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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (prEN 15085-3:2004) has been prepared by Technical Committee CEN/TC 256 “Railway Applications”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive:

— Council Directive 93/38/EEC of 14 June 1993 coordinating the procurement procedures of entities operating in the water, energy, transport and telecommunications sectors[1])

This series of European Standards prEN 15085 "Railway applications – Welding of railway vehicles and components" consists of the following parts:

— Part 1: General

— Part 2: Quality requirements and certification of welding manufacturer

— Part 3: Design requirements

— Part 4: Production requirements

— Part 5: Inspection, testing and documentation

[1]) Official Journal of the European Communities No L 199 of 9.8.93

Introduction

Welding is an essential process in the manufacture of railway vehicles and their parts. The required provisions for the special process “welding” are laid down in the standards EN ISO 9001 (see [1]) and EN 729 (see [2] to [5]). The basis of these provisions is the basic technical welding standards in respect of the special requirements for the construction of railway vehicles.

This standard is aimed at defining the terms of enforcement applicable to European Standards, it shall not be construed as a substitute to these standards.

This standard can also be used by internal and external parties, including certification bodies, to assess the organisation’s ability to meet customer, regulatory and the organisation’s own requirements.

1 Scope

This document applies within the framework of standard prEN 15085.

As an integral of the above-mentioned standard, its scope covers design and calculation rules applicable to the building and welding repairs of railway vehicles and constituent items thereof.

As regards the welding of metals, acceptance authority prescribe performances applicable to finished weldments; they do not prescribe welding methods. The manufacturer has full freedom to select whichever welding process, consumables and edge preparation he wishes to implement.

However, customers may contractually restrict the use of certain welding processes.

In return, upon customer request, the manufacturer is to demonstrate, in particular through the following, i. e.:

— company qualification,

— welder and welding operator qualification,

— welding process and mock-up qualification,

that they have full control and that the quality level requested by customers will be achieved.

As regards drawings issued prior to this standard, the prescriptions laid down herein may be applied.

The manufacturer shall inform their customers beforehand.

NOTE This standard does not deal with product qualification (refer to other standards for fatigue mock-ups for instance).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1011-1, *Welding – Recommendations for welding of metallic materials – Part 1: General guidance for arc welding.*

EN 1011-2, *Welding – Recommendations for welding of metallic materials – Part 2: Arc welding of ferritic steels.*

EN 1011-3, *Welding – Recommendations for welding of metallic materials – Part 3: Arc welding of stainless steels.*

EN 1011-4, *Welding – Recommendations for welding of metallic materials – Part 4: Arc welding of aluminium and aluminium alloys.*

EN 1011-5, *Welding – Recommendations for welding of metallic materials – Part 5: Welding of clad steel.*

prEN 1011-6, *Welding – Recommendations for welding of metallic materials – Part 6: Laser beam welding.*

prEN 1011-7, *Welding – Recommendations for welding of metallic materials – Part 7: Electron beam welding.*

prEN 1011-8, *Welding – Recommendations for welding of metallic materials – Part 8: Welding of cast irons.*

EN 22553, *Welded, brazed and soldered joints – Symbolic representation on drawings.*

EN ISO 5817, *Welding – Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections (ISO 5817:2003).*

EN ISO 6520-2, *Welding and allied processes – Classification of geometric imperfections in metallic materials – Part 2: Welding with pressure.*

EN ISO 13920, *Welding – General tolerances for welded constructions – Dimensions for lengths and angles, shape and position.*

EN ISO 14273, *Specimen dimensions and procedure for shear testing resistance spot, seam and embossed projection welds (ISO 14273:2000).*

ISO 10042, *Arc-welded joints in aluminium and its weldable alloys – Guidance on quality levels for imperfections.*

ISO 10447, *Welding – Peel and chisel testing of resistance spot, projection and seam welds.*

ISO 15608, *Welding guidelines for a metallic materials grouping system.*

prEN 15085-1:2004, *Railway applications – Welding of railway vehicles and components – Part 1: General.*

prEN 15085-2:2004, *Railway applications – Welding of railway vehicles and components – Part 2: Quality requirements and certification of welding manufacturer.*

prEN 15085-4:2004, *Railway applications – Welding of railway vehicles and components – Part 4: Production requirements.*

prEN 15085-5:2004, *Railway applications – Welding of railway vehicles and components – Part 5: Inspection, testing and documentation.*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in prEN 15085-1:2004 apply.

4 Design requirements

4.1 General

As regards weldments forming an integral part of items of rolling stock, except for specific provisions laid down within the framework of the project or in the product specification, design and requirements shall be defined as follows.

4.2 Joint static sizing

Calculated stresses shall be less than or equal to the admissible limits of the assembly considered which are proposed in the specification or by the manufacturer and accepted by the acceptance authority.

Examples of welding beam static dimensioning: “effective cross-sections a_R” are given in annexes B and C.

Calculation on local areas shall be performed to ensure that the cross section of the weld is both required and sufficient to withstand static stresses.

4.3 Joint fatigue sizing

Joints are selected according to admissible fatigue limits and safety requirements.

The admissible fatigue limits, which are defined by standards, code, methods, guidelines or by stress/cycle diagrams, are proposed in the specification or by the manufacturer and accepted by the acceptance authority.

The reference curve shall either be laid down in specifications or proposed by the manufacturer and approved by the customer. Usually, this curve applies to a given type of joint (butt weld, fillet weld, etc.). The stress to be considered when defining a quality class is the stress that is applied orthogonally to the longitudinal centreline of the weld.

4.4 Stress categories and stress factors

The stress category is determined by the stress factor according to table 1. The stress factor is the ratio of the calculated fatigue stress to the admissible fatigue stress of the joint type, adjusted by the appropriate safety factor. The standard or source of data for the admissible stress is agreed with the acceptance authority. In this connection the European standards for structural requirements of railway vehicles should be considered, e. g. EN 12663, prEN 13749 (see [6] and [7]). In addition to this the application of national standards is also possible.

Alternatively, the admissible fatigue stress can be obtained from fatigue tests on representative joint samples. The statistical evaluation of the fatigue tests should be of a standard agreed with the acceptance authority. In this way the European standards for structural requirements of railway vehicles should be also considered, e. g. EN 12663 (see [6]). Furthermore the application of national standards is also possible.

Table 1 — Stress categories

Stress category	Stress factor (S)		
	Fatigue strength values from calculation standard	Fatigue test values for representative joint sample	
		Option 1	Option 2 [a]
High	≥ 0,9	≥ 0,8	≥ 0,9
Medium	0,75 ≤ S < 0,9	0,5 ≤ S < 0,8	0,75 ≤ S < 0,9
Low	< 0,75	< 0,5	< 0,75

[a] The decisive limiting value should be agreed with customer or acceptance authority.

4.5 Safety categories

The safety category defines the consequences of failure of the single welded joint in respect to the effects on persons, facilities and the environment.

The safety categories are differentiated as follows:

Low: Failure of the welded joint does not lead to any direct impairment of the overall function. Consequential events with personal injuries are unlikely.

Medium: Failure of the welded joint leads to an impairment of the overall function or can lead to consequential events with personal injuries.

High: Failure of the welded joint leads to consequential events with personal injuries and breakdown of the overall function.

4.6 Attributing weld quality classes

Weld quality classes are defined by the designer depending on the status of the welded joints as regard safety requirements and dynamic stress levels.

Hence, welded joints found on items of rolling stock are divided into the following six quality classes A, B, C1, C2, C3 and D given in table 2.

Table 2 — Weld quality classes

Stress categories	Safety categories		
	High	Medium	Low
High	A	B	C2
Medium	B	C2	C3
Low	C1	C3	D

The designer defines the weld quality classes of each individual joint (see annex A); these classes may be validated by the customer's technical department.

If a joint can be inspected during production but cannot be inspected and repaired in service, the quality requirements of this joint shall be those of the next higher inspection class according to table 3.

If the butt weld or T-joints with full penetration cannot be inspected using volumetric control devices during production and in service, the designer shall reduce stress levels (see annex E).

Finishing-up a weld is one of the possible ways which by increasing the admissible fatigue stresses of an assembly may consequently lead to downscaling the weld quality class.

Weld quality classes shall be shown on drawings or laid down in the product specification.

If no reference to the applicable weld quality class is made, class C3 shall be applied.

4.7 Attributing inspection classes

The inspection class applicable to each welded joint is defined depending on the weld quality class defined formerly.

These inspection classes are used to identify the various inspections on the welded joints.

Where a drawing shows no additional information of inspection classes, table 3 shall be applied.

Table 3 — Correpondence between weld quality classes and inspection classes

Weld quality class	Inspection class Minimum requirement
A	I (or 1) [a]
B	II (or 2) [a]
C1	II (or 2) [a]
C2	III (or 3) [a]
C3	IV (or 4) [a]
D	IV (or 4) [a]

[a] In order to allow computer assisted compilation of parts lists, Roman numerals may be replaced by Arabic numerals.

The tests applicable to these inspections classes shall be at minimum the same as described in prEN 15085-5:2004.

If a weld seam cannot be inspected by volumetric control (e. g. fillet welds, T-welds and butt welds with partial penetration, butt welds with full penetration without accessibility for volumetric testing) for the application of quality class A, B and C1 special agreements for inspection are necessary (e. g. surface test).

In special cases additional non-destructive testing may be necessary.

If the relation between weld quality class and inspection class is different of table 3, the inspection class for the welds shall be indicated on the drawings or on attached documents.

If the welds have different weld quality classes the indications should be close to each weld seam.

Additionally the certification/qualification level (level 1 to 4 according to prEN 15085-2:2004) should be identified in the drawings.

NOTE In the case of mechanised welding processes at quality class B the expense of testing can be reduced in arrangement with the acceptance authority.

4.8 Relations between stress category, safety category, weld quality class, imperfection acceptance level, inspection class and testing

For relations between stress and safety category, quality class, imperfection acceptance level, inspection class and testing, a comparison is given in tabe 4.

Table 4 — Comparsion between stress category, safety category, weld quality class, imperfection acceptance level, inspection class and testing

Stress category [a]	Safety category [a]	Quality class [a b c]	Imperfection acceptance level EN ISO 5817 ISO 10042	Inspection class [b]	Volumetric tests RT or UT [d e f]	Surface tests MT or PT [d]	Visual inspection VT [d]
(1)	(2)	(3)		(4)	(5)	(6)	(7)
High	High	A	see table 5 or 6	I	100%	100%	100%
High	Medium	B	B	II	10%	10% [g]	50% [g]
High	Low	C2	C	III	NR [h]	NR	10%
Medium	High	B	B	II	10%	10% [g]	50% [g]
Medium	Medium	C2	C	III	NR	NR	10%
Medium	Low	C3	C	IV	NR	NR	NR
Low	High	C1	C	II	10%	10% [g]	50% [g]
Low	Medium	C3	C	IV	NR	NR	NR
Low	Low	D	D	IV	NR	NR	NR

[a] Columns (1), (2), (3) according to table 2.

[b] Columns (3), (4) according to table 3.

[c] Column (3) according to table 5 and 6.

[d] Columns (5), (6), (7) according to prEN 15085-5:2004, table 1. See also additional notes to table 1.

[e] Volumetric tests only for butt welds and T-welds full penetration. Not applicable for T-welds partial penetration and for fillet welds (see also [8]).

[f] Work tests prior to manufacture required in case of NDT not feasible. In addition to work test, mock-ups during the production required if agreed between customer and manufacturer. For the methods pertaining to the construction, preparation and destructive testing on the work test and on mock-ups according to prEN 15085-4:2004 and according to clause 6.

[g] For fillet welds and T-welds partial penetration in inspection class II and classified C1 on the drawings it is required to extend the percentage of surface test and visual examination to 100%.

[h] not required

5 Weld acceptance criteria

5.1 General

Welding imperfections are defined in accordance with EN ISO 6520-1 (see [9]).

Welding imperfections acceptance criteria according to the applicable quality classes defined herein are listed in table 5 and 6.

5.2 Attributing imperfections acceptance levels

Welding imperfections acceptance levels according to the applicable quality class are listed in table 5 and 6 in accordance with EN ISO 5817 and ISO 10042.