



Guideline for:

TRAINING AND CERTIFICATION OF WELDING INSTRUCTORS

iQvet: D2.2: Best practice pedagogical guideline based up on the results from demonstrations and pilots for teachers in each country

Association of certified teachers of joining materials

And

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1 Purpose and Scope

The document deals with the process of training, qualification and certification of welding instructors according to applicable standards and guidelines. It determines the entry conditions for the implementation of theoretical knowledge and practical testing as well as other activities in the certification process.

The entire work process is described, from the application of the candidate to the decision on certification or the issuance of the certificate.

The technical and personnel requirements that it must meet are also defined to be met by the training school and certification body.

1.1 Frame of the project

In collaboration with 9 welding trainers we prepared a guideline for formal education of Slovenian welding trainers, as per the framework of the project. Together with VET trainers we have tested parts of a new MIG MAG educational guideline which involved new innovative modern teaching methods on around 200 trainees in 4 welding schools.

To achieve the sustainability, we have included results of the project (D2.1.) into Working procedure for education and certification of Slovenian welding trainers. Guideline will be used and maintained by nonprofit organization DCSUM (Association of certified teachers of joining materials). As well presented and proposed as a guideline to European welding federation EWF.



1.2 References

Guidelines DVS 1192, DVS 1151, DVS 1152, DVS 1154, DVS 1155-56, and IIW / EWF.
Standards: ISO 29993, SIST EN ISO 17024, SIST EN ISO 9606, EN 287, ASME IX, EN 13067, SIST EN ISO 3834, AD 2000 -Merkblatt HP-3:2014, PED 2014/68/EU, Annex I, t .
3.1.2

1.3 Definitions

Welding instructor- Teacher for specialized (practical) courses (e.g. various welding techniques, welding technologies, ...).

Lecturer - Teacher of theoretical courses.

School of Education - an educational institution/institute/organization that meets the formal requirements for the education of certain personnel

Exams – approved practical and theoretical knowledge tests

Exam assessor - a professionally qualified person who did not train the trainee

Certification bod - independent certification body Verification and Certification Board





2 Requirements

2.1 General requirements

Training for a welding instructor in educational institutions lasts a maximum of 216 hours. The certificate is valid for 3 years, after which re-certification is required in the form of a two-day seminar.

The system for certification of welding instructors is a comprehensive system that provides for the verification and certification of individuals who wish to demonstrate their knowledge and / or competence in their field of activity.

The Certification Society understands the importance of impartiality in the conduct of its certification activities, managing conflicts of interest and ensuring the objectivity of all its certification activities in accordance with ISO 17024.

Requirements Governing Certification of welding instructors are written in Annex 1 - Scheme.

2.1.1 Application of candidates

First, the association publishes an open call for education, training and certification of welding instructors. Then candidates can apply for the process.

The application can be obtained on request by post or email. A CV must be attached to the application.

The conditions of performance (place of education, exam, etc.) are coordinated by the candidate with the president of the association.

The candidate must read the scheme and sign a statement on the use of the certificate.





2.2 Requirements for VET schools

2.2.1 Head of the educational institution or society

The qualification of the manager depends on the relevant field of technology and activity, as well as the scope of the school's activities.

The head of the educational institution is responsible for the educational programs and/or audits that are carried out in accordance with the rules and/or standards and for the prescribed curriculum and learning materials.

2.2.2 Approval of the educational institution

The institution must have a registered activity and all other necessary documentation in accordance with the legislation.

It must have adequate technical and spatial requirements.

2.2.3 Lecturers in specialized and theoretical classes

Lecturers are persons who provide training in educational institutions within the framework of specialized and theoretical knowledge. Teaching must only be provided by professional staff.

A third party must be present during the verification of qualifications.

2.3 Welding instructors

A candidate for an instructor must meet the knowledge requirements:

A. WELDING TECHNOLOGIES

He must demonstrate knowledge in the processes for which he wishes to teach.

The necessary knowledge is given in Appendix 1 of this work procedure. Applicants must provide evidence of training covering the relevant knowledge base.





2.3.1 Instructor Responsibilities

Welding instructor candidates are expected to master all of the items listed below:

a) Supervision

- Discipline and supervision of trainees
- Ordering materials
- Preventive maintenance of equipment
- General management of the workshop
- Counselling

b) Course planning

- Preparation of the training program
- Preparation of modern teaching methods
- Preparation for test and assessment of welds
- Writing notes and instructions about the course and the material

c) Implementation of the course

- Security and related items
- Training of interns for learning programs
- Lectures and interviews on practical training
- When lecturing, he must follow the instructions for conducting the course (DL, RPL, WBL, ...)
- Practical demonstrations
- Reading welding instructions (WPS)
- Instructions for improving imperfect welds

d) Inspection and testing

- Testing according to applicable standards or industry specifications, if applicable
- Checking examinees from trainees

e) record keeping

- Measuring and recording trainees' skills
- Progress in training apprentices
- Written reports

f) Professional development

- Carry out continuous professional development

As professional welding instructors, certification candidates are expected to demonstrate knowing and understanding all of these items in the lists above.





2.4 Content of training courses for instructors

2.4.1 Theory course:

- standards and guidelines for training and other regulations,
- teaching methodology and didactics,
- conflict management, motivation,
- welding processes and dislocations,
- materials and their behaviour during welding,
- technology of production and use,
- safety at work and accident prevention,
- instructor training systems and their use in welding (training with previous experience).
- exchange of experience

TOTAL: up to 56 hours

2.4.2 Training course:

The training is divided into four parts in four main areas:

- Part 0: general technical basics34 hours
- Part 1: technical/specialist basics20 hours
- Part 2: practical basics60 hours
- Part 3: expertise specific to the process20 hours
- Part 4: modern pedagogical skills.....0 hours
- EXAMS up to 6 hours

TOGETHER: up to 160 hours - depending on the prior knowledge of the candidates, the DCSUM committee may reduce the maximum recommended number of hours accordingly.

- Main area 1: Welding processes and equipment
- Main area 2: Materials and their behaviour during welding
- Main area 3: Construction and design
- Main area 4: production and use technology
- Main area 5: Pedagogical skills





2.4.3 Modern teaching methods course,

Requirement:

Proficiency in utilizing modern teaching technologies, specifically focusing on the integration of welding simulators, virtual platforms (e.g., Zoom), and learning management systems (e.g., Moodle).

Rationale:

Mastery of modern teaching tools is paramount to creating an engaging and dynamic learning environment. Instructors must be adept at leveraging welding simulators to provide hands-on, risk-free practical experiences for students. Additionally, proficiency in virtual platforms like Zoom ensures effective remote instruction, while expertise in learning management systems such as Moodle facilitates seamless organization and accessibility of course materials.

Topics that must be discussed:

- Improving classical classroom lectures
- Video as a teaching media
- Work based learning
- Brunner Curve
- Distance learning
- Zoom lectures
- Moodle or equivalent learning management platform
- Welding simulator

TOTAL: up to 24h





2.4.4 Process of recertification

Further training for welding instructors lasts 2 days of 8 hours in the form of a seminar and is mandatory every 3 years.

Program for a 2-day seminar:

- innovations in the field of welding,
- the current state of standards, guidelines and regulations in the EU,
- selection of consumables for welding,
- preparation of welding instructions
- virtual welding systems
- mechanized welding procedures
- Exchange of experience with colleagues from other educational institutions

2.4.5 Examination

THEORETICAL PART

The exam is designed to test the candidate's knowledge of general welding and related welding procedures. The exam is in the form of questions with given answers, where the correct answer is circled. The curriculum is given in Appendix 1. This part also tests the instructor's knowledge and willingness to use modern teaching methods. At a minimum: distance learning, learning via video link (Zoom), learning through the Virtual Welding system and its animations and Video instructions, recognition of prior knowledge and attachments

PRACTICAL PART

Candidates must demonstrate their competence in teaching techniques:

- Controlling and commenting on the welded product (welder), in the presence of an examiner or assessor,
- delivering classroom instruction that includes at least 20 minutes of verbal communication.

Further details are given in Appendix 2.





3 Responsibilities

The president of Association of certified teachers of joining materials is responsible for the operation of the association, and authorized examiners, authorized in writing by the president, are responsible for all other work.

4 Appendices and annexes

Appendix 1: *Syllabus for an approved training course*

Appendix 2: *Exam format*

Annex 1: *Scheme*

Annex 2: *Application*

Annex 3: *Sample certificate*

Annex 4: *Declaration of the candidate*





Appendix 1: Syllabus for an approved training course

The duration of the course must be a minimum of 70 hours, a maximum of 216 hours (160 hours of practice and 56 hours of theory).

THEORY maximum 56 hours:

1. INSTRUCTIONS AND OBJECTIVES

This appendix lists the topics that must be covered by an approved welding instructor training and certification course.

The order of the chapters can be changed.

2. CONTROL, PRODUCTION AND PLANNING

- Introduction
- Responsibilities, duties, qualifications and supervisory abilities of instructors
- Welding terms, symbols and definitions
- Welding standards and activities
- Pedagogical practice

3. MATERIALS

- Classification, properties and typical uses of steels, stainless steels, aluminum alloys and other shared materials.
- The basic structure of metals and the effect of adding alloying elements.
- Carbon equivalent formula.

4. WELDING TECHNOLOGY

Welding and related processes

- Description, characteristics and application of all welding processes
- Flame cutting
- Cutting and punching holes

Welding equipment

- Principles of operation; the main components of energy sources and auxiliary equipment.
- Care and maintenance.





Welding practice

- Welding consumables (electrodes, fillers, fluxes, gases, etc.) and their selection:
- Standards and classification
- Storage, drying,...
- Hydrogen control.

Security variables and their effects:

- Current, voltage, speed, circuit length, electrode angle, electrode, polarity, current, protection and gas purification levels.

Preparation of the weld:

- Requirements for the preparation of welds and examples
- Cleanliness of welding preparations.

Welding process specifications:

- Content, a key role in quality assurance.

Deformation control:

- Factors affecting the deformations of the welds of the process used, material thickness, weld preparation, weld speed,...
- Corrective measures

Preheating, heat treatment and heat treatment:

- Methods of heating, measuring and controlling temperature.

Welding errors:

- General welding defects: misalignment, poor shape, excess penetration, slag, porosity, lack of fusion, lack of penetration,...
- Repair of welds.

Properties of welded joints

- Properties of welded joints including strength, toughness, hardness, corrosion resistance.
- The effect of heat treatment, including normalizing, annealing, preheating, solution treatment and post-weld heat treatment.
- Effect of heat input and cooling rate on the heat affected zone weld.
- The effect of base and filler material on welding properties
- Dilution





- The effect of retention
- Deceptiveness
- Hydrogen decomposition, solidification cracking, cracking and lamellar tearing
- General modes of deformation: brittle fracture and fatigue.
- Impact of stress

5. QUALITY ASSURANCE AND CONTROL

Quality Assurance (QA):

- Quality manual (or quality plan) according to ISO 3834
- Quality documentation for welding: welding process specifications - WPS, welding process qualifications - WPQ and welders,...
- Calibration of welding equipment and instruments.

Quality Control (QC):

Inspection requirements before, during and after welding;

- qualification of inspection staff.
- Performance and accuracy verification; calibration.

Methods of inspection and testing in accordance with the relevant standards of use:

- Visual tests: size and shape of welds; exceeding, overlapping, surface.
- Destructive testing: chemical analysis, tensile, bending, impact tests, macro and hardness test.
- Non-destructive testing: visual, magnetic, penetrating, ultrasonic and radiographic testing;
- Detection and measurement of weld defects.

6. SAFETY AND ENVIRONMENTAL IMPACT

Definition of the hazard and necessary measures to eliminate or reduce the hazard:

Examples of hazards:

- Electric shock
- Fire and explosion
- Smoke
- Cylinder handling
- X and gamma radiation,...

Typical security procedures:



- Safety education
- Ventilation and monitoring of the workplace
- Eye, ear and skin protection
- Gas storage
- First aid

Statutory requirements for health and safety at work:

- A safe workplace
- Provision and use of safe work equipment
- Procedure for safe handling of equipment
- Personal protective equipment at work
- Occupational health and safety management

Environment:

Choose and use resources efficiently, taking into account possible effects on the environment.





Appendix 2: *Exam format*

General theory test

Candidates will have to solve:

- A 30-question exam with multiple possible correct answers to circle
- Allowed time 45 minutes
- Positive grade: at least 60% correct solutions

Practical test

The practical test includes a classroom exercise where a minimum of 20 minutes of oral presentation by the candidate is expected and workshop supervision.

The performance assessment takes into account:

- learning objectives
- instructor's notes during teaching
- use of notes
- used teaching aids
- participation of interns
- instructor's lecturing skills.

Control in the workshop:

Controlling and commenting on the welded product (welder), in the presence of an examiner or assessor





Test exercises

Table 1. Test exercises

Ser. no.	Test exercises (not less than 250 mm long)	Weld method	Weld position	Work thickness, mm
1	Square-butt, corner, and fillet welds (continuous Z-section), Fig. 1	L	G, VU, H	1
2	Square-butt weld	R	G	5
3	Two-pass V weld	R	G	10
4	One-pass V weld	R	H/V	8
5	One-pass V weld	R	O	8
6	Single-pass square-butt pipe/tube weld (pipe/tube axis vertical), Fig. 2	R	H/V	3...4
7	V-type pipe/tube weld, diam. ca. 100 mm (pipe/tube axis 45°), 2 passes, Fig. 3	R	O, VU, G, VD	3...5
8	Fit-up and weld horizontal pipe/tube, dia. 100mm...150mm, to vertical half-shell, dia. 300mm x 8mm, single-bevel butt weld, 2 runs (prepared by flame cutting), Fig. 4	R	H/V, VU, SO, H	4.5 on 8
9	Lap joint fillet weld on half-shell (diam. 250mm x 8mm, pipe/tube axis horizontal), Fig. 5	R	H, SO	8
10	Brazing of pipe/tube sockets, diam. ca. 50mm, steel or copper piping/tubing (pipe/tube axis vertical)		G	
11	Cast-iron joint weld, Fig. 6			
12	V preparation on clamped pipe/tube, diam. ca. 200mm x 8mm, by manual flame cutting (pipe/tube axis horizontal)		O, VU, G	
13	Weld shoe-type Y-branch to pipe/tube, diam. 50mm...100mm (principal pipe/tube axis vertical, direction of flow rising), Fig. 7			
14	Window-type weld on pipe/tube, diam. 50mm...100mm (preparation by external drain, pipe/tube axis vertical), Fig. 8	R	H/V	3...5
15	Square-butt weld on copper pipe/tube, dia. 100mm (pipe/tube axis vertical)	R	H/V	2...3



Abbreviations used for weld methods: L = leftward, R = rightward.
 Abbreviations used for weld positions: G = gravity, VU = vertical-up, H = horizontal, H/V = horizontal/vertical, O = overhead, SO = semioverhead, VD = vertical-down.

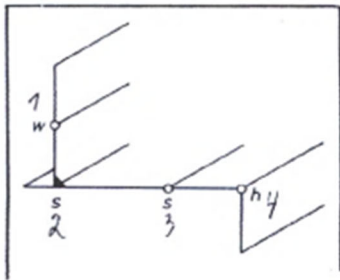


Fig. 1. Exercise 1
 1 G 3 VU
 2 VU 4 H

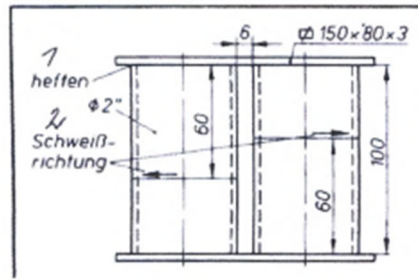


Fig. 2. Exercise 6
 1 Tacking
 2 Direction of welding

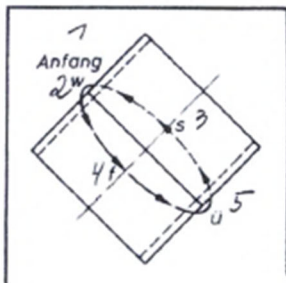


Fig. 3. Exercise 7
 1 Start
 2 G
 3 VU
 4 VD
 5 O

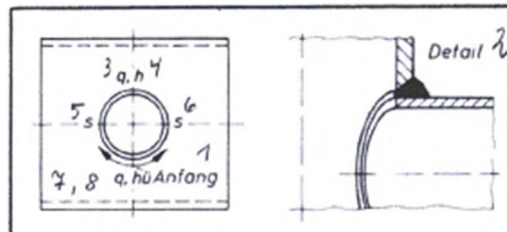


Fig. 4. Exercise 8
 1 Start
 2 Detail
 3 H/V
 4 H
 5 VU
 6 VU
 7 H/V
 8 SO

Detail for Fig. 4

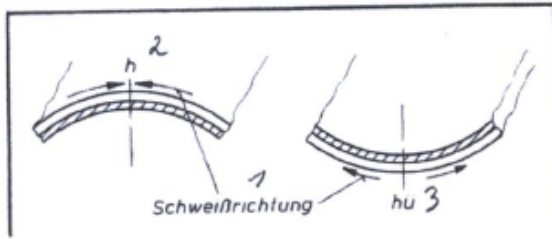


Fig. 5. Exercise 9
 1 Direction of welding
 2 H
 3 SO

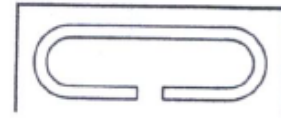


Fig. 6. Exercise 11

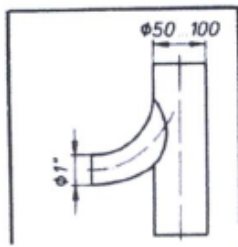


Fig. 7. Exercise 13

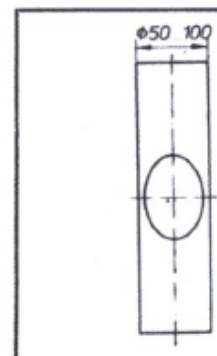


Fig. 8. Exercise 14