

EWF Guideline EUROPEAN WELDING PRACTITIONER FOR RESISTANCE WELDING



Minimum Requirements for the Education, Examination and Qualification



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MINIMUM REQUIREMENTS FOR THE EDUCATION, TRAINING, EXAMINATION AND QUALIFICATION

European Welding Practitioner for Resistance Welding EWP-RW

Prepared and issued by EWF- European Federation for Welding, Joining and Cutting

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Minimum Requirements for the Education, Training, Examination and Qualification of European Welding Practitioner For Resistance Welding

The use of this guideline is restricted to organizations approved by the Authorized National Body (ANB).

Introduction

This guideline for the European education and training of Welding Practitioners for resistance welding has been prepared, evaluated and formulated by members of the Technical Committee of EWF.

It is designed to provide the basic core education in resistance welding as required by resistance welding personnel who is active in job functions in accordance to EN ISO 14 554 - 1 (chapter 6.3), technical sales etc.

The education and training covers the elementary knowledge that is needed in a wide range of the job functions in resistance welding e.g. weld setter, instructor, inspector, supervisor, foreman, constructor and technical sales personnel.

European Resistance Welding Practitioner may also be a relevant qualification for people whose job is to assist responsible Resistance Welding Coordinators in accordance to EN ISO 14554-1 (chapter 6.4) in manufacturing companies.

Additional training and/or experience relevant to the specific job function may be required beyond the ERWP education. Additional training programmes will be established as required to meet this need.

The guideline covers the minimum requirements for education and training which is related to resistance welding within EWF, in terms of themes, keywords and recommended times devoted to them.

It will be revised periodically by the Technical Committee of the EWF taking into account any changes that may effect the “state of the art”.

A subsequent section II covers examination and qualification.

The contents are given in the following structure:

Theoretical Education (Part I and Part III) teaching hours

1. Resistance welding processes and equipment	10,5
2. Materials and their behaviour during resistance welding	4,0
3. Construction and design	0,0
4. Fabrication, applications engineering	4,0
	<u>18,5</u>

Practical Part II	16,5
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Examination (oral, written and practical)	4
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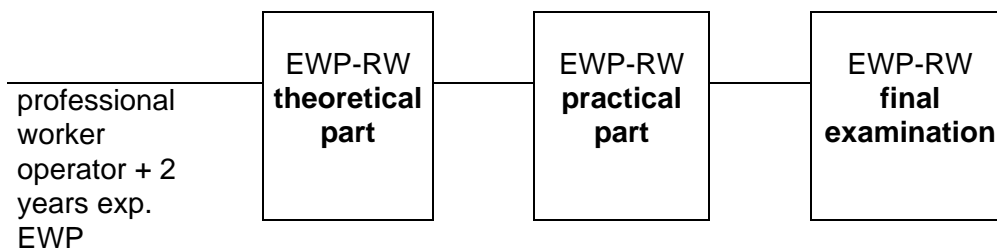
total: 40

A teaching hour will contain at least 50 minutes of direct teaching time.

It is not obligatory to follow exactly the order of the topics given in this guideline. It exists the choice in arrangement of the syllabus by the authorised training body (ATB).

The depth to which each topic is dealt with is indicated by the objectives and the number of hours allocated to it in the guideline. This will be reflected in the scope and depth of the examination to meet the required result.

Route to Qualification



Access Conditions

The minimum requirements for a candidate are at least:

Minimum age of 18 years and a qualified as

- ◆ Professional worker (with certificate after examination) in metal working profession
- or
- ◆ Operator with an experience of 2 years in resistance welding (to be affirmed by his company)
- or
- ◆ Foreman
- or
- ◆ EWP

Section I: Theoretical and Practical Education EWP-RW I and EWP-RW II

I.1 Theoretical Education EWP-RW I

1. Resistance Welding processes and equipment teaching hours

1.1 General introduction to resistance welding technology 1

Objective:

Understand the resistance welding processes including accepted terminology, standards and abbreviations.

Scope:

Definitions and terminology
Schematic presentation of resistance welding processes
(spot welding, seam welding, projection welding, pressure butt welding, flash butt welding)
Mechanical joining processes
General applications for resistance welding processes
Abbreviations for welding processes (international and national standards)

Expected Results:

Detail the differences between each type of resistance welding
Differentiate between processes with reference to standards
Recognise a welding process by the common abbreviation
Explain the principle of the different resistance welding processes and their range of application

1.2 Electrotechnics, a review 1

Objective:

Understand the basics of electricity and electronic components used in resistance welding power sources

Scope:

Basics of electricity and electronics (what is current, voltage and resistance)
Ohm's Law
Electric circuit
Direct current (DC), polarity, alternating current (AC)
Effects of the electric current
Technical power sources
Conductivity
Effective value
Current density
Joule's law
electrical work

Expected Results:

Explain current, voltage and electrical resistance
Discuss competently the differences between AC and DC current
Interpret and apply knowledge of electricity and electronics to welding applications

1.3 Electrotechnics of resistance welding processes

1**Objective:**

Understand in detail the special electrical effects that are influencing the resistance welding process and manufacture

Scope:

Parallel and series circuits
Transformer, tap setting
Heat losses, Cooling
Secondary circuit impedance
Taking measurements of electrical parameters

Expected Results:

Explain influences of the various items on the welding process
Discuss the selection of appropriate devices for measuring different parameters

1.4 Characteristics of resistance welding machines

1**Objective:**

Understand in detail the components and operation of resistance welding machines

Scope:

Definitions according to ISO 669
Characteristic values of the mechanical, electric and operative parts
Selection criteria

Expected Results:

Explain the components of a common resistance welding machine
Explain influences of the various items on the welding process
Discuss and compare different types of machines

1.5 Weld controllers for resistance welding machines

1**Objective:**

Understand in detail the characteristics and components of weld controllers

Scope:

Power stage: cooling, current adjustment
Control unit: basic functions, timer functions, pressure control, control parameters, programs, modes of operation, input/output, multi-program control, constant current, special functions, types of power sources, symbols, set up and program input

Expected Results:

Explain the components of a controller for resistance welding
Discuss the differences between various types

1.6 Resistance welding electrodes

1,5**Objective:**

Understand in detail the differences between electrode materials and electrode shapes

Scope:

Functions, requirements
Electrode materials
Electrode geometry

Cooling
Electrode pick-up
Typical defects
Rework, Tip dressing
Time of replacement
Electrode life
Selection of electrodes
Standards review

Expected Results:

Explain the differences between electrode materials
Interpret standards for resistance welding electrodes
Discuss selection of electrodes and lifetime criteria

1.7 Spot welding

2

Objective:

Understand in detail the resistance spot welding process

Scope:

Procedural principle
Range of application
Requirements on welded joints
Preparation of material to be welded
Influencing variables
Special requirements on the electrodes
Welding parameters
Setting of the parameters following standard values and adjustment tests
Influence of electrode wear
Interfering influences

Expected Results:

Explain in detail the principle of resistance spot welding
Discuss various types of spot welding processes
Detail parameters to be used for different materials
Interpret appropriate standards and parameter tables

1.8 Projection welding

1

Objective:

Understand in detail the projection welding process

Scope:

Procedural principle
Range of application
Requirements on welded joints
Preparation of material to be welded
Types of projections
Geometry of projections
Influencing variables
Special requirements on the electrodes
Welding parameters
Setting of the parameters following standard values and adjustment tests
Interfering influences

Expected Results:

Explain in detail the principle of projection welding
Discuss various types of the projection welding processes
Detail parameters to be used for different materials and projections
Interpret appropriate standards and parameter tables

1.9 Roller Seam Welding**1****Objective:**

Understand in detail the roller seam welding process

Scope:

Procedural principle
Range of application
Requirements on welded joints
Preparation of material to be welded
Special requirements on the Electrodes
Welding parameters
Current programs
Welding speed
Setting of the parameters following standard values and adjustment tests
Interfering influences
types of seam welding machines

Expected Results:

Explain in detail the principle of resistance seam welding
Discuss various types of resistance seam welding processes
Detail parameters to be used for different materials
Interpret appropriate standards and parameter tables

1.10 Fully mechanized resistance welding processes with robotics and other equipment 0

Total hours (1): 10,5

2. Materials and their behaviour during resistance welding teaching hours

2.1 Materials 1

Objective:

Understand the principles of manufacture and designation of steel and aluminium

Scope:

Classification and properties of metals
designation of steel materials and treatment conditions
Alloyed and unalloyed steel
Aluminium
High strength steel
Change of properties as a result of resistance welding
Material related imperfections

Expected Results:

Explain different types of steel materials
Explain different types of coatings and their properties
Explain the designation of steels

2.2 Weldability of steel 1

Objective:

Understand the influence of steel materials on their weldability

Scope:

Material types and properties
Melting and solidification of weld nuggets
Weldability
Pretreatment
imperfections (cracking, porosity, spatter...)

Expected Results:

Explain basic influences on the weldability
Discuss the weldability of different materials
Discuss reasons for problems that might occur when welding specific materials
Interpret Standards and parameter tables

2.3 Weldability of coated Steel 1

Objective:

Understand in detail the different types of coated steel materials and their weldability

Scope:

Range of application
Types of coating
Weldability compared to uncoated material
Electrode pick-up
Electrode life
Scatter of strengths
Quality of the welded joint

Welding parameters
Standards review, parameter tables

Expected Results:

Explain the different types of coatings commonly used
Discuss the effect of specific coatings on the weldability and electrode life
Interpret Standards and parameter tables

2.4 Weldability of aluminium and aluminium alloys

1

Objective:

Understand in detail the metallurgy and weldability of aluminium and aluminium alloys

Scope:

Material types and their properties
Weldability of different aluminium alloys
Surface condition and pre-treatment
Electrode pick-up
Welding machines
Current and force programs
Welding parameters
Spot, projection and roller seam welding
Standards review, parameter tables

Expected Results:

Explain different types of aluminium alloys
Discuss the weldability of different alloys
Interpret Standards and parameter tables

Total hours (2): 4

3. Construction and design

0

Total hours (3): 0

4. Fabrication, application engineering teaching hours

4.1 Introduction to quality assurance in resistance welded constructions 0

4.2 Quality control during manufacture 2

Objective:

Understand in detail the requirements and function of Quality Control during manufacture

Scope:

Destructive and non destructive testing methods 1

General review (standard CEN/ISO)

imperfections

visual test

shop tests

laboratory tests

metallographic examination

non destructive testing methods

Documentation 0,5

test protocol

welding instructions

data sheet (welding parameters)

failure report

Maintenance 0,5

Mechanical: electrodes, devices, tools, lubrication

Electrical: contact surfaces, secondary connecting cables, insulation (secondary circuit only)

Cooling: flow rate, water temperature

Compressed air: air filters, silencer, pressure control, air lubricator, water separator

Maintenance examples, maintenance schedules

Expected Results:

Explain in detail the different methods for assessing the weld quality

Discuss the different methods

Selection of the appropriate method for the given parts

Explain in detail the purpose of a WPS and the main advantages to the quality of welded fabrication

Explain the different parts of the device to be maintained

Interpretation and use of Standards

4.3 Machines, resistance welding jigs and fixtures 1

Objective:

Understand in detail the need for and function of auxiliary equipment, jigs and fixtures, around the welding machine

Scope:

Manual and automatic clamping devices

Checking dimensions and condition of electrodes

Functionality and safety check of transport equipment, lifters, tool and/or device exchange systems, guiding slides, couplings and connected secondary contacts of change devices, e.g. rotary indexing machines

Final evaluation of the assembled structure for its dimensions and specific spot weld quality

Expected Results:

Explain the use of welding jigs and fixtures

Discuss the parts to be checked and adjusted

Interpretation and use of standards

4.4 Health and safety

1

Objective:

Understand in detail the health and safety hazards associated with resistance welding in fabrication processes

Scope:

Accident prevention

Regulations

Instructions

Danger and protective measures: electrical, mechanical, noise, gases, fumes, hazardous materials, standardised safety equipment, safety requirements, responsibilities, procedures. Personal protective equipment.

Expected Results:

Explain the risks associated with welding from electricity, gases, fumes, fire, expulsions and noise

Interpret Health and safety regulations with respect to the above hazards

Produce safe working procedures to ensure the requirements are met

4.5 Economics

0

4.6 Installation of resistance welding machines

0

Total hours (4): 4

Total hours Theoretical part I: 18,5

I.2 Practical Part II

teaching hours

1. Spot welding

3

Selection and set-up of electrodes

Set-up of welding parameters: according to standard values and based on test experience
optimisation of the weld quality

Limiting values: stuck weld condition, expulsion limit

Shunting effect: due to technical reasons, avoidable shunts

Window effect: influences by size of secondary window and magnetizable material

Influence of workpiece geometry: test strip, flange width, fit-up

Imperfections: causes for imperfections and corrective actions

2. Projection welding

2

Selection and set-up of electrodes

Set-up of welding parameters: according to standard values and based on test experience
optimisation of the weld quality

Deformation of projections under load

Imperfections: causes for imperfections and corrective measures

Types of current, current distribution

3. Roller Seam welding

1

Selection and set-up of electrodes

Set-up of welding parameters: according to standard values and based on test experience
optimisation of the weld quality

Current programs and welding speed

Imperfections: Reasons for imperfections and corrective measures

4. Measurement, control and recording in resistance welding

1

Geometry of secondary circuit and value of the achievable weld current

Weld current measurements: measurement methods, effective value, peak value, measurement of rectified current

Measurement of electrode force (static values and dynamic curve)

Temperature measurements of the cooling water

5. Resistance welding electrodes

2

Selection and check of the geometry

Check of the cooling circuit

Effects of defective electrode cooling

Defects as a result of inappropriate selection of electrode geometry and material

Defects caused by electrode wear (enlargement of contact area)

Electrode pick-up

Overheating and deformation of welded material

Rework, tip dressing

Time for exchange or rework

6.	<u>Resistance welding of surface refined sheet metal panels</u>	2
	Welding of materials with different coating and different thickness (spot, projection and seam welding) Set-up of the parameters using standard values Optimisation of the welding parameters Electrode pick up, electrode life Scatter of strengths	
7.	<u>Resistance welding of aluminium and aluminium alloys</u>	2
	Welding of aluminium materials, different surface pre-treatment Application of current/force programs Welding with AC and DC Influence of electrodes (material and shape) Demonstrating the behaviour in the cases of spot, seam and projection welding	
8.	<u>Weld controller</u>	1,5
	Program-input (analogue and digital timers) Multi-program controls Constant current control Stepper-programming	
9.	<u>Devices and fixtures, mechanization and robotics</u>	0
10.	<u>Quality control</u>	2
	Visual inspection Measurement of geometry Workshop testing methods Laboratory testing methods (demonstration) Non-destructive testing methods (demonstration) Metallographic tests (demonstration) Evaluation and documentation of test results	
11.	<u>Demonstration of other processes</u>	1
	Pressure butt welding Flash butt welding Stud welding (DS and TS) Mechanical joining processes	
<u>Total hours practical part II: 18</u>		

Section II: Examination and Qualification

1. Introduction

The Guideline seeks to achieve harmonisation and common standards in the training, qualification of professional welding experts in resistance welding in Europe as required in European Standard EN ISO 14554-1(Chapter 6.3).

The national welding organisations, being members of EWF, mutually acknowledge the Diploma awarded in any Member State to experts in Resistance Welding, following examination conducted in accordance with this Guideline.

Education must have followed this EWF guideline „European Welding Practitioner for Resistance Welding“ and the examination must have been conducted by the national body authorised by EWF for this purpose.

2. Approval of the course

Any training course leading to the EWF examination must be approved by the ANB. The number of teachers required to give the course shall be sufficient to insure that the essential specialist knowledge and industrial experience to cover the syllabus is adequately represented in the team of teachers and visiting lecturers. Standard requirements are documented in Doc. IAB-001. Special requirements are defined in Appendix A of this guideline.

3. Board of Examiners

The Authorised National Body shall nominate the Chairman and the members of the Board of Examiners. The examining board shall consist of:

- a) The Chairman, who shall be representative of the Authorised National Body, and he shall be independent from the training school;
- b) Main teacher(s) of the subjects;
- c) Experts from industry

The responsibilities of the Board of Examiners are:

- a) Organise the examination
- b) Set the examination question (written and oral)
- c) Conduct and mark the written and oral examinations
- d) Decide on borderline results

4. Admission to the examination

Admission to the examination leading to the award of the qualification will be restricted to those who

- a) comply with the minimum requirements specified in the access conditions
 - b) have attended at least 90% of the course, approved by the ANB according to this guideline.
- Exceptions are at the discretion of the Board of Examiners.

5. Examination procedures

The examination procedures described below are designed to simulate the different situations of a welding expert in resistance welding active in industry. The examination shall cover all topics in this Guideline.

5.1 Written examination

At the discretion of the Board of Examiners the examination shall consist of:

- a) A series of essay questions covering the whole field of the subject
- or
- b) A series of multiple choice questions covering the whole field of the subject,
- or
- c) A combination of a) and b) with equal marks allocated to each type.

The time devoted to the written examination shall be a minimum of 1 hour.

5.2 Oral examination

The oral examination will be optional at the discretion of the board of examiners except in borderline cases where it will be mandatory.

5.3 Practical examination

The time dedicated to the practical examination shall be a minimum of 3 hours, approximately 1 hour per process (see in appendix B).

6. Evaluation of performance

In order to pass the examination candidates must achieve at least 60% of the maximum possible mark in both written and practical examination.

7. Re-examination and appeals procedure

Re-examination and appeals are covered by Doc. IAB-001.

8. Diploma

After successful examination a Diploma is awarded to the candidate by the ANB.

Those, who qualified as “European Welding Practitioner For Resistance Welding”, may use the professional designation EWP-RW.

Appendix A:

1. Resistance Welding Equipment

Equipment for the following processes must be available for practical exercises in sufficient number

- ◆ Spot welding
- ◆ Projection welding
- ◆ Roller Seam welding

The maximum size of study group shall not exceed 4 persons per welding machine.

Further processes covered by the syllabus may be shown by means of demonstrations or video presentations.

2. Other equipment

Mechanical testing must, metallurgical examination and NDT equipment should be available for both demonstration and laboratory work purposes.

3. Specimens

A reference collection of well documented weld specimens, polished and etched, should reflect the processes covered by the Guideline and, as a minimum, one specimen per process is required. Preferably the specimens should cover a number of materials and thicknesses.

Appendix B: Practical Examination

No.:	Process	Examination subjects	Approval standard
1	Resistance spot welding	Straight line spot welding according to specifications in a manufacturing drawing selection of electrodes, set-up of the welding machine and welding parameters based on a) test experience b) tables of standard values including optimization of welding parameters, measurement of welding parameters, checking and evaluation of the weld quality (strength and surface)	EN 1418
2	Resistance projection welding	Welding of a multiprojection joint according to specifications in a manufacturing drawing Alignment of the electrodes, set-up of the welding machine and the welding parameters based on a) test experience b) tables of standard values including optimization of welding parameters, measurement of welding parameters, checking and evaluation of the weld quality (strength and surface)	EN 1418
3	Resistance seam welding	Welding of a seam joint according to specifications in a manufacturing drawing Determination of the electrode geometry, set-up of the welding machine based on a) test experience b) tables of standard values including optimization of welding parameters, measurement of welding parameters, checking and evaluation of the weld quality (strength and surface)	EN 1418