

RAILSAFE

Education, Qualification and Certification

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Industry requirements for a Harmonised System for Education, Qualification and Certification of Railway Track Welders

**Report made after discussions
with 50 railway track welding experts
from seven different European countries**

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RAILSAFE is a LEONARDO DA VINCI Community Vocational Training Action Programme Project

Foreword

On 1 October 2004 a project has started, under the title RAILS SAFE, with the purpose to develop a non-mandatory harmonised system for education, qualification and certification of railway track welders. Draft documents were produced on the performance objectives of welders [1], on welding procedures [2], on a database for certified welders [3] and on a system to operate the system [4]. These draft documents were discussed by 50 railway track welding experts in workshops in Copenhagen, Cambridge, Genova, Hannover and Bratislava. Process suppliers and railway authorities were asked to give their opinion on the draft documents. During the start of the project a draft of a new CEN standard (prEN 14730) became available on the approval of aluminothermic welding processes and on qualification of aluminothermic welders [5]. The comments received during the workshops and during the visits to the process suppliers and railway authorities as well as the emerging standard have led to an adaptation of the originally produced documents. The result is the present document.

Before introducing the new document it is useful to be reminded of the original objectives and aims of the project. RAILS SAFE 's objectives are:

- to have trained and certified railway track welders available for railway companies to assure the quality and reliability of the railway tracks and thus reducing accidents and downtime caused by welding problems,
- to harmonise welding procedures and to harmonise education, qualification and certification to make exchange of welders for national railway authorities and companies in the European Union possible,
- to assure the quality of and access to continuing vocational education and certification for life-long competences and better employability of railway welders across national borders.

These objectives are to be achieved by continuing education and training and qualification and certification of welders, according to a harmonised European guideline, to be developed in the project.

RAILSAFE 's aims are:

- to have a guideline for a harmonised system for education, qualification and certification of railway track welders,
- to have a guideline for specification and approval of welding procedures for track welding in production and for training,
- to have a database of certified railway track welders,
- to have the system verified by pilot courses,
- to have a system to operate the harmonised system,
- to have the results of the project disseminated in Europe.

Part 1 of the present report gives a general description of the education, qualification and certification system. The major change with respect to the first set-up [4] is that it is now proposed to have the system operated by a European Rail Welding Organisation, to be assigned or established by the European rail welding community. The nature of this organisation and its feasibility are still subject of discussion.

Part 2 specifies the performance objectives for the European aluminothermic welder. There are a great number of changes, when compared with [1], based on the comments received. The performance objective part is the basis for the guideline for education, qualification and certification. This guideline will be complementary to the prEN 14730 part 2.

The prEN 14730 part 1 seems to adequately cover the description and approval of welding procedures. Because of this the welding procedure document [2] has been reduced to a Practical Test Specification, which will be an appendix to the guideline for education, qualification and certification and is here shown as Appendix 1.

The Appendix 2 describes the requirements for a database for qualified and certified aluminothermic welders.

The content of prEN 14730-1 and prEN 14730-2 has been considered in detail.

Part 1 of the standard gives details about the requirements and procedures for assessing and approving a specific aluminothermic welding technique for use on the rail infrastructure. It covers standard rail configurations only: welds made between different rail profiles, worn rails and different rail grades are not included. Although attempts were made to draft a guideline for the specification and approval of welding procedures as indicated in the RAILS SAFE project objectives, such a document did not find favour with the experts consulted. It was felt that Part 1 of the standard, together with the aluminothermic welding 'process manuals' produced by the process suppliers, were sufficient. However, the partners are keeping an open mind as to whether something more detailed than the Practical Test Specification shown in Appendix 1 would be useful. For example, a document outlining a standard format of an aluminothermic welding process manual may be of some value.

With regard to Part 2 of the standard, although this describes a framework for the qualification of welders, it is not prescriptive in terms of the content of the training or about the details of the examination. A harmonised guideline on the training and testing of welders, such as that envisaged by RAILS SAFE, could therefore be expected to underpin the standard and add value to it.

Given the above it is believed that full and appropriate account has been taken of the standard in relation to the direction of the RAILS SAFE project.

References:

- [1] Performance Objectives for Railway Track Personnel, RAILS SAFE/GUIDE/PR/IIS/CR/050517/3
- [2] Rail welding – Aluminothermic welding procedure specification, RAILS SAFE/GUIDE/CO/ISQ/JPH/050331/5
- [3] Access Data Base for Welders, RAILS SAFE/GUIDE/PR/EWF/IF/050512/4
- [4] Comparison between the original RAILS SAFE plan and the CEN standard prEN14730-2 on training of aluminothermic railway welders and a proposal for a revised RAILS SAFE plan, RAILS SAFE/LTR/CO/RI/JP/050427/3
- [5] Railway applications - Track - Aluminothermic welding of rails, prEN 14730

When drafting the RAILS SAFE documents, use has been made of an inventory of existing (national) curricula, guidelines, educational products, standards and welding procedures and of statistics on newly made rejected welds.

The referenced RAILS SAFE documents have been reworked into new versions.

Part 1

Education, Qualification and Certification System

1 Overall structure

A European Rail Welding Organisation (to be assigned or established by the European rail welding community) produces special rules for Authorised National Bodies (ANBs) in each country that wish to implement the rail welder training, qualification and certification scheme. These rules would require the ANB to establish a National Rail Welding Specialist Committee for this activity with representatives of the national rail industry sector. The representation on this committee would include:

- rail authorities
- rail welding contractors
- the rail welding process suppliers that are active in the country concerned
- rail welder training organisations.

This rail welding National Rail Welding Specialist Committee would be responsible for the implementation of the scheme at the national level on behalf of the governing board of the ANB.

ANBs assess and approve Approved Training Bodies (ATBs) and the ANB's Authorised Examiners (AE).

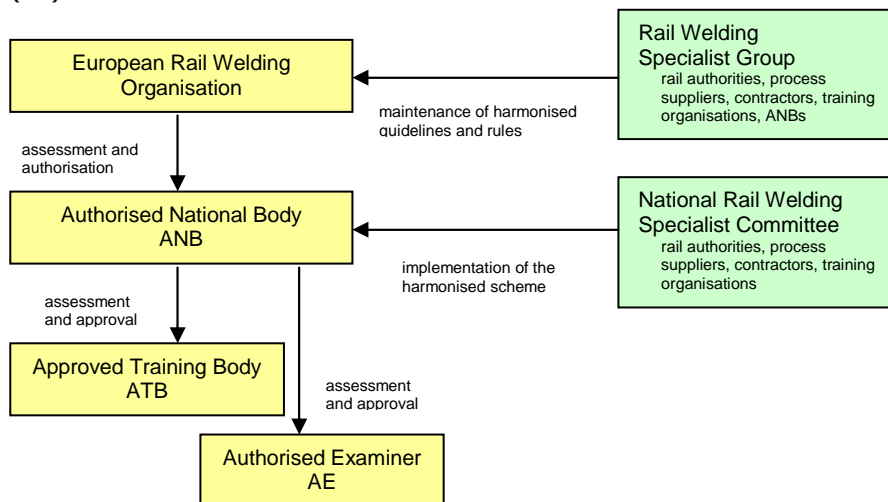


Figure 1 Overall structure of the scheme

A Rail Welding Specialist Group is established on a European level to maintain the harmonised guidelines and rules. The representation on this group would include:

- rail authorities
- rail welding contractors
- rail welding process suppliers
- rail welding training organisations
- ANBs.

The harmonised system provides for theoretical education and training of aluminothermic welders, their examination, issue of a life-long Diploma and Certificates with limited time validity.

Qualification, resulting in the issue of a Diploma, requires theoretical education, practical training and theoretical and practical examination.

Certification requires qualification as above plus track welding experience.

The theoretical education and examination for a Diploma is generic and the practical training and examination for a Diploma is process specific. After passing the examinations the welder will receive a generic Diploma valid his/her whole life.

Diploma holders are required to demonstrate a one year period of supervised, documented and satisfactory experience to receive a Certificate, which is process specific. This applies to the Certificate of the process in which the welder has been trained for the Diploma as well as to additional Certificates in other processes. To get a certificate in other processes, the welder must also undergo practical training in that process.

Certificates are valid for two years. In order to renew a Certificate for another two-year period, holders are required to demonstrate supervised, documented and satisfactory experience in the process for which the certificate was awarded during the period of validity of the certificate.

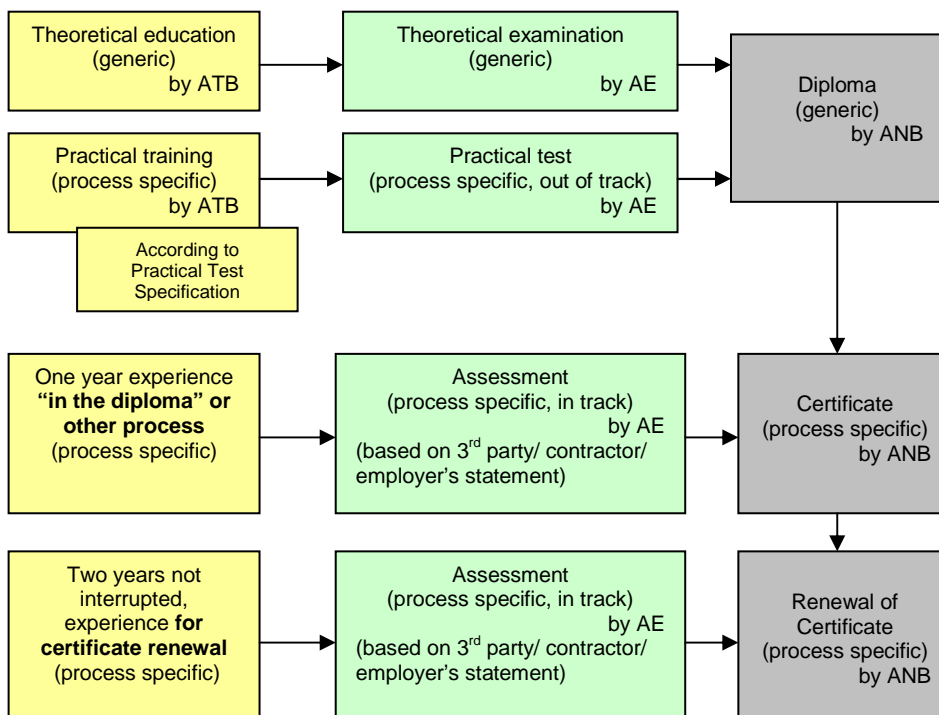


Figure 2 Overall structure of education, training, qualification and certification

2 Responsibility for education and training for a Diploma

Education and training of aluminothermic welders is by ATBs, approved by the ANB through the ANB's National Rail Welding Specialist Committee.

3 Scope/content of education and training for a Diploma

Theoretical education and practical training according to a curriculum Guideline "Minimum Requirements for the Education, Training, Qualification and Certification of a European Aluminothermic Welder", incorporating those of and approved by process suppliers.

The order of theoretical education and practical training is to the discretion of the ATB.

4 Responsibility for examination for a Diploma

Theoretical and practical examination of welders is by ANB's Authorised Examiners.

The theoretical examination is according the Examination Question Database.

The practical examination is according the Practical Test Specification, which is specific for each aluminothermic process/ process supplier.

5 Responsibility for issuing qualification (Diploma)

European Qualification (generic Diploma) is issued under ANB's responsibility.

6 Requirements for Certification

For a Certificate in any process the Diploma holder is required to demonstrate a minimum period of one year of supervised, documented and satisfactory experience in that process with a minimum of 50 welds per year (number subject to discussion).

For prolongation of their Certificate after it has been expired, Certificate holders are required to demonstrate a 2 year period of supervised, documented and satisfactory experience with a minimum of 50 welds per year (number subject to discussion) and with no interruption of work longer than a period of 6 months (number subject to discussion).

Evaluation of the supervised, documented and satisfactory experience is by ANB's Authorised Examiners, based on a 3rd party/ contractor/ employer's statement specifying process and inspection reports on made (including rejected) welds.

Note: The Certificate is not a Permit to Weld, but railway authorities may use a Certificate as a basis for issuing a Permit to Weld.

7 Responsibility for certification

European Certification (process specific Certificate) is issued under ANB's responsibility.

8 Administration of database of qualified and certified welders

Qualified and certified welders in a database by ANBs.

9 Transition arrangements

Diploma's (with accompanying Certificate) can be issued by ANBs to existing trained, qualified and practising welders under transition arrangements, open for 3 years.

Observations

- 1 This general description of the harmonised system could be part of a future standard or could be referenced in a future revision of the present standard. The curriculum Guideline for education, training, qualification and certification should be a separate document to keep it flexible.
- 2 The European Rail Welding Organisation, which has to assigned or established by the European rail welding community, could copy the current European education, qualification and certification system in use by the European Welding Federation (EWF) for conventional welding personnel or could ask EWF to perform the organisational and administrative work.
- 3 Although the project outcome will interfere with the complex existing systems for certification and permits to weld, which vary from country to country and contractor to contractor and although there is strong reluctance of process suppliers and railway authorities to "submit" to a central third party authority, one of the three RAILS SAFE objectives is "continuing education", the project should contain certification. Moreover, during the workshops no comments have been received, which suggested deleting the certification.
- 4 Although the need for a central European database is questioned, one of the deliverables of the project is such a database. A database will therefore be developed, which can be used by authorities, companies and organisations, who do want it.
- 5 The proposed system accommodates the diploma issuing part of EN 14730-2.

- 6 It is believed that many countries in Europe do not have a nationally harmonised system for rail welder training. Therefore it is likely that differences will exist in the competence of welders within, as well as across, national boundaries. The RAILS SAFE project will simultaneously bring about national and European harmonisation.
- 7 It has taken a considerable amount of work within CEN to reach a consensus on the qualification requirements for aluminothermic welders of railway tracks.
Even so, the current draft standards do not specify in detail the level of training or competence of welders, they mainly indicate who is responsible for doing what. The outcomes of RAILS SAFE will include unified performance objectives for welders, and guidelines on education and training to achieve those objectives. Because of differences from country to country, this will not be an easy task. However, the value of success is considerable: a European benchmark for effective implementation of the new standards when they are published.
- 8 A document will be needed covering the rules for implementation of the system.

Part 2 Performance objectives for European Aluminothermic Welders

1 Performance objectives

Performance objectives are statements which identify the specific knowledge and skills the person should gain and display as a result of his/her education and training.

The performance objectives in this document have been developed to provide a common basis for education, qualification and certification, recognised throughout Europe, for persons wishing to be qualified and certified "European Aluminothermic Welder" (EAW), on railway tracks.

The performance objectives, comprising theoretical and practical parts, are given in terms of "expected results".

The performance objectives will lead to a guideline for "Minimum Requirements for the Education, Training, Qualification and Certification of a European Aluminothermic Welder".

2 Education and training

2.1 Course content

The performance objectives are divided in several parts, as shown in table 1.

Anticipating the guideline, the minimum hours for theoretical education and the average number of practical training are shown in this document.

The applicant is required to attend a training course giving, as a minimum, the hours of theoretical instruction shown in table 1, "recommended teaching hours" for module I.

Module	Sub Module	Recommended teaching hours
I. Theoretical education	1. Materials and their behaviour during welding	8
	2. Welding Processes and Equipment	24
	3. Fabrication, Applications Engineering	8
	Total Module I	40
II. Practical training	1. Aluminothermic welding	64
	2. Ancillary activities	16
	Total Module II	80
Total Course		120

Table 1 - Parts composing the training course

The recommended periods of time given in table 1 referenced as module II (practical training) represent the average time required attaining the expected level of skill, and can be changed depending on applicant's skill and/or attitude, subject to evaluation of the trainers.

Although the theoretical part of the course covers the different proprietary aluminothermic welding process variants, it is intended that the bulk of the training will be on one process variant, to be selected by the student or employer.

A "teaching hour" shall contain at least 50 minutes of direct teaching time. Free choice in the arrangement of the syllabus is permitted.

The order of theoretical education and practical training is of the discretion of the training establishment.

2.2 Minimum requirements for the education and training

In the following paragraphs the minimum requirements for education and training courses are given, with the indication of teaching hours, making particular reference to the 'expected results' (welder performance objectives).

The scope and the objectives of each item will be added later when the expected results have been agreed.

	EAW
Module I – Theoretical education	40
I.1 Materials and their behaviour during welding	8
<u>I.1.1 Basics of metallurgy</u>	4
<i>Expected results</i>	
1. Describe properties of rail steel	
2. Evaluate the effects of cooling rate	
3. Interpret mechanical properties	
<u>I.1.2 Welding metallurgy and structure of welded joints</u>	2
<i>Expected results</i>	
1. Understand the effect of the heat input on the weld metallurgy	
2. Describe the different regions constituting a weld	
3. Identify the effects of the welding parameters on the thermal cycle	
<u>I.1.3 Rails</u>	2
<i>Expected results</i>	
1. Compare different types of rail steels	
2. Appraise the susceptibility to cracking by reference to chemical composition of steels	
3. Identify welding procedures depending on different factors affecting weldability	
4. Identify rail profiles and grades	
I.2 Welding processes and equipment	24
<u>I.2.1 Principles of Aluminothermic welding</u>	2
<i>Expected results</i>	
1. Understand the base materials, equipment, plant and consumables used in aluminothermic welding	
2. Understand given standards for consumables	
<u>I.2.2 Aluminothermic welding process application</u>	4

Expected results

1. Identify correct equipment, consumables, parameters and procedures for the execution of both normal and wide gap welds
2. Appraise the susceptibility to welding defects and the influence of operative and metallurgical factors
3. Know how to use and care for the equipment and accessories
4. Outline the different process variants (from different process suppliers) and techniques (e.g. two piece moulds, three piece moulds, etc)
5. Care for the equipment and accessories

I.2.3 Cutting processes for rails

4

Expected results

1. Recognise gas equipment and explain the principle of oxy-fuel cutting
2. Know how to use (including assembly, testing, lighting up and closing down), and care for, the equipment and accessories
3. Limitations of oxy-fuel cutting
4. Compare mechanical and oxy- fuel cutting

I.2.4 Grinding of completed welds

2

Expected results

1. Select correct equipment and grinding material
2. Understand working temperatures
3. Identify the correct tolerances to be achieved

I.2.5 Welding defects and imperfections

2

Expected results

1. Understand common types of welding defects and imperfections and their causes, e.g. mould off centre, stresses in track, preheating offset, sand inclusions, moisture
2. Understand and apply defect acceptance criteria

I.2.6 Practice and application of aluminothermic welding processes

10

Expected results

1. Identify components and equipment for all the welding and related processes
2. Identify good and bad practices in welding and in storage and transportation of welding and related equipment

I.2.7 Arc welding application for repair and building up of rail

0

These subjects are not part of the teaching, but should be included in the handout material

1. Evaluate correct parameters and establish procedures for the execution of welds
2. Appraise the susceptibility to welding defects and the influence of operative and metallurgical factors
3. Care for the equipment and accessories

I.2.8 Other joining processes

0

These subjects are not part of the teaching, but should be included in the handout material

1. Explain principle and field of application for each process (e.g. enclosed arc welding, flash butt welding, gas pressure welding)
2. Compare different processes in use for rail track welding

I.3 Fabrication, Applications engineering 8**I.3.1 Health and safety 4***Expected results*

1. Describe the risks associated with welding processes and equipment, including transportation of gases and other consumables in accordance with regulations and published guidance documents.
2. Interpret Health and Safety regulations with respect to the above hazards.
3. Understand risk and risk assessments associated with welding operations.
4. Describe safe working procedures to ensure the requirements are met.
5. Correctly use protection devices
6. Recognise and have an understanding of the relevant safety documentation
7. Understanding measures of prevention of fire, environmental pollution

I.3.2 Fabrication of rail tracks 4*Expected results*

1. Describe the phases of rail track construction, including rail tensioning
2. Know and interpret the relevant rail fabrication standards, specifications and documents.
3. Correctly describe measures of thermal deformation control in welding
4. Understand marking systems for rails and welds
5. Identify actions to be taken after rejections of welds
6. Understand the documentation to be completed by the welders

Module II – Practical education¹ 80**II.1.1 Aluminothermic welding 64***Expected results*

1. Competent and full execution of an aluminothermic rail weld; including:
 - Prepare and dry the crucible
 - Select the correct portion
 - Ensure correct rail end preparation and condition, and align the rails
 - Understand alignment requirements.
 - Understand the need for, and correctly apply, datum marks
 - Select and attach the support equipment and align the preheater
 - Select and modify moulds
 - Fit and lute moulds
 - Align and charge the crucible and attach remaining equipment
 - Set pressures and flame conditions
 - Eliminate moisture from support equipment prior to welding
 - Preheat rail ends
 - Ignite portion, cast the weld, remove support equipment, trim weld, note timings
 - Produce a simple weld between two new rails of the same profile
 - Produce a weld between rails of dissimilar wear
 - Produce standard gap and wide gap welds
 - Produce a weld using three piece moulds
 - Produce a composite weld (two different rail profiles)
 - Identify pour irregularities and take appropriate remedial action

¹ In the following paragraphs the items to be covered in the practical training are given. The typical training time is reported, assumed as average teaching hours to be spent on every item, however subject to evaluation by the trainers, taking into consideration applicants skill and experience

- Identify correct procedure for removal of waste material and hot material
 - Reinstall track fastenings, remove runners and risers, clean the weld, clear and tidy the site, store equipment correctly
2. Interpret good practice in the execution of welds
 3. Correct use of ancillary equipment.

II.1.2 Ancillary activities

16

Expected results

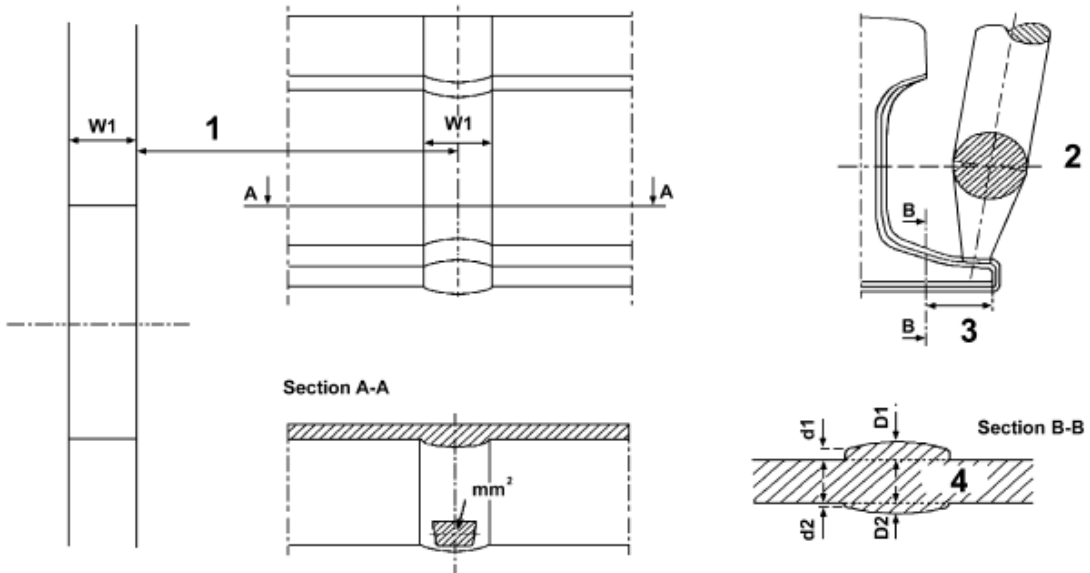
1. Execution of ancillary activities, including:
 - Clean rails ends, prior to producing the weld gap, remove ballast/fastenings
 - Prepare a welding gap using mechanical methods
 - Prepare a welding gap using a cutting torch
 - Select, inspect and mount abrasive wheels safely and correctly
 - Operate the abrasive wheel cutting machine safely
 - Correctly assemble a set of tensors around the weld joint
 - Use heating equipment for keeping a neutral temperature
 - Carry out all pre-start checks on the rail grinding machine and to understand correct use
 - Grind welds to the required standard
 - Verify track alignment and weld geometry after welding and grinding
 - To visually inspect the weld before leaving site.
 - To complete all necessary documentation before leaving site

Appendix 1

Practical Test Specification (PTS) form

1. GENERAL			
PTS reference number			
Welding process supplier			
Type of weld			
2. WORK DESCRIPTION			
Rail profile/ rail head wear differences			
Material / Standard designation		welded to	
(EN 13674-1) Group		welded to	
(EN 13674-1) Profile		welded to	
3. CONSUMABLES			
Kit reference (process supplier and designation)			
Designation/ Reference No.	Portion	Moulds	Crucible
4. JOINT DETAILS			
Rail end preparation/cutting method			
Joint relevant dimensions to be achieved before welding			
Vertical alignment (mm)		Sketch area	
Horizontal alignment (mm)			
Nominal welding gap (mm)			
Requirements for datum marking			
Requirements on mould adjustments			
5. WELD DETAILS			
Heating equipment			
Pre-heating gas pressure			
Temperature / time			
Length from weld face to be pre-heated			
Critical process timings / temperatures			
Time / temperature from ignition to tap			
Rate of cooling or time/temperature until mould removal			
Time/temperature before course grinding			
PTS ref.:	Date:	Approved by:	Page No. 1 of 2

Practical Test Specification (PTS) form

Stripping			
Mould removing instructions			
Equipment			
Method description			
Final Grinding			
Equipment			
Method description			
Maximum grinding length (mm)			
Finished profile requirements			
6. WELD COLLAR / INTERNAL MOULD GEOMETRY (drawing is from prEN 14730)			
Weld collar width (W1)			
Maximum collar depths at section B-B (D1 and D2)			
Minimum collar depths at section B-B (d1 and d2)			
			
7. ACCEPTANCE REQUIREMENTS			
Geometry			
Visible defects			
Misalignment			
Surface quality			
PTS ref.:	Date:	Approved by:	Page No. 2 of 2

Note: It will be necessary to specify the procedure for carrying out the practical test including an indication of the criticality in terms of competence in each element of the test

Appendix 2

Database requirements for Qualified and Certified European Aluminothermic Welders

The requirements for the database are:

- 1 A web-based database. Access to be discussed
- 2 Data supplied by ATBs and inserted by ANBs.
- 3 Data is based on one life-long European Aluminothermic Welder Diploma and one or more Certificates with limited time validity issued to the welder.

The Diploma contains:

- name
- date of birth/ or other identification number
- issue date
- Diploma number
- reference to the Guideline
- reference to the "Practical Test Specification"

The Certificates contain:

- name
 - date of birth/ or other identification number
 - issue date
 - expiration date
 - Certificate number
 - company/employer
 - process, rail grade and profile used for practical test used for in-track assessment prolongations, including date of issue and expiration
- 4 Database contains all data of Diploma and Certificates as well as PDF files of Practical Test Specification, PDF file of Diploma and Certificate and supporting document of issuing and prolongation.
 - 5 Welder/employer agrees (or not) to data kept in database.

Observations

- 1 Provides visible verification of a welder's generic competence in accordance with harmonised European guidelines.
- 2 The database could be developed further in future to deal with permits to weld.
- 3 European diplomas, certificates and a database for rail welders increase the feeling of professionalism of welders.
- 4 The welder's passport is a virtual passport, in the database.
- 5 Maintenance of the database is critical and will need to be considered in more detail.
- 6 It may be desirable in future to include performance data on each weld, e.g. percentage of rejected welds. However this is outside the scope of the current project.