g. document updates)
- Verification that internal audits of design have been completed and managed appropriately
- Verification of the specifications and/or procedures provided to subcontractors
- Verification of subcontractor management.

3.2 Weld performance classes

In addition to EN 15085-3 the following are definitive selection criteria for the weld performance class:
1. The safety requirements of the individual weld. The safety category is determined in the context of the failure risk analysis.
2. The stress level of the individual weld. The stress level can be determined by means of a fatigue strength test.
Applicable regulations:
- EN 12663-1 and -2
- EN 13749
- EN 15827
3. The type of weld (with full or partial penetration).
4. The possibility of inspection during its life cycle.
The combination of high safety category and high stress category is prohibited in new build production resulting in the exclusion of the weld performance class CP A. If the weld performance class CP A is required in maintenance, its application shall be agreed with the ECM.
Increasing the weld seam strength through the use of the fatigue class pursuant to EN ISO 5817, Annex C is only permitted with the consent of the client or the ECM.

Beside the safety and stress categories according to table 2 the choice of a CP level should also refer to the metallurgical risk that a defect in a weld can cause.

In EN 15085-3, the choice of material and its requirements are addressed in Article 6.1. the correct choice of material, strength calculation shall be taken in account by the designer including the mechanical properties of the material (WPQR).

3.3 Weld inspection classes

The designer is responsible to define the CP level in the design phase.
In case something happens in the production phase, the WC in charge can upgrade the CT level.

Independent of this, the manufacturer who puts the product into circulation is responsible.
The manufacturer and a possible subcontractor must consult each other.

3.4 Selection of parent materials

The parent material shall satisfy the requirements of the material groups according to CEN ISO/TR 15608 (CEN ISO/TR 20172) and shall have verified weldability. Weldability according to ISO/TR 581 is considered proven if the parent materials comply with the relevant EN standards and therein designated as suitable for welding.
For a parent material without verified weldability, a report on the qualification of the welding procedure (according to EN ISO 15614 or comparable) shall verify that the welded joint properties achieved through use of the parent material meet the requirements of the design (see EN 15085-4).
For components of rail vehicles with welded joints with the safety category High or Medium, only parent materials for which stresses that can be withstood under dynamic load exist or have been agreed may be used. Only parent materials that also achieve the mechanical and technical properties laid down in the standard after welding may be used.
A WPQR does not eliminate the necessity to determine fatigue strength values.
These values shall be agreed with the design.
For the welding of high strength steel (with ReH > 690 N/mm²) or TM steels whose properties result from the rolling process as well as for aluminum and aluminum alloys (material groups 21 through 26 to CEN ISO/TR 15608), the reduced strength properties in the heat affected zone (HAZ) shall be considered.

3.5 Selection of welding consumables

Welding consumables are to be selected according to EN 15085-4, Annex A.

3.6 Welding joint design

For the welding design a welding design review is to be conducted by the RWC or a person assigned by the RWC. The objective of the welding design review is to verify that the designed assembly can be welded and inspected in conformity with the contract. The review includes, among other things, feasibility, accessibility, and compliance with order requirements.
The inspection content shall be executed according to clause 5, EN ISO 3834-2, -3, -4, depending on the classification level, aligning with EN 15085-requirements.

3.7 Joint preparation

Weld form, weld thickness and weld length (see Annex B) shall be indicated on the drawing.
Deviations of joints shown in table B.1 are allowed, if there is no influence on mechanical properties (heat input) and a production weld test shows the possibility of execution.
Table B.1 of EN 15085-3 is informative. That means design engineering can propose alternative weld seams in addition to those described in this table.
A weld seam that complies with table B.1 shall have a symbol that complies with table B.1 as well. In addition, the use of “z” instead of “a” shall be clearly indicated in the drawing. A corresponding table can be issued if necessary.

The Design throat area for plug welds A_R (mm) shall be defined.

A design responsible person should check if the information in table B.1 is correct – e.g. the thickness of root face c (mm) for Y, HY and DY welds.

3.8 Design documentation related to welding

For welding production the currently valid welding regulations and guidelines apply, i.e. the welding planning documents shall comply with these regulations and current standards, if the safety relevance meets the new current standards.
For maintenance welding according to drawings that do not correspond to current welding regulations (e.g. old drawings), changes to drawings are not required. Instead, the following shall be specified in the welding planning documents for production (welding plan, welding drawings):
• Classification level according to EN 15085-2
• Joint type according to EN 15085-3
• Weld performance and weld inspection class according to EN 15085-3
• Materials and welding consumables according to current standards
For the rewriting renewal of existing welding designs that were not created according to the EN 15085 series of standards, the requirements shall be fixed with the customer.
• Regarding the structural design, no changes to the design requirements of EN 15085-3 are required. Existing specifications remain valid.
• Welding consumables are to be selected according to EN 15085-4, Annex A, and specified according to current standards.
• Materials are to be selected according to current standards.
Modification of the drawings can be documented on the individual drawings (e.g. with a welding stamp) or with a cover sheet. For modification, the welding design review is to be conducted according to EN ISO 3834 by the RWC or a person assigned by the RWC.

4. Interpretation of EN 15085-4

4.1 Supplementary regulations

Finishing
Requirements shall be defined for:
- TIG remelting (procedure)
- Grinding (procedure)
- Pickling, passivation, etching and other chemical treatments (procedure)
- Spatters (quantity, dimensions…): Not allowed on CL 1 parts with painted surface.

Post-weld heat treatment
The PWHT shall be performed according to a written procedure which defines the essential parameters. EN ISO 17663 “quality requirements for heat treatment in connection with welding and allied processes” shall be respected.

Heat straightening.
Requirements (parent material, max. temperature, duration, testing, jigs, blowtorch …) need to be defined. A written procedure shall describe the execution and control of the straightening process.

Subcontracting activities beside welding
The subcontractor shall respect the same specifications and requirements as the manufacturer.
This remark is applicable for subcontracting of:
- Cutting, bending
- Heat treatment/PWHT: Respect EN ISO 17663.
- Painting and varnishing
- Straightening

The manufacturer shall qualify all the subcontractors of primary parts (CL1).

Subcontractors for these activities should comply with EN ISO 9001.
- NDT: External personnel shall be certified on base of EN ISO 9712.
- DT: External laboratories shall be accredited.

Manufacturer's qualification for longitudinally welded pipes as semi-finished products.
To produce longitudinal welded pipes, there are 3 possibilities:
- Use of standards for pressure equipment complying with Directive 2014/68/EU or
- Implementation of EN 15085 series of standards or
- Certificate according EN ISO 3834-2 and qualification of the process according EN ISO 15614.

The use of European standards of welded pipes intended to be used for pressure equipment as per the Directive 2014/68/EU is acceptable, because the requirements are equivalent to those specified in EN 15085. The inspection certificate, according to EN 10204 Type 3.1, shall show full compliance with the EN for pipes according to Directive 2014/68/EU.
Otherwise, the pipe manufacturer shall show evidence of the compliance with EN 15085.
The requirements of EN 15085 are applicable, in particular
- Welder and welding operator qualifications
- Welding procedure qualification according to EN ISO 15614.

Single-purpose production
Single-purpose production in the classification level CL 1 is the fully mechanized welding production of identical subassemblies in a series (e.g. cardan shafts).
The field and range of application of the certificate according to EN 15085-2 shall be limited to the subassembly and the welding procedure specification.
Deviating from the requirements of EN 15085-2, a RWC of the qualification level B may be accepted by the MCB for this purpose.
Details on the inspection and verification measures shall be agreed upon with the MCB, a shorter verification interval (e.g. every six months) may be necessary.

Finishing welding of castings
Finishing welding of aluminium castings after heat treatment is forbidden.
A WPQR shall be performed to prove that the nominal mechanical properties (such as elastic limit, tensile strength, elongation, toughness KCV, hardness) and, if required, the chemical composition of the repaired areas are maintained after welding. Preheating and heat treatment are essential variables of the WPQR.
WPQR can follow EN ISO 15613 with tests according to EN ISO 15614-1 or EN ISO 11970.
A mock-up specimen shall be made to validate the joint preparation (grinding, arc gouging, groove, depth), the welding process (accessibility, shrinkage, hammering, welding position), the heat treatment after welding (with oven or annealing by welding) and the quality of the welded areas according to the relevant standards.
For finishing welding on subassemblies of the classification level CL 1, the foundry shall provide proof of the required properties and casting quality by tests and inspections. The evaluation criteria (such as weld performance class CP) and the inspection procedures (such as weld inspection class CT) shall be determined by the RWC and – if contractually agreed – be approved by the customer.
The RWC may also be a foundry engineer if he/she has demonstrated "comprehensive technical knowledge" pursuant to EN ISO 14731 for this field of application in an extended interview – EN 15085-2 Level A.
The manual skill of the welder shall be demonstrated by an appropriately documented production weld test, see EN 15085-4.
EN 1011-8 shall be taken into consideration.

Friction stir welding
For the application of friction stir welding, the following provisions shall apply:
- The series of EN ISO 25239.
- Process number: 43 according to EN ISO 4063

- Materials: Aluminium and Aluminium alloys
- Dimensions: All dimensions covered by the manufacturer´s welding procedure specifications according to EN ISO 25239-4.
- Quality and inspection requirements:
According to EN ISO 25239-5, levels for imperfections see EN 15085-3, 5.3.2
- Operational prerequisites:
Deviating from the requirements of EN 15085-2 Annex B, a RWC of the qualification level B may be accepted by the MCB, if the scope of the certificate according to EN 15085-2 is limited to friction stir welding.
• Welding procedure specification: according to EN ISO 25239-4 / EN 15085-4, 4.1.4
• Welding operator qualification test: according to EN ISO 25239-3 / EN 15085-4, 4.1.5
• Production weld tests: according to EN ISO 25239-4 / EN 15085-4, 4.2.10

Welding of damper rings in wheelsets
Some railway vehicle wheels have grooves with Y-welded rings that are used to dampen noise. Because of the safety relevance of the wheel sets, manufacturers that weld damper rings of this type shall be classified to CL 1. The EN 15085-2 certificate shall include specifically “Welding on damper rings“ in the field of application.
Restrictions or prohibitions of welding specified in clause 4.4 of EN 15085-6 shall be considered.

Brazing
For brazing on railway vehicles, a certificate according to EN 15085-2 is not necessary, but can be required by customers.

4.2 Preparation before welding

4.2.1 Welding planning documents

Weld joints shall be qualified by a WPQR according to the requirements in EN 15085-4 clause 4.1.4. For each weld joint in the design, the welding coordinator shall determine if relevant mechanical properties are verified by the WPQR and take additional steps for supplementary tests, if necessary. An example can be a weld joint qualified by a pre-production test ISO 15613 and a supplementary butt weld test according to EN ISO 15614 is necessary to verify tensile strength and charpy-V impact strength e.g. if the geometrical shape does not allow mechanical property verification.

The WPQR shall including essential information like the type of welding machine (e.g. software status, type of wave form, torch system, length of hoses…).

In case, qualification is based on EN ISO 15613, the range should match with EN ISO 15614. Deviations and limitations should be decided by the WC in charge.

For the weld performance class CP D, WPS and WPQR are only necessary if requested by the customer.

Each WPS shall be checked and approved by the RWC or by the assigned WC.
The welding manufacturer shall have a written procedure that describes how the welding procedure specifications are qualified and documented.
For qualification of the WPS by the WC, the same requirements apply as described in the case of in-house training according to clause 4.2.3.

Qualification according to EN ISO 11970 is permitted for finishing welding of steel castings and EN ISO 25239-4 for friction stir welding.

Welding on Additive manufactured parts see table below:

Part 1	Part 2	Requirement
AM	AM	ISO 15613* or 15614
AM	All except cast iron	ISO 15613* or 15614
AM	Cast Iron	ISO 11970 / ISO 15614
AM repair **	---	ISO 15613*

*: Proof of mechanical properties
**: Only if agreed with customer

Friction stir welding 43:
Every friction stir weld in production shall be approved based on EN ISO 25239-4.
Imperfections shall be verified based on EN ISO 25239-5.

Laser welding 52:
Every laser weld in production shall be approved based on EN ISO 15614-11.
Imperfections shall be verified based on EN ISO 13919-1 and part 2.

In these cases production weld tests shall be completed, see above.

Special remarks can be stated in the certificate.

4.2.2 Qualification of welders and operators

For each welding process, material group, joint type and dimension, at least two permanent welders/ welding operators with a valid qualification pursuant to EN ISO 9606-1, EN ISO 9606-2, EN ISO 9606-3, or EN ISO 14732 shall be available.
Depending on the type of work, the workload and the shifts, the number of qualified welders or welding operators needs to be increased.
For welding manufacturers with the type of activity M, the welders for the welding positions (PC, PD, PE, PF see EN ISO 6947) shall be qualified for the special requirements in the area of maintenance welding.
For joints which are not covered by standard test pieces, production weld tests according to EN 15085-4 shall be done to demonstrate the skill of the welder.
Weld positions which are not in use frequently but are covered by the welder qualification may be re-qualified with production weld tests.

EN ISO 9606-2: A radiographic examination shall be conducted for buttweld test pieces irrespective of the welding process (applies only to welds with full penetration).
The radiographic examination can be replaced by a comparable volumetric method (e.g. PAUT and TOFD).

The field of work of the welder/welding operator in production shall be in line with the range of certification of the available welder's/operator's qualification test.
Production weld tests may also be used for the qualification of welders/welding operators.

Qualification of welders subcontracted to external examiners:
If an examiner of an external independent examining body conducts qualification of welders/ operators, the examining body generally has to be accredited in accordance with EN ISO/IEC 17024.

4.2.3 Internal qualification of welders / operators

If the WC intends to conduct in-house qualification of welders/ operators as an internal examiner several points shall be verified by the MCB during the EN 15085 audit.

The manufacturer shall issue test procedures/instructions for all tests that are performed internally, and those procedures/instructions shall comply with relevant standards (e.g. EN ISO 17637, EN ISO 17639, EN ISO 9017…) and be approved by the RWC or WC in charge.

The WC who will be responsible for issuing the welder and welding operator qualification approvals needs to demonstrate to the MCB that a complete test according to EN 287-6, EN ISO 9606 relevant parts, EN ISO 14732 or other relevant standards is done correctly, including the test piece evaluation and all related documentation.

Acceptance of welder's/operator's qualification tests by the WC of the manufacturer is permitted under the following conditions:
1. The WC`s responsible for testing of the welders and welding operators shall be appointed by the welding manufacturer.
2. The welding manufacturer shall ensure that the WC is independent from production during verification and examination of the test pieces.
3. The welding manufacturer shall issue a written procedure that describes the welder and welding operator qualification process. This procedure shall include the following:
– Required documents (e.g. WPS, evaluation sheet, qualification record)
– Identification and storage of test pieces
– Traceability of test piece execution data (e.g. welder identification, start and stop locations)
– Performance of welding work (tacking, execution, allowed repairs, preparation of the next layer for multipass welding),
– Performance of visual testing, DT and NDT
– Determination of the range of validity of the qualification
– Qualification record numbering
– Verification of welder/welding operator technical knowledge
– Standard form for the welder and welding operator qualification record

4. In case of a manufacturer which tests and qualifies his own welders, operators and processes in an own testing laboratory and / or welding training center the independency of this units and its personnel shall be clearly described and shall be independent from the production process.

5. Examiner and examining body shall be nominated/ appointed.

The WC`s who are responsible for welder and welding operator qualification shall be named on the EN 15085-2 certificate.
The MCB should make a remark on the back page of the certificate:
“The welding coordinator/s is/are authorized, within the scope of this certificate, to test welders/operators in accordance with the relevant standards.”
Name/s, qualification/s:

Welders’ prolongation shall be done only according to 9.3. a or b,
Operators’ prolongation only according to 5.3. a or b.

4.3 Production weld tests

Objectives of production weld tests acc. EN 15085-4, 4.2:

Practical solutions for handling of Production weld tests (PWT)

	Base of qualification and documentation	Types of tests	Validity
Suitability of the design	EN ISO 15613 / EN ISO 15614*	See *	As long as the design is valid
Suitability of welding conditions	EN ISO 15613	VT / PT or MT/ macros, hardness (if necessary)	As long as the PWT-conditions are the same

Skill of the welders/operators	EN ISO 9606 EN 287-6 EN ISO 14732	VT, fracture or macros **	Acc. EN ISO 9606 EN 287-6 EN ISO 14732
Quality of the welded joint	EN ISO 9606 EN 287-6 EN ISO 14732	VT, fracture or macros	Acc. EN ISO 9606 EN 287-6 EN ISO 14732

*: In case of lack of access: VT and fracture or macros, in case of choosing the material: With mechanical properties

** Fracture in case the thickness and geometrical shape allows macro for very thin and very thick test pieces or if the shape does not allow fracture (e.g. HV on T-joints)

The WC in charge specifies all details above including other applicable standards!

4.4 Requirements for welding

Before, during and after welding the welding production inspection shall be documented by procedures and reports for:

- Weld preparation and other requirements (conducted before welding, see EN 15085-4, 5.2.1)
- Execution of the welding (during welding, see EN 15085-4, 5.2.2)
-Weld quality (after welding, see EN 15085-4, 5.2.3)

4.5 Welding consumables

The welding consumables used shall meet the following requirements:
Conformity of welding consumables shall be in line with EN 15085-4, clause 5.3.2.
The new requirement is for a inspection certificate according to EN 10204, 3.1 for chemical composition and type 2.2 as a minimum for mechanical properties.

In case that it is intended to use a filler metal that is not provided with CE / DB marking or is not covered by a European designation, the following requirements shall be applied:

1. An approval from the customer is to be obtained and documented as part of the technical review of the job in which the intended use is specified.
2. A specific WPQR with all the required mechanical properties shall be qualified for that welding material.
3. A 3.1 inspection certificate from the material manufacturer is obtained for any amount that is different to the one tested on the specific WPQR.

4.6 Parent materials

As required by EN 15085-4, components with classification level CL 1 and CL 2, an inspection certificate 3.1 according to EN 10204:2004 is necessary. In case of deviation the minimum requirements of Table 1 shall be considered.
Legal situations can require a full traceability, different from EN ISO 3834.

If the welding manufacturer intends to use an alternative material, it shall be approved that the alternative material fully complies with the specifications of the original material and is in line with ISO/TR 15608. A 3.1 inspection certificate according to EN 10204 shall confirm that the specified properties are met by the alternative material. The customer needs to agree to the proposed change.

Inspection certificates 3.1 shall be issued in a language understandable by the manufacturer´s competent incoming inspection personnel.

5. Interpretation of EN 15085-5

5.1 Inspection and testing of welded joints

Inspection and testing of welded joints shall be conducted under the responsibility of the RWC after welding; inspection content: see above.
In the case of non-conformance or an imperfection that is not acceptable and cannot be removed, the procedure for management of non-conformity pursuant to EN 15085-5, clause 7, is to be applied.
Waiting times shall be taken in consideration, e.g. acc. EN 1090-2 (table 23).

5.1.1 Inspection personnel

In general, the welding manufacturer shall use qualified inspection personnel according to EN ISO 9712 if NDT such as visual testing (VT), penetrant testing (PT), magnetic particle testing (MT), radiographic testing (RT), ultrasonic testing (UT) or eddy current testing (ET) according to EN 15085-3 and EN 15085-5 have to be done. NDT can also be subcontracted.

NDT of welds shall be performed in accordance with written instructions prepared by a person qualified according to ISO 9712 level II in the method and approved by the RWC or a person designated. This procedure shall be in accordance with the relevant standard (e.g. EN ISO 17636, EN ISO 3452…) and include the quality levels for imperfections required for each weld performance class.

For CT1 and CT2 the NDT personnel (including VT) shall be independent from production.

For the VT of CT3 and CT4 welds, the inspection personnel shall be trained by the RWC, or a person designated by the RWC on the quality levels for imperfections of the weld performance classes to EN 15085-3. The training shall be documented.

The WC is authorized to perform visual inspections, provided competence can be demonstrated to the MCB on this subject.
In case of CT3, the visual inspection personnel shall be different from the persons who performed the weld. The inspection personnel e.g. can also be another welder.

For CT4 the welder can perform inspections on his own welds.

According to EN 15085-5, clause 6, CT1 and CT2 need full documentation.
CT3 should be documented in the same way.
For CT4 a remark in the working plan or tolerance report is sufficient.

In all cases visual acuity shall be checked every 12 months based on the requirements to EN ISO 9712.

A permission to operate stating validity is required, this can be a nomination or an appointment e.g. in the training report.

5.1.2 Inspection and testing before welding

see clause 4.2 of EN 15085-5

5.1.3 Inspection and testing during welding

see clause 4.3 of EN 15085-5

5.1.4 Inspection and testing after welding

see clause 4.4 of EN 15085-5

In connection with EN 15085-4, clause 4.1.5 – training – it is also recommended to train welders and operators for this. EN 1011, EN 15085-4 clause 5 should also be included.

5.2 Visual Inspection

For the inspection and testing of welded joints during and after welding production the requirements of EN 15085-5, clause 4, shall be observed.
To demonstrate weld quality the required weld tests shall be conducted according to EN 15085-5, Table 1. For weld inspection class CT3, the welders shall not perform a self-inspection of their welds without inspector (four eyes principle, see above).
The test methods specified in Table 1 are minimum inspection and testing requirements for welds.
Additional testing may be required depending on the material, design, welders used (agency welders), jigs and fixtures which reduces access, customer requirements, and particular specifications of the WC.

5.3 Requirements for other NDT examination personnel

shall be agreed and verified by the customer (e.g. level 3 acc. EN ISO 9712).

5.4 Type and extend of NDT

Deviations from table 1 of EN 15085-5 shall be agreed by the customer (e.g. specific kinds of UT).

5.5 First article inspection (FAI)

First article inspection (FAI) is applicable for subcontracted and purchased welded components.

In case a first article inspection (FAI) is necessary on basis of the descriptions in EN 15085-5, chapter 4.8.1, the FAI shall be conducted by the RWC or a person assigned by the RWC. The competence requirements depending on the classification level is stated in chapter 4.8.2 table 2.
Details on the content and documentation of the FAI are provided in EN 15085-5, clause 4.8.2. and 4.8.3.

5.6 Management of welding defects

Procedures shall be available which describe who is responsible for managing weld defects:

- Repair decision is made by the welder: defect type for simple repair is fixed, size of defect is limited, welding according to original WPS.

- Repair decision is made by the WC or weld inspectors: larger defects,
new approved WPS may be necessary.

- Repair decision made by the customer: repair may have influence during use, e.g.
change in mechanical properties, changes in joint design, e.g. DV-joint instead of V-joint),
several repairs in the same place.

5.7 Traceability

Identification means assigning an individual number (numbering). In the case of issued documents, numbering should include the date of issue and revision.
Traceability is important for the management of documents and records in any quality system.
Traceability concerns:
- Drawings
- Procedures
- Welding procedures
- Welder and welding operator qualifications

- Welding processes
- Inspection certificates (parent materials and consumables)
- Repair locations
- Location of temporary attachments
- Reports (manufacturing data sheets, visual, NDT, non-conformance, calibration, heat treatment)
- Manufacturer’s declaration of the welding activities and organization

The traceability is the link between two actions.
The traceability mainly refers to 3 items:
- Link between the inspection certificate and the plate or sheet metal (up until the cutting operation)
- Link between the inspection certificate and the filler material
- Link between the visual examination and the welder
Other identification and traceability requirements should be defined by the contract.
The extent of traceability depends on the following circumstances:
- Are there any legal requirements regarding the part or component in case of failure?
- EN 15085-4 requires an EN 10204 Type 3.1 inspection certificate for CL 1 and CL 2.
In general, these certification levels correspond to welds with safety categories high and medium. That implies the necessity of traceability in all stages of
manufacturing. For important parts and components, full traceability is useful!

5.8 Declaration of conformity for the part or component

Declaration of conformity is not required by the standard.
If demanded by the customer it can be completed on the bases of
EN ISO/IEC 17050-1, Annex A (informative)
Supplier’s declaration of conformity including
A.1 Guidance to complete the form of declaration of conformity and
A.2 Example of form of declaration of conformity.

6. Interpretation of EN 15085-6

6.1 General

According to the definitions of types of activities, table 2 of EN 15085-2, welding of spare parts and replacement parts is not included in type of activity M.
P for the necessary classification level is sufficient in this case.

A manufacturer with the type of activity M that purchases welded EN 15085 parts also requires type of activity S.
For small manufacturers with the type of activity “M” this means that they shall check whether the manufacturer of the purchased part is in possession of a valid certificate that covers this requirement and they shall check the purchased parts during incoming inspection (see 2.3).

The following variants are permitted within the scope of maintenance welding:

- Welding maintenance measures are also permitted outside the welding manufacturer to establish running capability for transfer purposes in the rails. The responsible ECM specifies the procedures for transfer.

- A welding manufacturer qualified for maintenance welding may perform welding maintenance measures at other production sites (outside of his welding workshop) provided these are agreed contractually or based on ECM/QM instructions. In the verification procedure, the qualified welding manufacturer shall demonstrate that they fulfill the personnel, technical and quality requirements. In the certificate the respective welding workshop is listed as " further welding site for repair " along with its address in the comments section. The audit at these sites should take place once during the period of validity of the certificate.

- Mobile maintenance is handled as "further welding site for mobile repair "; the sites shall be included in the certificate and listed in the comments section.

- Mobile maintenance without naming the sites in the certificate is only possible if an approval procedure by the MCB is agreed in the individual case based on an ECM/QM instruction. The agreement shall be listed in the comments section in the certificate.

6.2 Welding coordination

In addition to the requirements of EN 15085-2, clause 5.3.1, the WC`s shall have experience in maintenance welding. This also applies to manufacturers that create designs for maintenance welding or purchase maintenance welding services.
The additional experience shall be demonstrated with the typical activities of the maintenance manufacturer and level (A, B, or C) according to EN 15085-2, Annex D.

6.3 Restrictions and prohibitions of welding

For maintenance welding the restrictions and prohibitions of welding according to EN 15085-6, clause 4.4, shall be observed.

6.4 Determination of weld performance class

The requirements according to EN 15085-6, clause 5.1, shall be observed when determining the weld performance class.
The determination variants according to EN 15085-6, clause 5.1, are applied:
In general a to f, but mainly c and f.

The combination of high safety category and high stress category is to be avoided. The maintenance design shall be adapted accordingly. If this combination cannot be avoided, EN 15085-6, clause 7.2, is to be observed and the ECM shall approve application of weld performance class CP A.

6.5 Parent metals

The requirements according to EN 15085-6, clause 7.3, shall be considered when selecting parent materials.
For maintenance welding it shall be ensured that for old rail vehicles in particular, the material to be welded on according to CEN ISO/TR 15608 comes from the same material group as the original material and has comparable mechanical and chemical properties as a minimum.

In case, material that tends to aging, welding in cold formed areas should be avoided, see Eurocode 3, Design of steel structures EN 1993-1-8, table 4.2.

7. Normative references

In clause 2 of all parts in the series of standards EN 15085, all dated standards shall be applied and undated standards are informative.
To exclude the possibility of significant changes of referenced standards having an impact on the EN 15085 series, changes to dated standards are reviewed by CEN TC 256/SC 2/WG 31.

8. ZA annexes

Part 2 to 6 of EN 15085 series of standards include an Annex ZA.

Harmonized European Standards (hEN) are standards mandated by the European Commission, prepared by one of the European standardization organizations.
In the case of railway vehicle construction hEN usually are prepared by CEN.
The harmonization applies to the Essential Requirements of EU Directive listed in Annex ZA of the European standard.

The new hEN's are published by means of individual legal acts (einzelner Rechtsakte) published in series L of the Official Journal of the European Union (OJEU) (Amtsblatt der Europäischen Union).
European standards are only finally harmonized when they are published in the Official Journal of the European Union. hEN's are mandatory after a so-called coexistence period.

If part 2 to 6 of EN 15085 series of standards are hEN's a specific guidance on how to proceed with Annex ZA may be required.

9. Abbreviations

AM	Additive manufacturing
DT	Destructive testing
DWC	Deputy WC
ECWRV	European committee for welding of railway vehicles
ECM	Entities in Charge of Maintenance
EWF	European Welding Federation
EN	European Standard
ET	Eddy current Testing
FWC	Further Deputy WC
hEN	Harmonised European Standard
FAI	First article inspection
IIW	International Institute of Welding
MCB	Manufacturer Certification Body
NDT	Non-destructive testing
PAUT	Phased Array Ultrasonic Testing
PT	Penetrant testing
PWHT	Post weld heat treatment
PWT	Production weld test
RT	Radiographic testing
RWC	Responsible welding coordinator
TOFD	Time of Flight Diffraction
VT	Visual testing
WC	Welding coordinator
WPS	Welding procedure specification
WPQR	Welding procedure qualification record