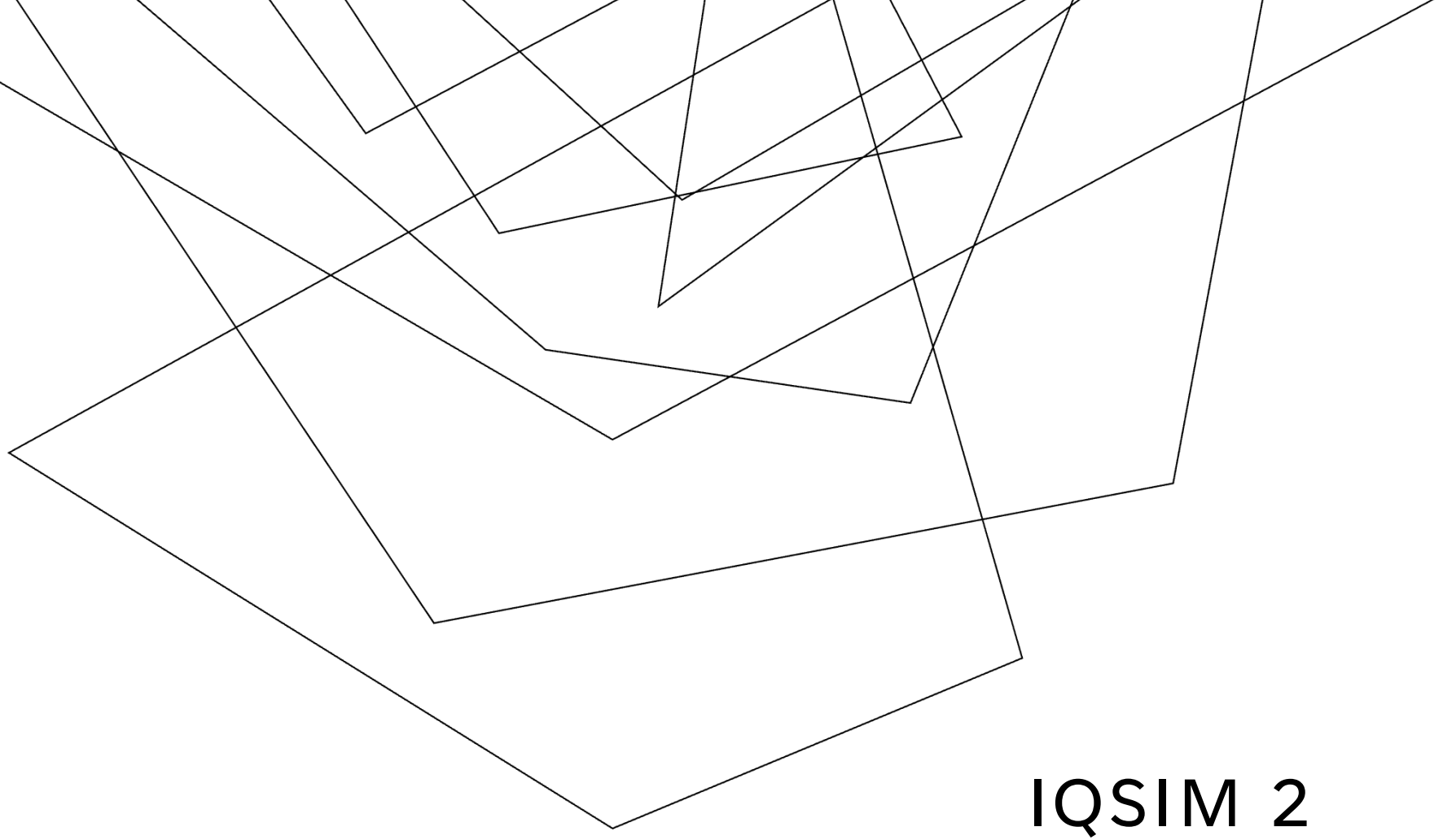

Erasmus+

IQSIM 2

Barsoum Engineering Consulting AB

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IQSIM2

New Innovative Simulator Tools for Quality Capacity Environmental Production Process Training in Education of Migrants

Erasmus+
Cooperation partnerships in adult education
Agreement no.: 2021-1-NO01-KA220-ADU-000033720

D4.1 **Framework of shared learning outcomes -Part-**

Version: **Final**
Date: **30.09.2023**

WP4- Specification of tools and methods for calculation of the environmental footprint in manufacturing for different welding processes

Starting period: 01-04-2022 Ending period: 01-02-2024

Needs: Worldwide, over five million workers perform welding as a full time or part time duty. These welders, depending on conditions, work in outdoor or indoor workplaces, in open or confined spaces, underwater, and above construction sites. Furthermore, air pollution due to welding leads to certain consequents on humans and environment. Therefore, there are strong reasons to deal with the welding processes and the working environment of the welder from different aspects. The most common gases emitted during welding are ozone, nitrous gases and carbon monoxide. (Air Pollution in welding process, F. Golbabaei, M. Kahdem 2015) Energy conservation and reducing greenhouse gas emissions are important to preserve the quality of the environment and sustain our resources for future generations. During the welding process an inert gas is often used to protect the welding region and prevent oxidation. Carbon dioxide and argon gas are both used as a preferred shielding gas because of their availability and relatively low cost. Extensive use of shield gases has a negative impact on the environment and presents needless expense to industry if not regulated properly. (JTMAE nr 28) Managing the risks of pollutants generated by welding process is carried out in some steps including identifying hazards, assessing the risks arising from these hazards, eliminating or minimizing the risks via proper control ways, and checking the effectiveness of controls. Monitoring the welder's exposure is a main component of risk management process. The hazard identification and risk assessment are necessary to work safely in a welding environment. As part of the European Green Deal, the Commission in September 2020 to raise the 2030 greenhouse gas emission reduction target, including emissions and removals, to at least 55% compared to 1990. It looked at the actions required across all sectors, including increased energy efficiency and renewable energy, and started the process of making detailed legislative proposals by June 2021 to implement and achieve the increased ambition. This will enable the EU to move towards a climate-neutral economy and implement its commitments under the Paris Agreement by updating its Nationally Determined Contribution. The result of the analysis was uncovering an urgent need for specifying rules and methods for simulating these emissions in a controlled manner so that the welding personnel were able to select the best suitable welding process for a given task.

WP4- Specification of tools and methods for calculation of the environmental footprint in manufacturing for different welding processes

Starting period: 01-04-2022 Ending period: 01-02-2024

Target groups:

The primary target group is teachers and welding personnel selecting welding process in real life and in an educational scenario.

Innovation:

iQSim will specify and develop methodology for enabling the teachers and students to be select the most environmental friendly process and define process parameters for the industry.

Impact:

A plan for application of blended learning methodology in combination with work based learning in partner institutions. Hands on demonstrations for teachers in each country, to be followed with piloting period and implementation in each country. - First set with baseline guidelines and scenarios for usage of tools/methods.

Tasks:

- Task 4.1: Plan for blended learning implementation in adult training sector
- Task 4.2: Hands on demonstrations for adult training teachers and instructors
- Task 4.3: Piloting and implementation in partner countries at adult training level through testing and evaluation in WP5.
- Task 4.4: Refine the first set of baseline guidelines and scenarios for adult training during implementation in WP5.

WP4 Deliverables

Starting period: 01-04-2022 Ending period: 01-02-2024

D4.1: Plan for blended learning implementation in adult training sector

At the second transnational meeting M2 partners will have the opportunity to refine the framework and scope of **blended and work based learning and teaching**[1)] combined with the use of **online simulator with evaluation of emission parameters**[2)] that has been discussed at the project preparation stage and in the first transnational meeting M1. Those parameters will be defined with partners feedback after the meeting giving partners the possibility to return to their institution and discuss with the management team and a sample of teachers.

- [1)] Draft have been prepared by QMSoft: IQSIM2-D4.1-Framework and scope-overview of CU and LO-v4 **(link)**
  - Need to be discussed within the consortium
  - Need to be cross checked/aligned with IIW Guideline - Blended LEARNING

- [2)] In progress: **The use of online simulator with evaluation of emission parameters and evaluation of design alterations**
  - Should be aligned with IIW Guideline for “Fillet Welder”
  - Will be based on current IQSIM 1 structure with additional Modules for the different parts/parameters
    - Fatigue strength module, Static strength module, “Emission parameters” module (informative)
  - Should be aligned with IIW Guideline for “Fillet Welder”
  - In alignment with WP3: D3.1 Industry cases

WP4 Deliverables

Starting period: 01-04-2022 Ending period: 01-02-2024

D4.2: Hands on demonstrations for adult training teachers and instructors

ELS and QMS will offer demonstrations of the tools to AT teachers from the participating institutions wishing to use blended and work based learning and assessment in a manufacturing learning setting together with the online simulator.

- Draft have been prepared by QMSoft: ”D1.4: A first set of Teach the Teacher Guidelines” **(link)**
- D1.4 will serve as guidelines in structuring the demonstration of tools
  - Blended and work based learning and assessment
  - Using Online Simulator

- D4.2 (and corresponding task 4.2) will be completed after D 4.1 (and corresponding task 4.1)

WP4 Deliverables

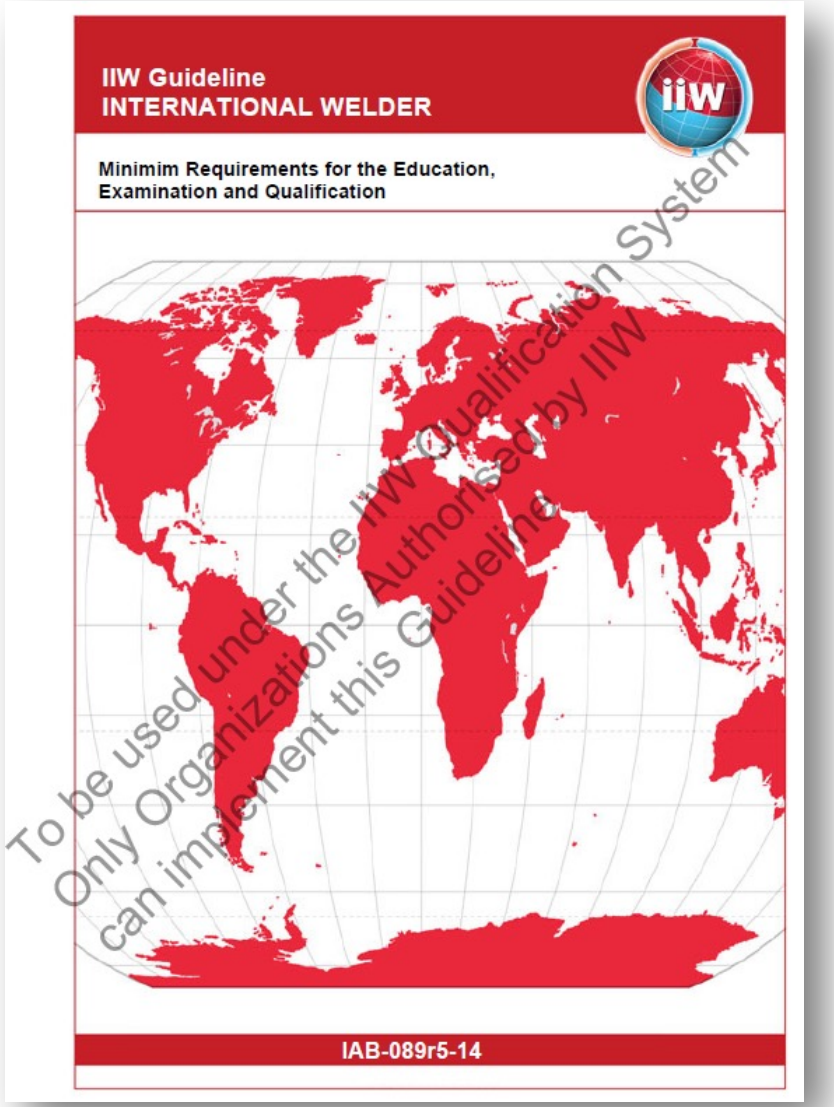
Starting period: 01-04-2022 Ending period: 01-02-2024

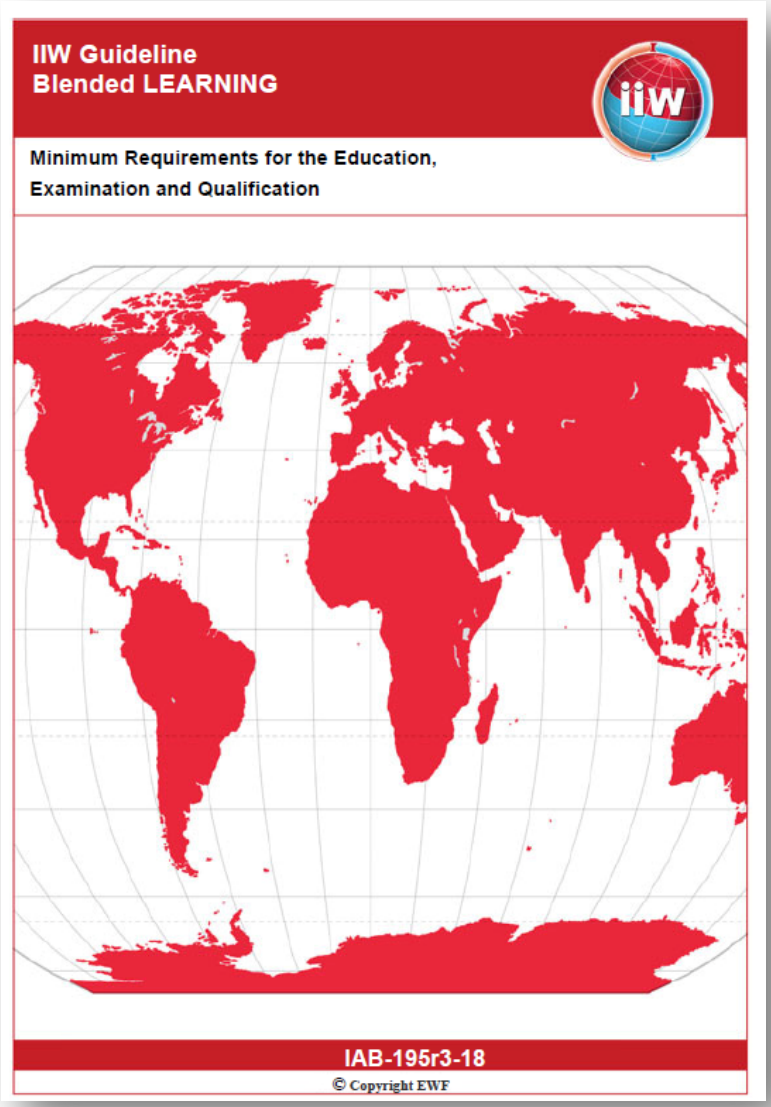
D4.3: Piloting and implementation in partner countries at adult training level

Piloting in partner countries will start short after the hands-on demonstrations. Parallel to this stage the WP4 team will elaborate the monitoring and support tools and support access and feedback mechanisms necessary for the teachers.

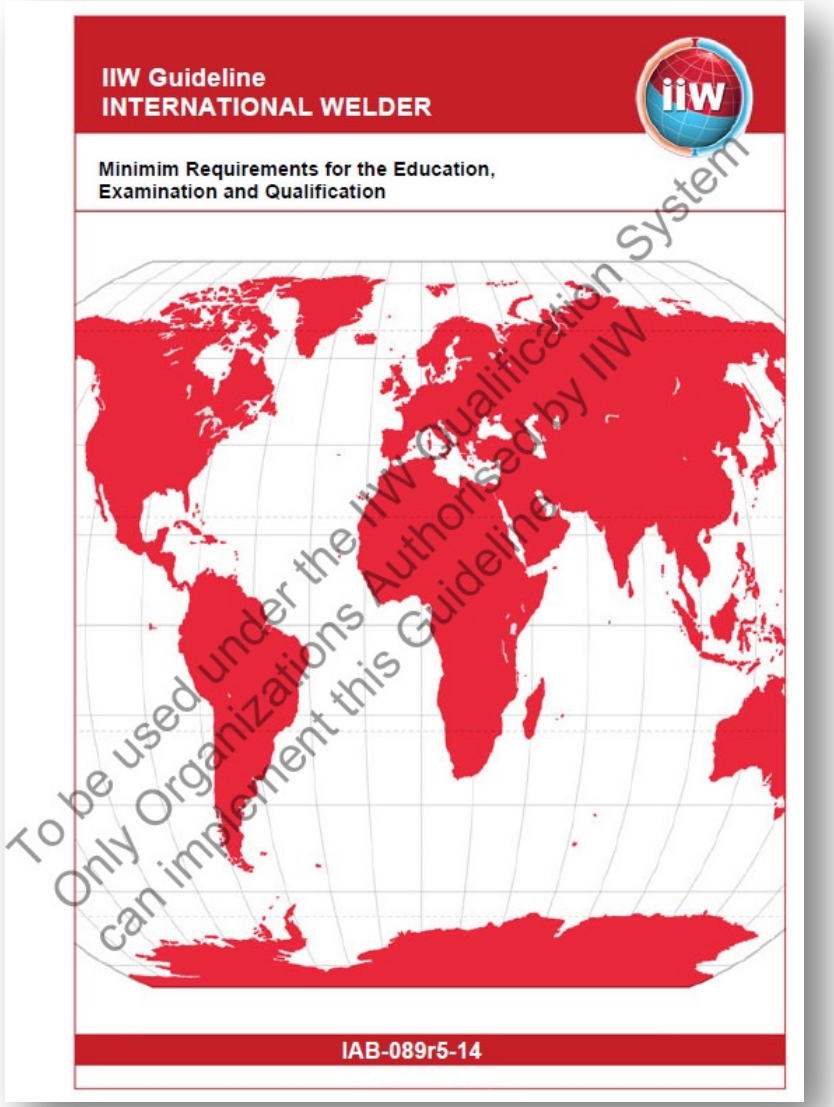
- Task 4.3: Piloting and implementation in partner countries at adult training level through testing and evaluation in WP5.
  Task 4.4: Refine the first set of baseline guidelines and scenarios for adult training during implementation in WP5.

IQSIM 2 – Based on International Guidelines (IIW)





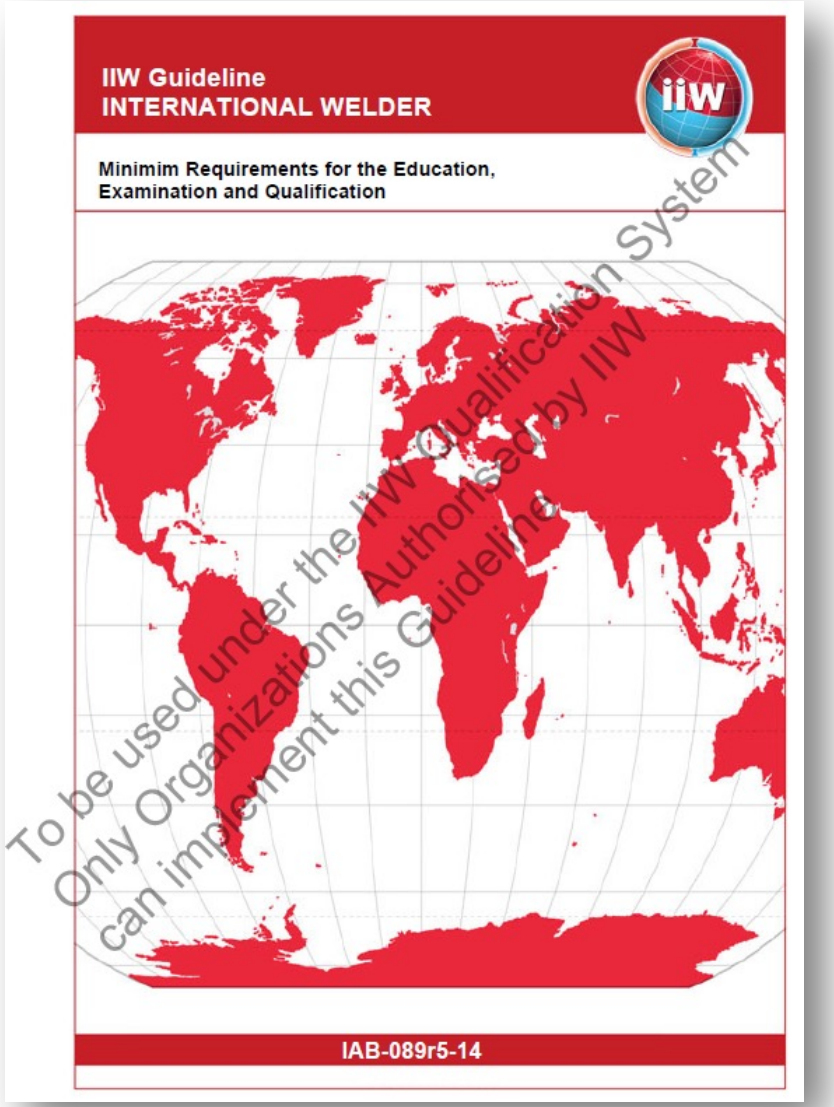
IIW Guideline – INTERNATIONAL WELDER



Which **Intended Learning Outcomes** will an updated online simulator target?

- With the updated IQSIM online simulator (**D4.1**)
  - Fatigue strength module
  - Static Strength module
  - “Emission parameters” module (informative)

IIW Guideline – INTERNATIONAL WELDER



- IAB-089r5-14: for **fillet**, plate and pipe welder
- The education and training programme consists of three theoretical modules “A”, “B” and “C”, which provide basic theoretical knowledge in welding and six practical modules (3 pairs) corresponding to the three levels of skill
- Special requirements for each welding process are given in modules S
- Special requirements per material (group) are described in modules P

IIW Guideline – INTERNATIONAL WELDER

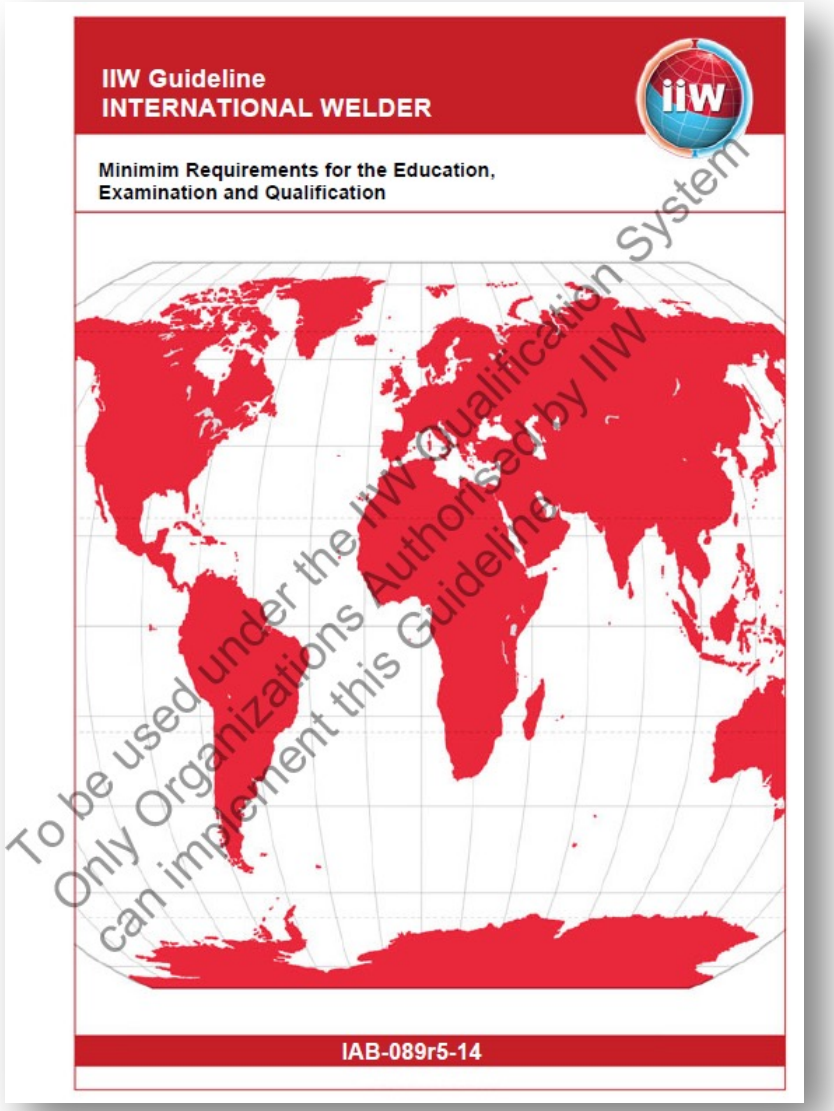
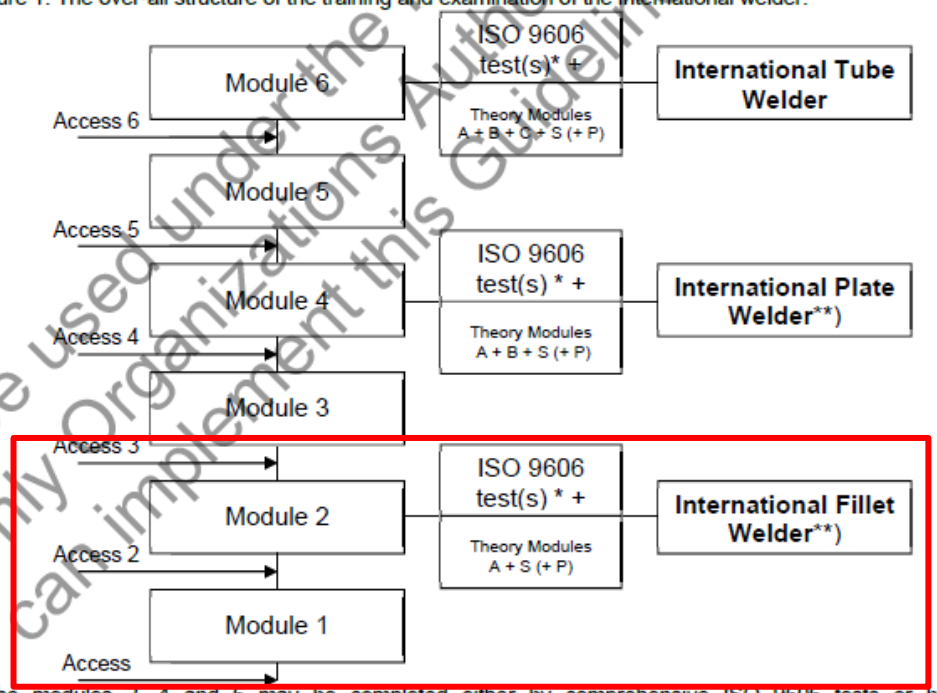


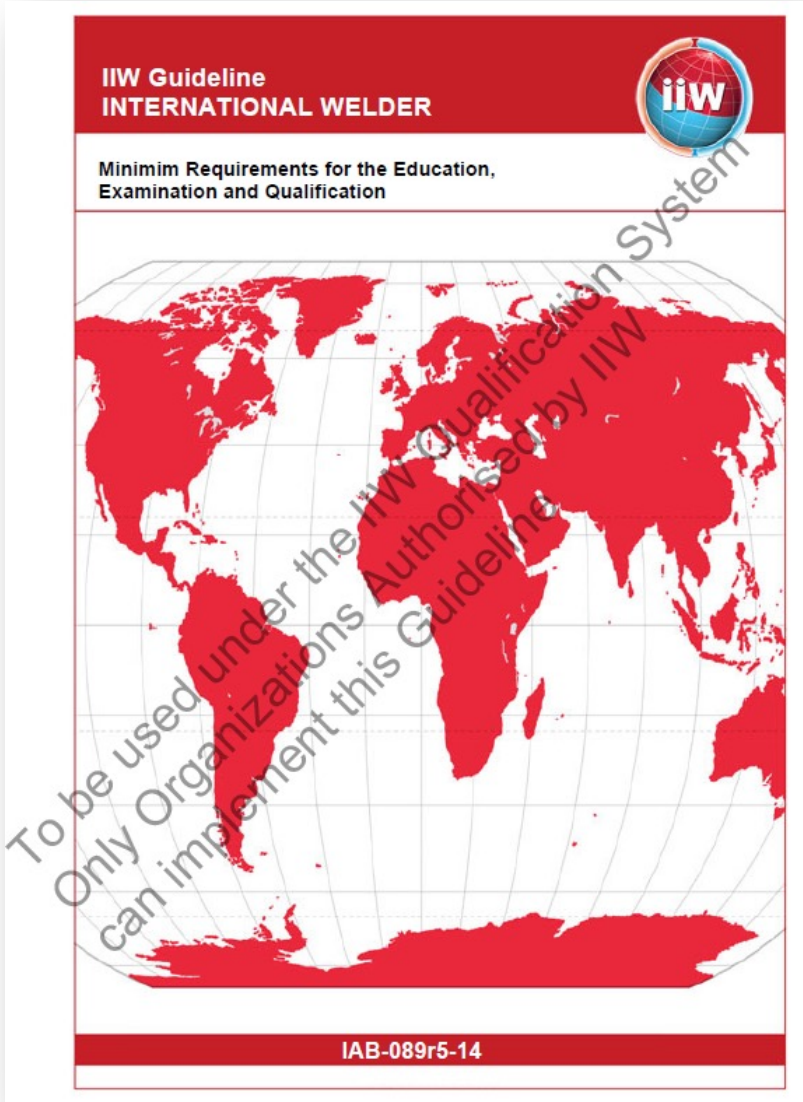
Figure 1: The over-all structure of the training and examination of the international welder.



*)The modules 2, 4 and 6 may be completed either by comprehensive ISO 9606 tests or by less comprehensive ISO 9606 tests and test objects. See Part II of this Guideline for test objects.

**) At the option of the ATB and in agreement with the ANB, it may not be necessary to issue intermediate certificates and diplomas.

IIW Guideline – INTERNATIONAL WELDER



MODULE A

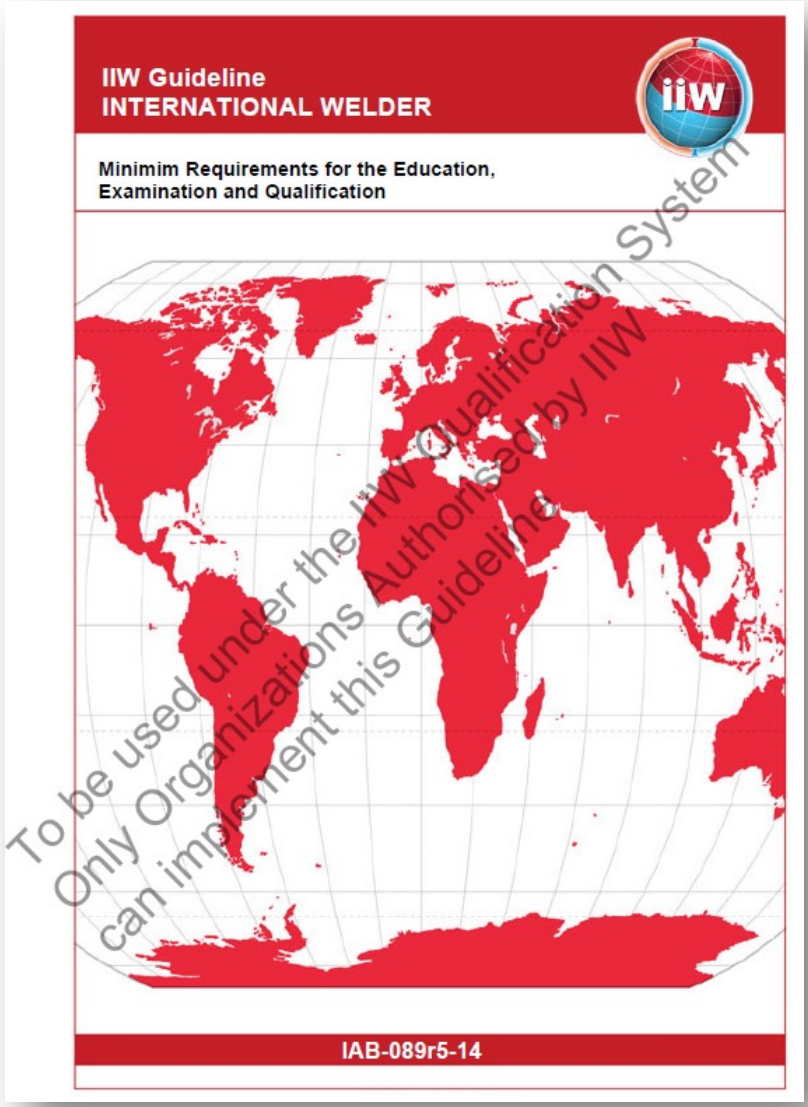
- **A1: Using electricity for arc welding (2h)**

Objective: Know the principle of arc welding

Scope:
- Basic of electricity
- Nature o the electric arc
- Arc power
- Basic terminology for welds (e.g. run, layer, top, root, penetration, etc.)
- Welding processes (MMA, MIG/MAG, TIG)
- Welding consumables
- Metal transfer, weld metal
- Formation of the weld pool

Learning Outcomes:
1. Describe the principal of arc welding
2. Understand the basic terms in welding
3. Brief explanation of the heat generation in the arc
4. Brief explanation of the formation of the weld pool

IIW Guideline – INTERNATIONAL WELDER



MODULE A

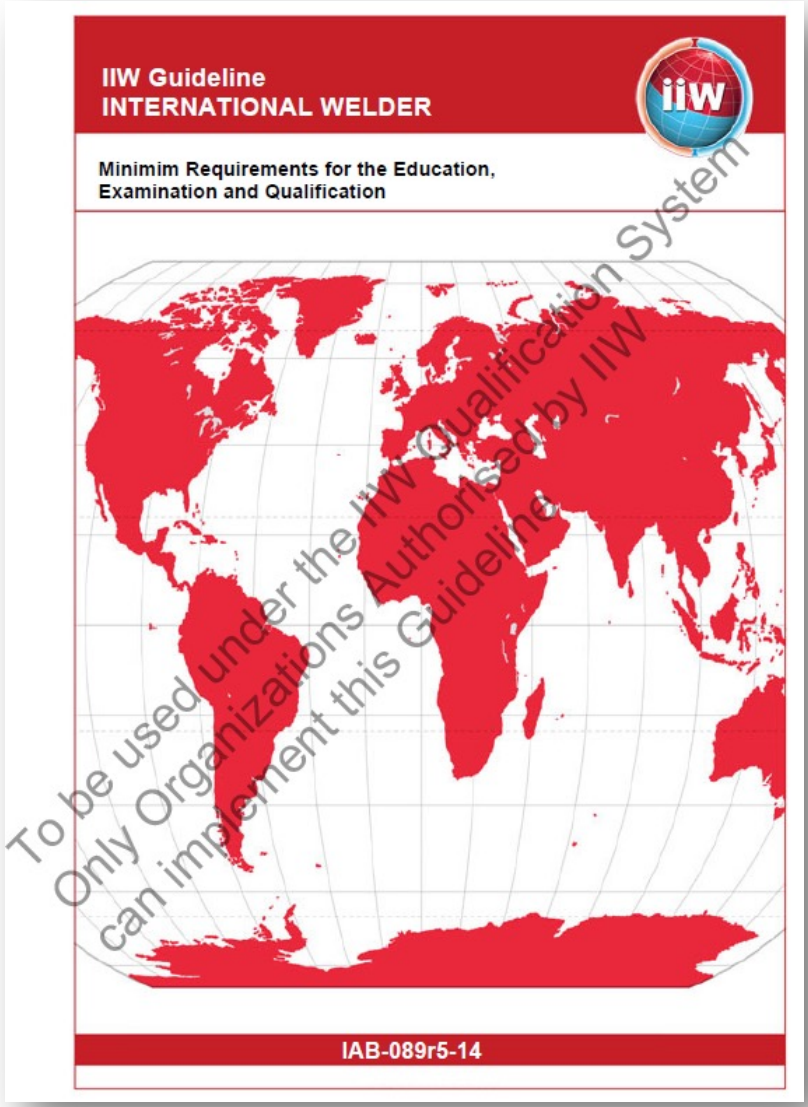
- **A2: Welding equipment (2h)**

Objective: Know the operation principles of welding equipment for arc welding

Scope:
- Distribution of electricity; mains supply
- Converting mains to welding power; welding power source
- Transformers; use of AC
- Rectifiers for DC
- Open circuit and arc voltage; welding current
- Type of welding current and polarity
- Duty cycle
- Shielding gas supply
- Welding parameters

Learning Outcomes:
1. Describe the major components of welding equipment and their function
2. Describe polarity and change of polarity
3. Name the essential parameters for arc welding

IIW Guideline – INTERNATIONAL WELDER



MODULE A

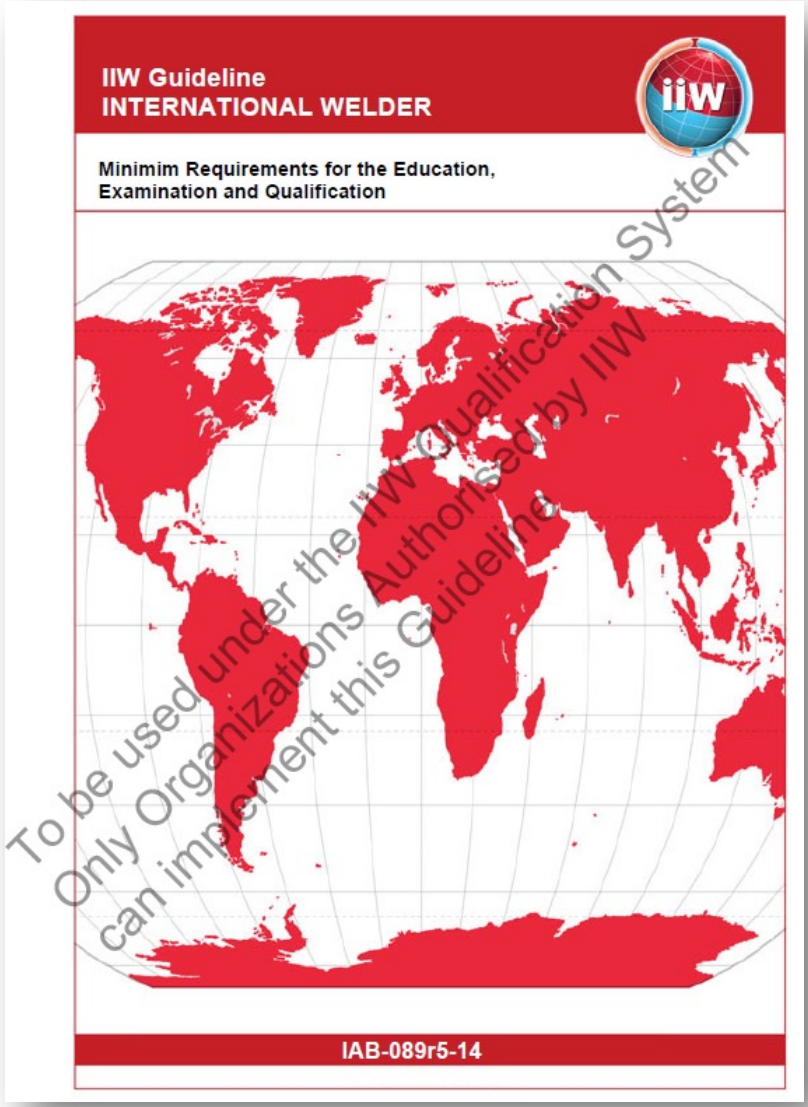
- **A3: Health and Safety (2h)**

Objective: Know and understand hazards and basic safety requirements when welding

Scope:
- Electric shock
- UV-and heat radiation
- Eye hazards
- Burns and fires, fire prevention, fire fighting
- Welding fumes
- Respiratory hazards
- Personal protective equipment and clothing
- Noise hazards
- Specific rules and regulations

Learning Outcomes:
1. Know dangerous situations in relation to electricity, humidity, DC and AC
2. Know the health risk of welding fumes
3. Know the signals for escape routes
4. Name adequate means of personal protection
5. Know measures to be taken to prohibit fire
6. Know measures to prevent noise hazards
7. Know the specific rules and regulations

IIW Guideline – INTERNATIONAL WELDER



MODULE A

- **A4: Safe working in the fabrication shop (2h)**

Objective: Know how to perform welding activities in the fabrication shop in a safe manner

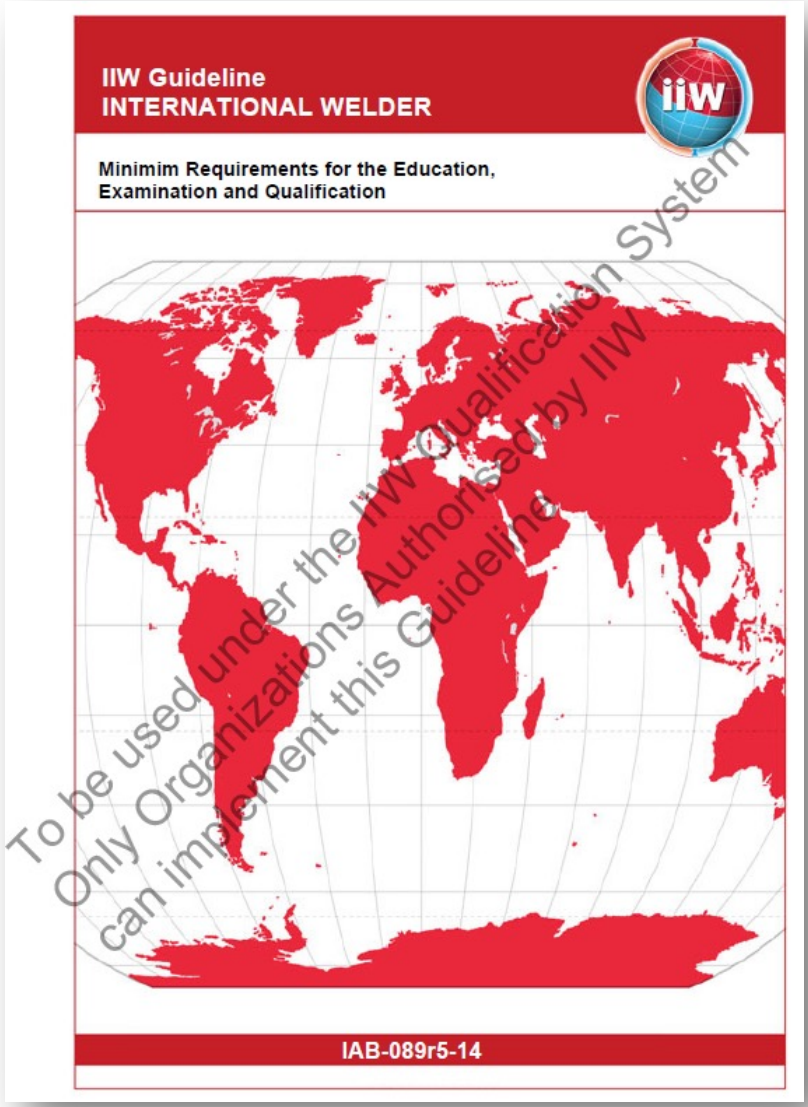
Scope:

- The working environmental of the fabrication shop; general hazards, dust, heavy and hot material, electrical cables
- Welding in the fabrication shop; protection of other workers from welding hazards
- General ventilation to minimize background pollution levels from welding hazards
- Control of the welders local environment; fume disposal
- Safety measures in case of personal accident monitoring of operations; escape procedures
- Working in confined spaces; build-up of pollutants; risk of explosion; enrichment of gasses like argon, helium, etc.
- Handling gas cylinders

Learning Outcomes:

1. Know the general hazards in a fabrication shop
2. Know the need for ventilation
3. Know the risk of explosions
4. Know safe handling of gas cylinders

IIW Guideline – INTERNATIONAL WELDER



MODULE A

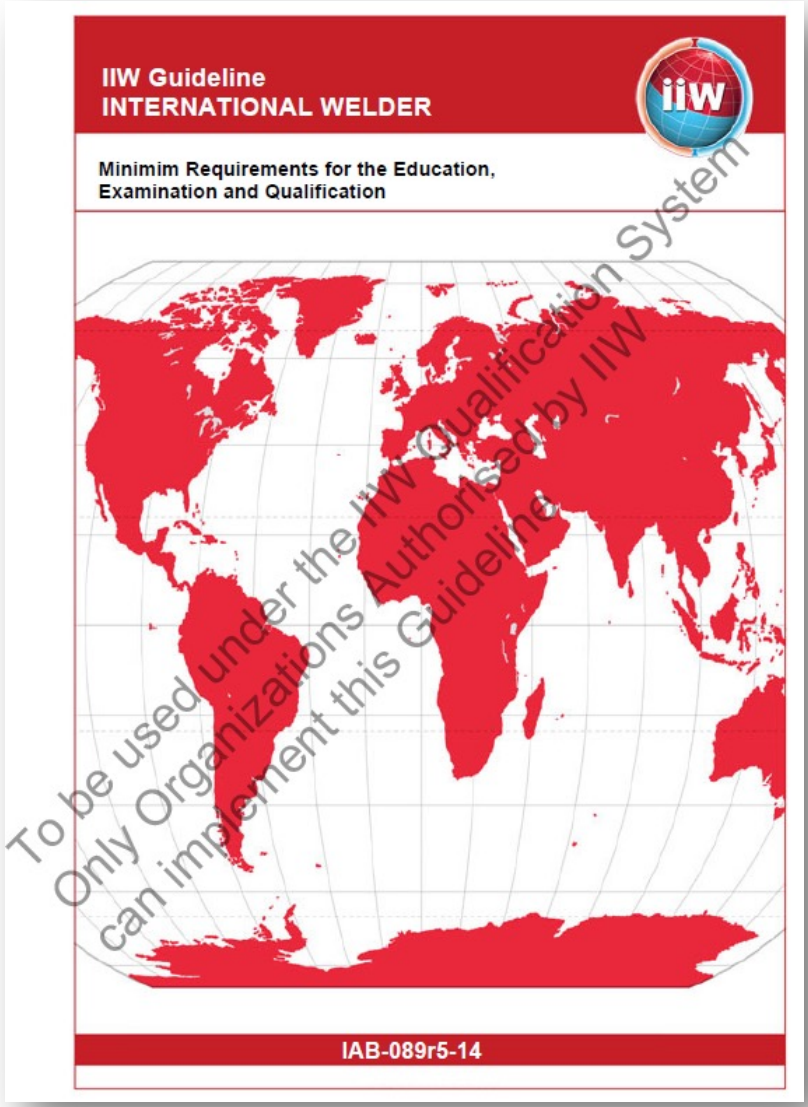
- **A5: Welding consumables (2h)**

Objective: Understand the basic principles of the use of welding consumables

Scope:
- Principle of welding consumables and functions of each type of welding consumables (electrodes, rods and gases)
- Shielding gases
- Backing gases
- Classification of welding consumables
- Storage, drying and handling

Learning Outcomes:
1. Know use, types and functions of welding consumables
2. Know why and how to dry, store and handle welding consumables
3. Identify the designation of welding consumables and use of WPSs of the training program

IIW Guideline – INTERNATIONAL WELDER



MODULE A

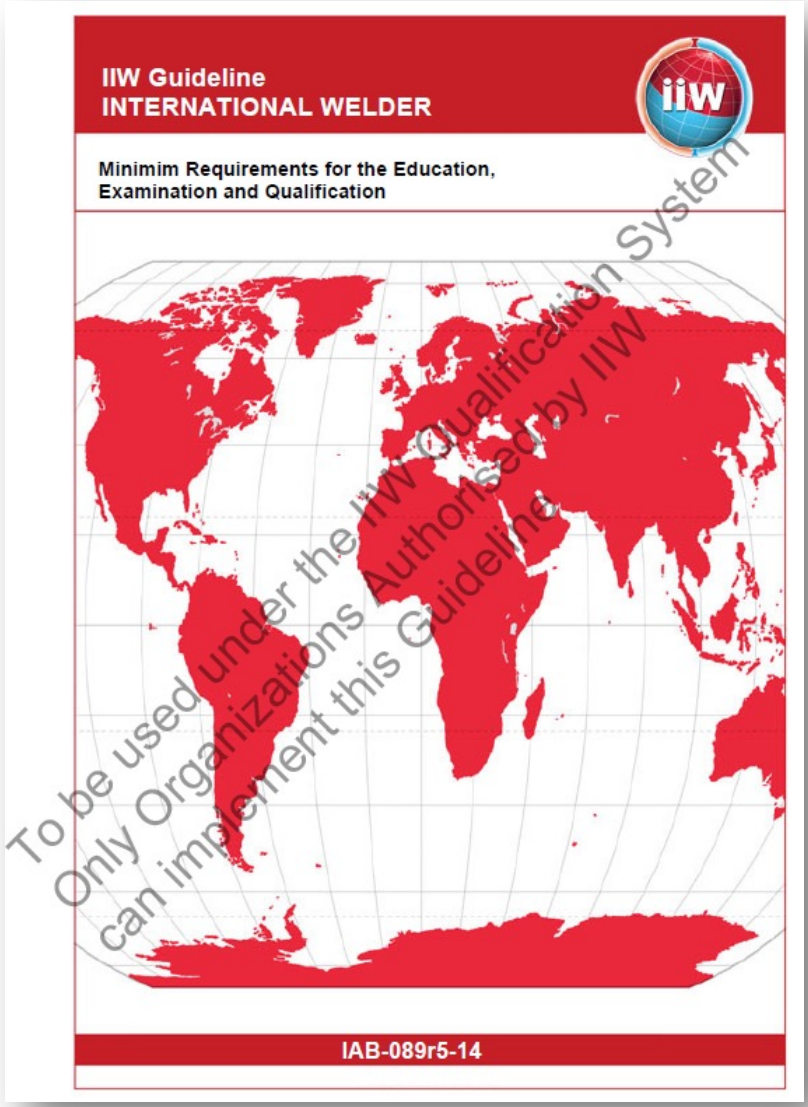
- **A6: Welding practice 1 (4h)**

Objective: Know how to work to a WPS, knowing the use of welding parameters

Scope:
- Welding Procedure Specifications (ISO 15609-1)
- Welding parameters, welding positions (ISO 6947)
- Types of welds and joints; characteristics, size, surface finish
- Welding symbols according to ISO 2553

Learning Outcomes:
1. Read welding details on a drawing and interpret welding symbols (ISO 2553)
2. Know the welding positions per ISO 6947
3. Identify the types of welded joints; “T”, lap, corner, etc
4. Identify the fillet weld; size, shape, tack weld and excess weld metal
5. Know the use in the production
6. Describe how to get the required parameters

IIW Guideline – INTERNATIONAL WELDER



MODULE A

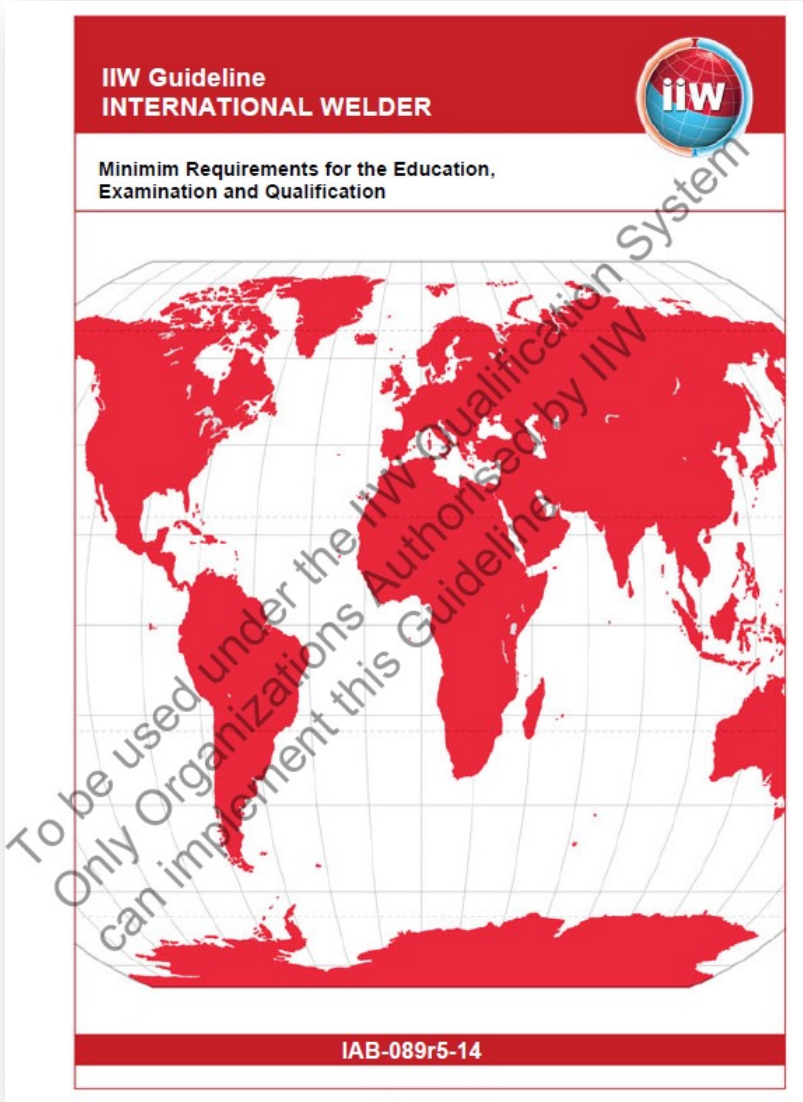
- **A7: Welding practice 2 (2h)**

Objective: Know the effect of welding parameters on performance and their influence on the weld geometry.

Scope:
- Introduction to weld imperfections, ISO 6520-1 and ISO 5817
- The control of welding parameters
- The effect of welding parameters on weld geometry
- The effect of magnetic arc blow
- Visual inspection

Learning Outcomes:
1. Describe the influence of the welding parameters o the weld geometry
2. Describe the effect of incorrect welding parameters
3. Knowing the different types of imperfections according to ISO 6520-1
4. Perform visual inspection on a fillet weld and subsequently evaluate to ISO 5817
5. Brief explanation of magnetic arc blow
6. Describe methods how to avoid magnetic arc blow

IIW Guideline – INTERNATIONAL WELDER



MODULE A

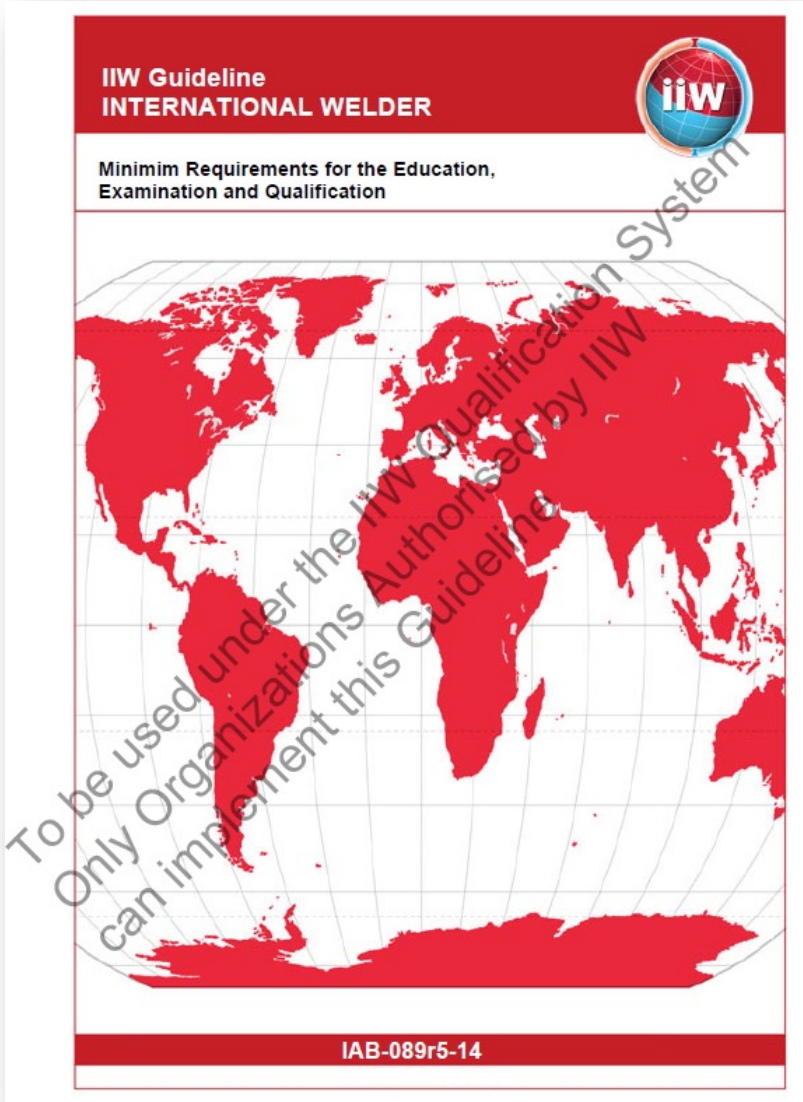
- **A8: Introduction to steel (2h)**

Objective: Know the basic of welding steel.

Scope:
- Different types of steels
- Effects of welding steels
- Materia grouping according to ISO/TR 15608 etc..

Learning Outcomes:
1. Explain the influence of welding on steel
2. Understand the difference between non alloy, stainless steels sand other alloy steels
3. Identify materials according to ISO/TR 15608

IIW Guideline – INTERNATIONAL WELDER



MODULE A

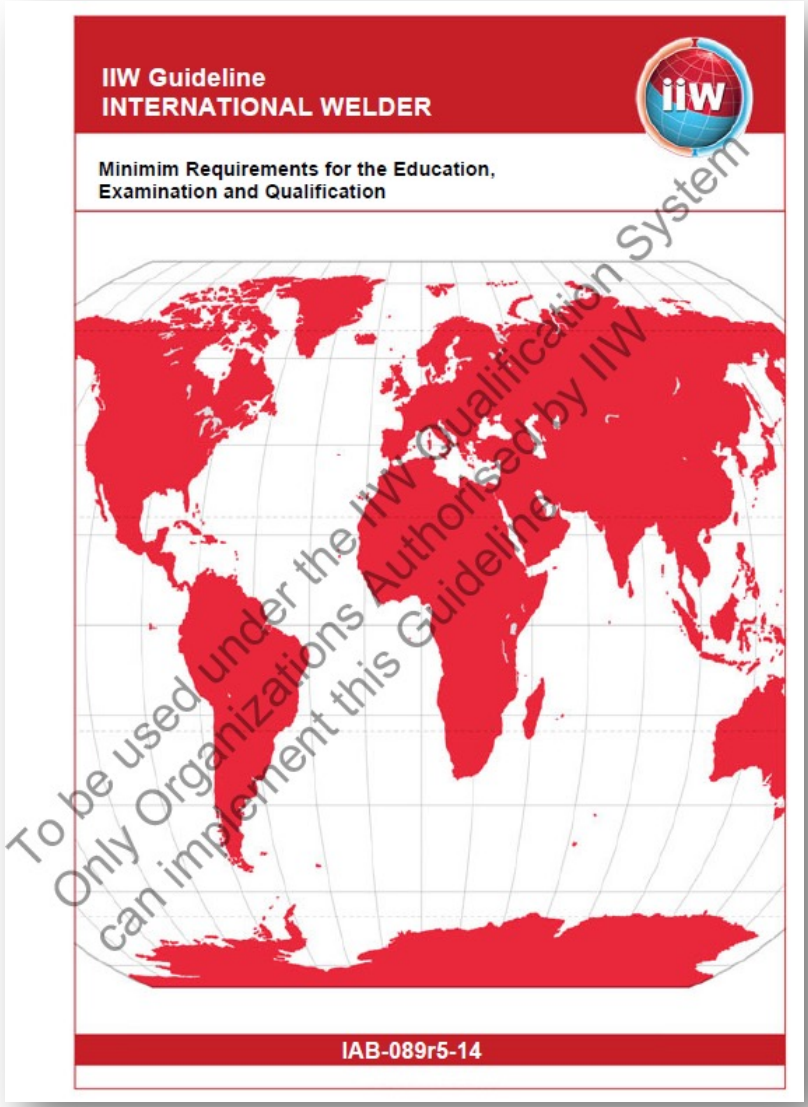
- **A9: Qualification of welders (2h)**

Objective: Know the basic of welder qualification according to ISO 9606.

Scope:
- Objectives of qualification tests
- Qualification of WPSs
- Welders qualification standard (ISO 9606)
- Essential variables; range of qualification, validity, test pieces and assessment of the welder

Learning Outcomes:
1. Know the range of qualification in a welder´s certificate
2. Outline the essential variables for a welder qualification test

IIW Guideline – INTERNATIONAL WELDER



MODULES SM: Supplementary theoretical education for MIG/MAG welding

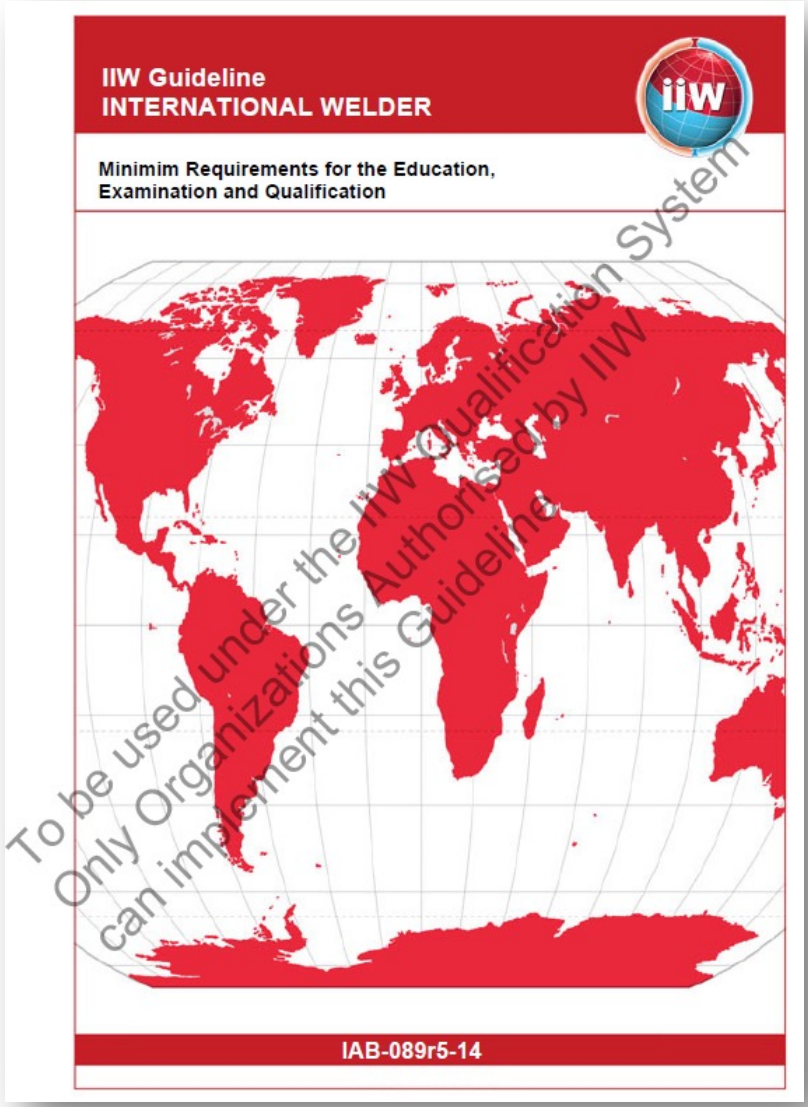
- **SM1: Construction and maintenance of MIG/MAG equipment (3h)**

Objective: Know about the basic construction of a power source for MIG/MAG welding and the influence of the typical MIG/MAG welding parameters on the final quality of the weld.

Scope:
- The AC transformer; windings, core, temperature rise and control
- MIG/MAG power source (DC)
- Primary and secondary circuits, mains protection
- Control of welding current, instruments to be used and validation of measuring instruments
- Earthen arrangements cables, welding guns
- Maintenance of equipment; condition of cables and connections; cleanliness of contact faces, cleanliness of internal components; gas supply and control
- The wire feed unit and its proper operation
- Checking for safe operation
- Selection of wire type and size

Learning Outcomes:
1. Describe the basics of a power source for MIG/MAG welding
2. Know different types of power sources, guns earth cables and earth clamps
3. Explain how the welding current is controlled
4. Know the main safety requirements when MIG/MAG welding
5. Know how to select proper type and diameter of wire electrode

IIW Guideline – INTERNATIONAL WELDER



MODULES SM: Supplementary theoretical education for MIG/MAG welding

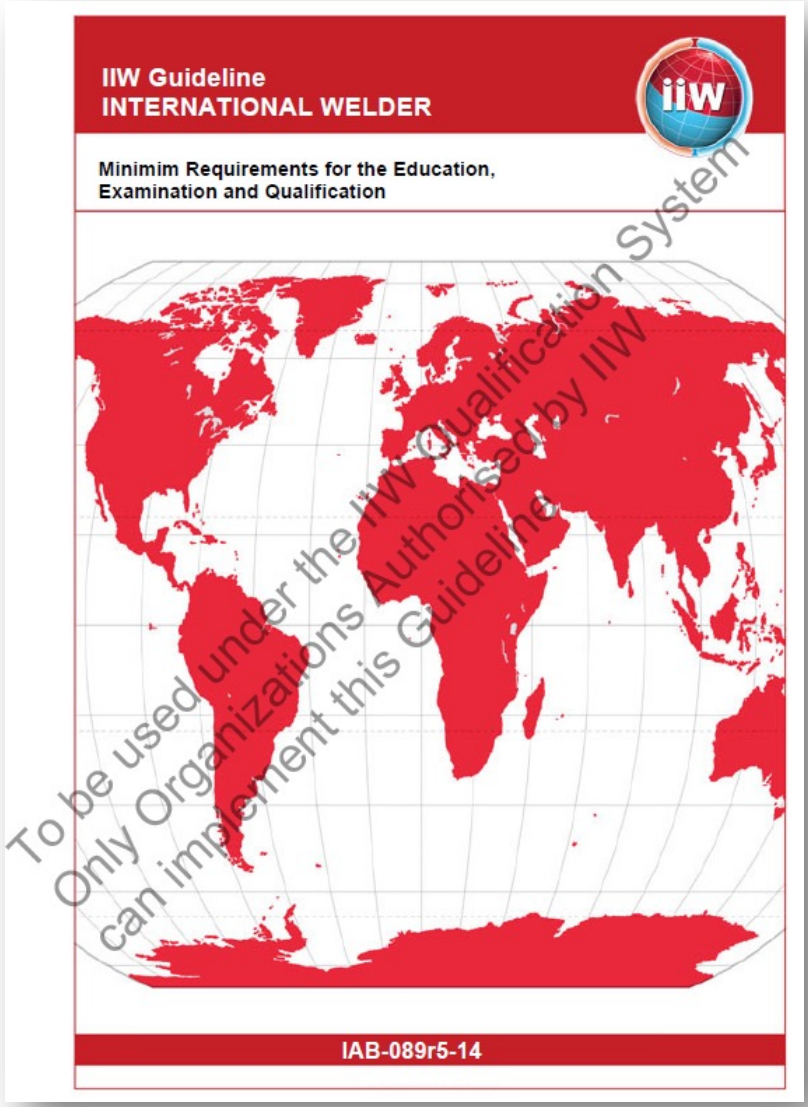
- **SM2: Welding consumables (1h)**

Objective: Have basic knowledge about the specific welding consumables used in MIG/MAG welding.

Scope:
- Classification of welding consumables (wire electrodes and shielding gases)
- Chemical composition of wire electrodes
- Application of different types of wire electrodes and size
- Selection of shielding gases

Learning Outcomes:
1. Check the correct selection of the welding consumables for a specific job (e.g. according to the appropriate WPS)

IIW Guideline – INTERNATIONAL WELDER



MODULES SM: Supplementary theoretical education for MIG/MAG welding

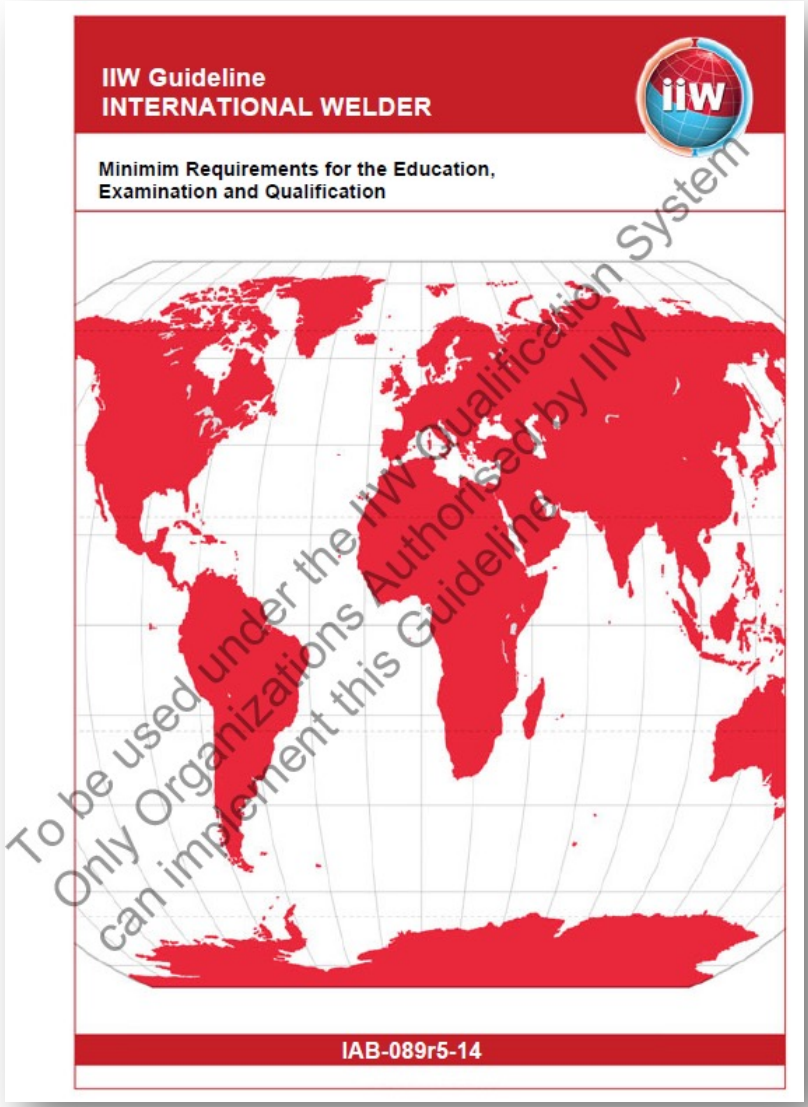
- **SM3: Health and safety (1h)**

Objective: Have basic knowledge about the specific health and safety precautions related to the MIG/MAG welding process.

Scope:
- Fumes
- UV radiation

Learning Outcomes:
1. Know how to protect the welder against the potential hazards of MIG/MAG welding

IIW Guideline – INTERNATIONAL WELDER



MODULES SM: Supplementary theoretical education for MIG/MAG welding

- **SM4: MIG/MAG welding characteristics and typical welding parameters (2h)**

Objective: Know about the different metal transfer modes and the influence on the final quality of the weld.

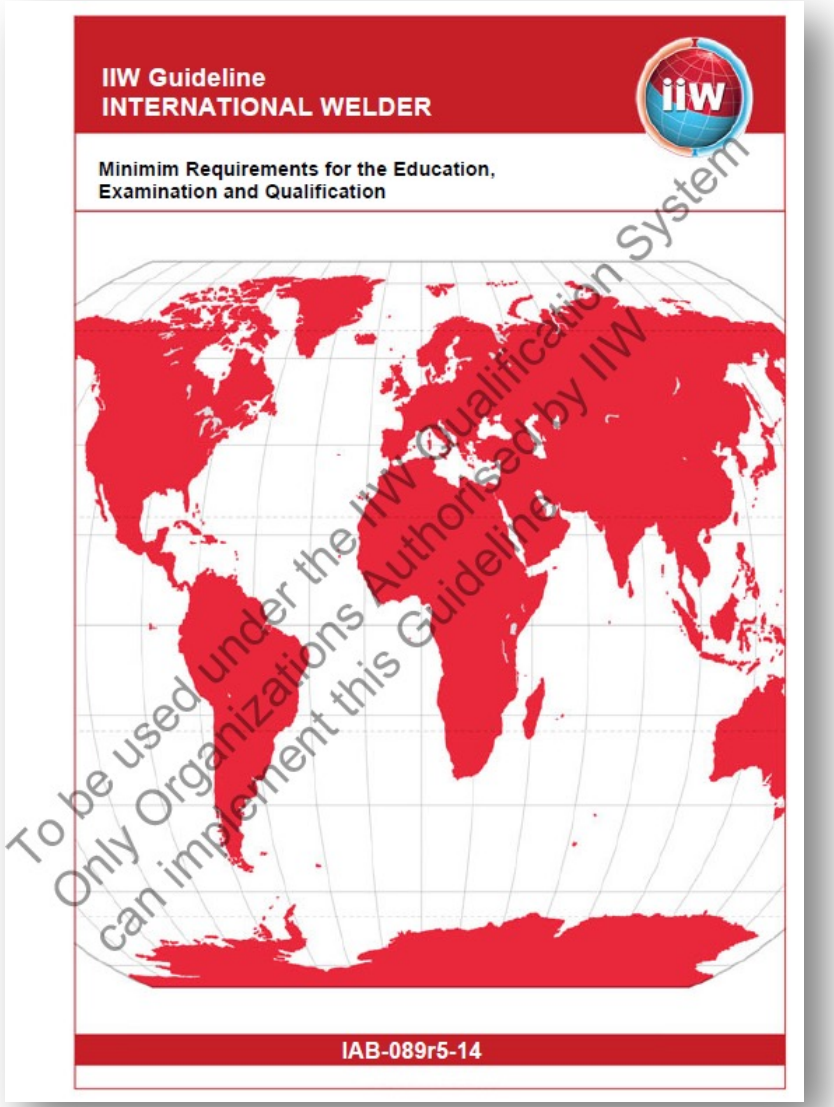
Scope:

- Short arc, spray arc, globular arc, etc.
- Typical welding parameters as e.g. distance contract tube / work piece, travel speed, gas flow rate, etc.
- Weld imperfections and possible problems specific to MIG/MAG (e.g. lack of fusion for solid wire).
- Torch angle and technique (push and pull)
- Use of so called synergic equipment

Learning Outcomes:

1. Describe the types of metal transfer
2. Identify the most common imperfections for MIG/MAG welding and how to avoid them
3. Know the difference between push and pull technique
4. Set and check the parameters (e.g. as specified in the WPS)

IIW Guideline – INTERNATIONAL WELDER



MODULES P: Dedicated to one specific material to be taught after or in parallel to theoretical modules if the sought qualification is for stainless steel or aluminum.

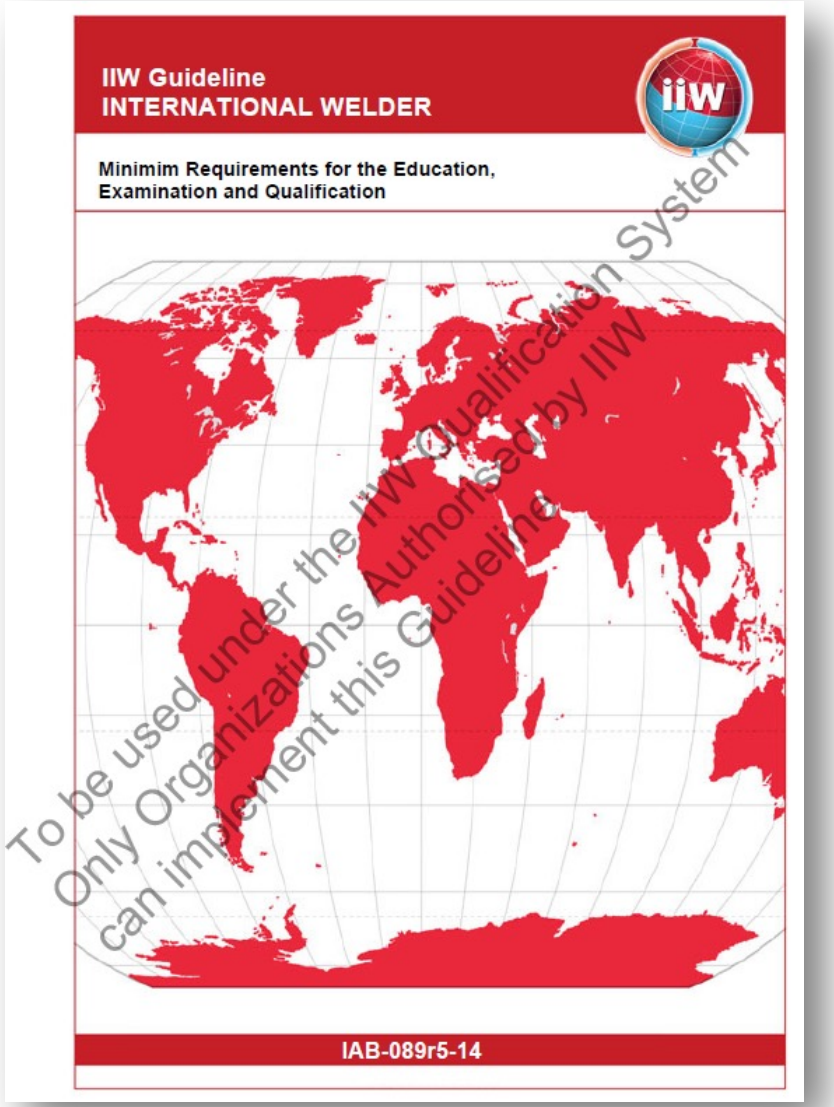
- **PSS1: Basics of stainless steel, welding processes and health aspects (2h)**

Objective: Know the basic of stainless steel, welding processes and health aspects

Scope:
- Definition of stainless steel
- Identification of stainless steel
- Protective oxide film
- Welding processes
- Characteristics of stainless steel compared to non-alloy steel and aluminum alloys
- Grades of stainless steel and their characteristics; austenitic, ferritic, martensitic, duplex (austenitic-ferritic)
- Health aspects during welding of stainless steel, alloys in stainless steel and their effect on the health
- Methods for preventing health risks related to welding of stainless steel, breathing zone, welders mask with fresh-air filters, hygiene
- Safety precautions for cutting

Learning Outcomes:
1. Definition of stainless steel and brief explanation of the protective oxide film
2. Understand the difference of welding stainless steel compared to welding unalloyed steel and aluminum alloys
3. Outline the grades of stainless steel and their characteristics; austenitic, ferritic, martensitic, duplex (austenitic-ferritic)
4. Give example of common welding processes for stainless steel
5. Knowing methods for preventing health risks related to welding of stainless steel

IIW Guideline – INTERNATIONAL WELDER



MODULES P: Dedicated to one specific material to be taught after or in parallel to theoretical modules if the sought qualification is for stainless steel or aluminum

- **PSS2: Weldability, welded joints and distortion of stainless steel (2h)**

Objective: Know the theoretical basics of welding stainless steel, the common welded joints and how to prevent distortion

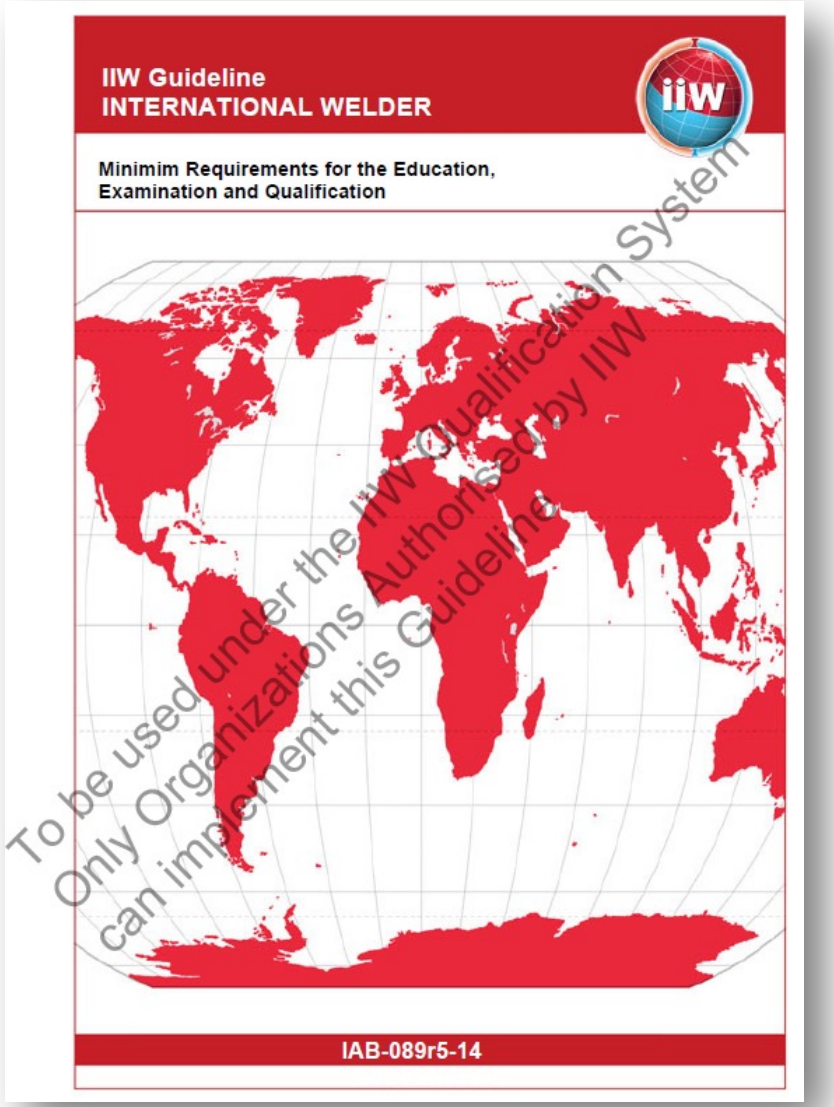
Scope:

- Welded joints for stainless steel
- Methods for joint preparation in stainless steel
- Weldability of stainless steel, heat input, interpass temperature
- Effects of composition, temperature, heat input
- Welding of dissimilar metals and clad metal (stainless steel-unalloyed steel) and control of dilution
- Distortion caused by welding stainless steel and the difference when compared to unalloyed steel
- Handling of stainless steel in the workshop and the use of tools for stainless steel

Learning Outcomes:

1. Outline the commonly used welding joints and the methods of joint preparation regarding stainless steel
2. Know about the importance of controlling heat input and interpass temperature
3. Name the influence of alloying elements on weld properties
4. Know the effect of heat input on material properties
5. Describe the methods of welding dissimilar metals and clad metal
6. Knowing methods to confined distortion of stainless steel caused by welding
7. Know how to control the dilution

IIW Guideline – INTERNATIONAL WELDER



MODULES P: Dedicated to one specific material to be taught after or in parallel to theoretical modules if the sought qualification is for stainless steel or aluminum

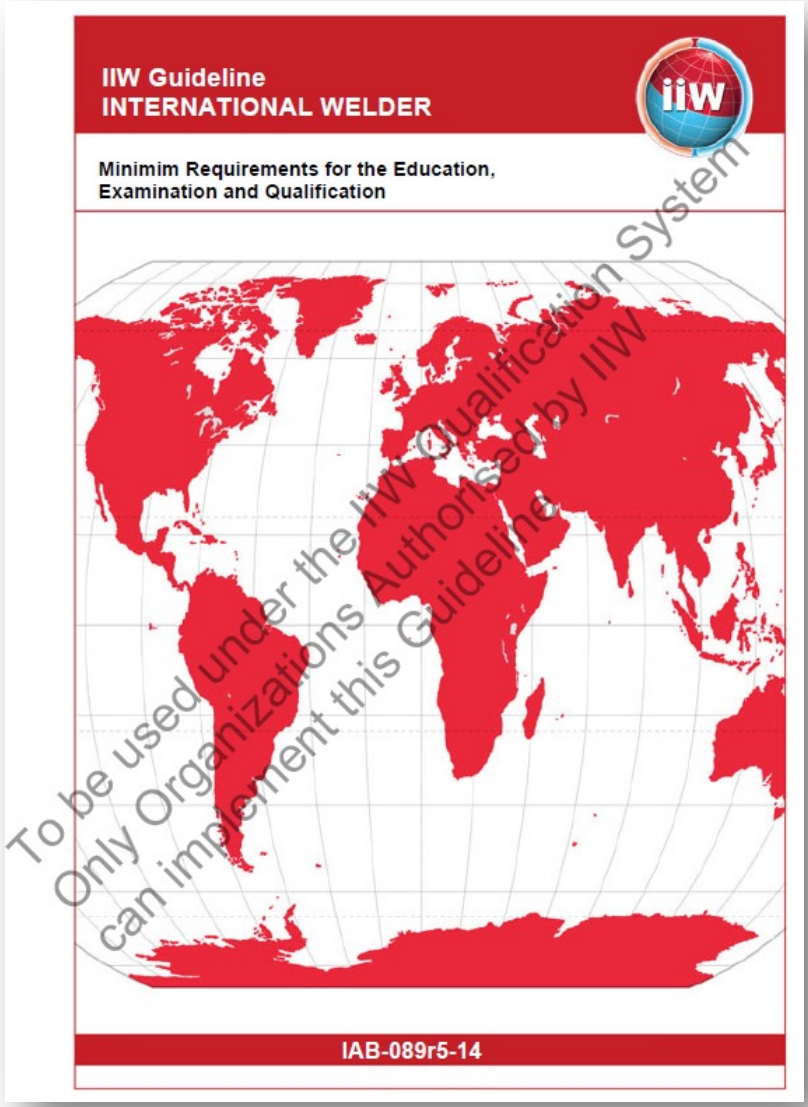
- **PSS3: Welding consumables for stainless steel (2h)**

Objective: Know the basics of welding consumables and of backing gas

Scope:
- Welding consumables (filler metals and shielding gases) adequate for stainless steels, standards
- Measurements (ppm) of oxygen on backing gas, requirements for different grades of stainless steels
- Equipment for backing gas

Learning Outcomes:
1. Know the main types and classification of welding consumables for stainless steel
2. Understand how to work with standards and manufacturers recommendations
3. Determine and measure required backing gas
4. Know about equipment for backing gas

IIW Guideline – INTERNATIONAL WELDER



MODULES P: Dedicated to one specific material to be taught after or in parallel to theoretical modules if the sought qualification is for stainless steel or aluminum

- **PSS4: Corrosion, post weld treatment (2h)**

Objective: Know the basics corrosion and post weld treatment of stainless steel

Scope:
- Use of protective means
- Corrosion types in stainless steel (pitting, intergranular, crevice corrosion)
- The influence on corrosion in stainless steel caused by welding and environment
- Post weld treatment; pickling, blasting, brushing and grinding
- Post weld heat treatment; austenitic, ferritic, martensitic, austenitic-ferritic (duplex)

Learning Outcomes:
1. Outline corrosion types in stainless steel
2. Know the key role of welding in corrosion of stainless steel
3. Describe post weld treatment; pickling, blasting, brushing and grinding
4. Brief explanation of post weld heat treatment of stainless steels

IIW Guideline – INTERNATIONAL WELDER

Summary of Intended Learning Outcomes (ILO) with connection to IQSIM2

A1: Using electricity for arc welding
- **ILO3**: Brief explanation of the heat generation in the arc
- **ILO4**: Brief explanation of the formation of the weld pool

A4: Safe working in the fabrication shop
- **ILO1:** Know the general hazards in a fabrication shop
- **ILO2:** Know the need for ventilation
- **ILO3:** Know the risk of explosions
- **ILO4:** Know safe handling of gas cylinders

A5: Welding consumables
- **ILO1:** Know use, types and functions of welding consumables
- **ILO3:** Identify the designation of welding consumables and use of WPSs of the training program

A6: Welding practice 1
- **ILO3:** Identify the types of welded joints; “T”, lap, corner, etc
- **ILO4:** Identify the fillet weld; size, shape, tack weld and excess weld metal
- **ILO6:** Describe how to get the required parameters

IIW Guideline – INTERNATIONAL WELDER

Summary of Intended Learning Outcomes (ILO) with connection to IQSIM2

A7: Welding practice 2
- **ILO1**: Describe the influence of the welding parameters o the weld geometry
- **ILO2**: Describe the effect of incorrect welding parameters
- **ILO4:** Perform visual inspection on a fillet weld and subsequently evaluate to ISO 5817

A8: Introduction to steel
- **ILO1**: Explain the influence of welding on steel
- **ILO2**: Understand the difference between non alloy, stainless steels sand other alloy steels

SM1: Construction and maintenance of MIG/MAG equipment
- **ILO1**: Describe the basics of a power source for MIG/MAG welding

SM4: MIG/MAG welding characteristics and typical welding parameters
- **ILO1**: Describe the types of metal transfer
- **ILO2**: Identify the most common imperfections for MIG/MAG welding and how to avoid them

IIW Guideline – INTERNATIONAL WELDER

Summary of Intended Learning Outcomes (ILO) with connection to IQSIM2

PSS1: Basics of stainless steel, welding processes and health aspects

- **ILO2**: Understand the difference of welding stainless steel compared to welding unalloyed steel and aluminum alloys

PSS2: Weldability, welded joints and distortion of stainless steel

- **ILO1**: Outline the commonly used welding joints and the methods of joint preparation regarding stainless steel
- **ILO2**: Know about the importance of controlling heat input and interpass temperature
- **ILO3:** Name the influence of alloying elements on weld properties
- **ILO4:** Know the effect of heat input on material properties

PSS4: Corrosion, post weld treatment

- **ILO3:** Describe post weld treatment; pickling, blasting, brushing and grinding

Blended learning strategy

IIW Guideline for Blended learning will be utilized for

- **Education**
- **Examination**
- **and Qualification**

The International Institute of Welding (IIW) has developed guidelines for blended learning in welding education and training. These guidelines recommend that blended learning programs combine online and in-person instruction to improve learning outcomes and increase access to training.

The IIW recommends that blended learning programs should be designed to accommodate a range of learning styles and preferences, using a variety of instructional methods and materials. Programs should also incorporate assessment and feedback mechanisms to monitor student progress and ensure learning objectives are being met.

In addition, the IIW suggests that blended learning programs should be flexible, allowing students to progress through the program at their own pace and providing access to resources and support as needed. Programs should also be designed to be scalable, so that they can be adapted to meet the needs of different groups and populations.

Overall, the IIW guidelines emphasize the importance of developing high-quality blended learning programs that are responsive to the needs of learners and that use a range of instructional approaches to maximize learning outcomes.

Blended learning strategy

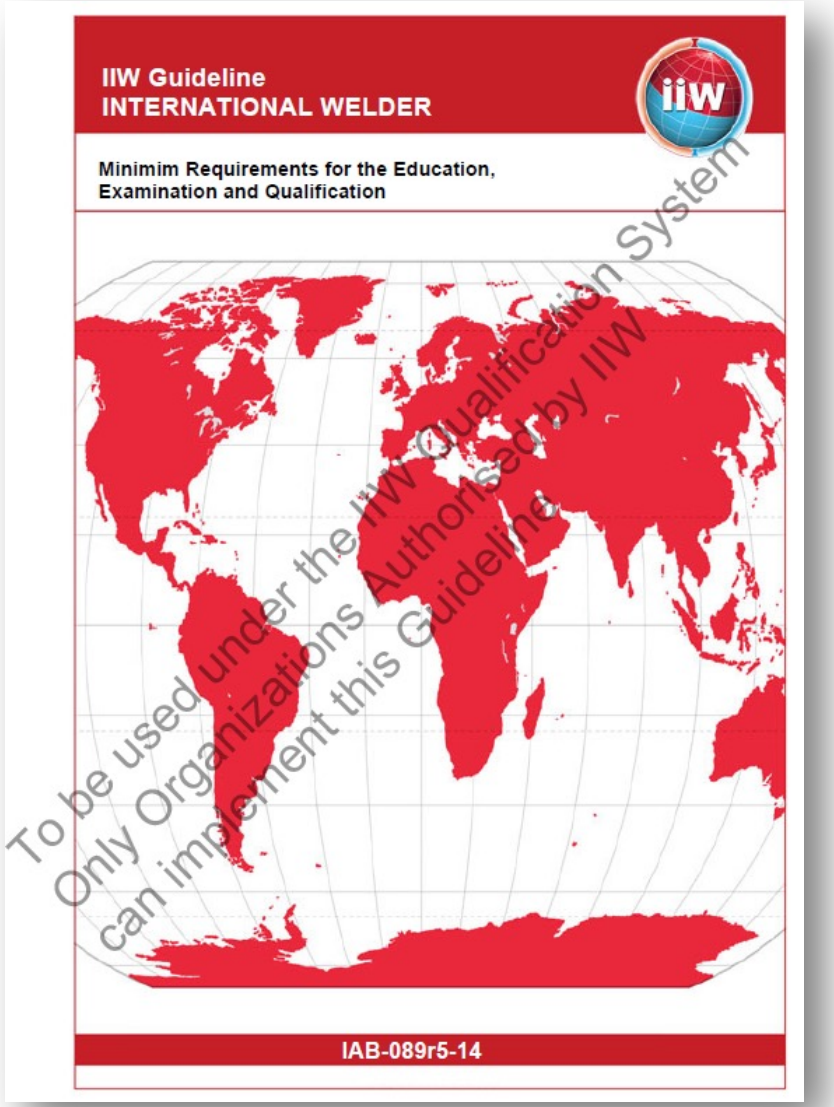
Blended learning is a combination of online and in-person instruction that allows for greater flexibility and customization in the learning experience. Here are some strategies for implementing a successful blended learning program:

1. Determine the best blend of online and in-person instruction: Identify the appropriate balance of online and in-person learning based on the subject matter, the target audience, and the available resources. For example, some topics may require more hands-on training than others, while some learners may prefer more online instruction.
2. Create engaging online content: Develop high-quality online content that is interactive and engaging, such as videos, quizzes, and simulations. This can help keep learners motivated and interested in the material.
3. Use a variety of instructional methods: Incorporate a range of instructional methods and materials, such as group discussions, case studies, and peer-to-peer learning, to cater to different learning styles and preferences.
4. Foster communication and collaboration: Use online discussion forums, video conferencing, and other tools to facilitate communication and collaboration among learners, as well as between learners and instructors.
5. Provide feedback and assessment: Use assessments and feedback mechanisms to monitor learner progress and provide timely feedback that helps learners identify areas for improvement.
6. Personalize the learning experience: Customize the learning experience based on the needs and preferences of individual learners, such as providing additional resources or support for those who need it.
7. Ensure technical support: Make sure learners have access to technical support and resources, such as troubleshooting guides and online help forums, to minimize technical issues and ensure a smooth learning experience.

By implementing these strategies, instructors can create effective blended learning programs that provide learners with a flexible, engaging, and personalized learning experience.

These strategies are facilitated through the teaching and learning platform *ItsLearning* which will be used as an educational tool in the different Competence Units (CUs). The CUs are structured as short courses with clear intended learning outcomes, specific learning outcomes but also what competence the pupils will gain after completed and examined CU. The Blended learning strategy is meet through several activities incorporated in each CU, both for the pupils and the instructors. Detailed instructions are outlined for each CU, both for pupils and instructors. The pupils do also have access to reference and learning materials which consists of lectures notes, power point, video materials etc. Furthermore, a pre-testing module of work experience related to the particular CU is available for the pupils including multiple tasks.

IIW Guideline – INTERNATIONAL WELDER connection to Competence Units



How do the **Intended Learning Outcomes** in the IIW Guideline connect to the different **Competence units**?

- Mapping of ILO for the different CUs

IIW Guideline – INTERNATIONAL WELDER connection to Competence Units

Competence Unit (CU) 1, Introduction, ICT and welding technology			
Content	**General Learning outcomes**	**Specific Learning Outcomes**	**Competence**
In this CU the students will get an introduction to the course, containing the following topics where they will learn to know each other and the teacher. A presentation of the course and the education methods for this course will be presented. The data tools in this course, Its Learning and ZOOM will be presented, and the students will be familiarized in how to use them for getting information, delivering reports and for communication purposes. A presentation of the education structure and methodology with emphasis on work-based training and how this will be implemented in the course will be presented and explained.	- Learn the EWF Guideline for International Welder - Be able to navigate through the available welding standards and select the right standard for a task - Get an overview of the welding standards - Be able to evaluate which other standards and procedures that shall be met during work - Be able to evaluate the HMS requirements for a job	- Know the basics responsibility for own work as a fillet welder - Identify the welders' responsibilities in fabrication - Understand the HMS responsibilities of the welder	The student will know how to: - Use the data tools needed for e-learning sessions - Use an LMS (its Learning) tool for extracting learning materials - Use an LMS tool for submitting tasks and solve multiple choice questions - Work in groups through using modern data tools, used in the course - Use Zoom, or similar, video communication tool to communicate with the teacher and other students
Connection to ILO (IIW Guideline – International Welder)	A1 (3, 4)		

IIW Guideline – INTERNATIONAL WELDER connection to Competence Units

CU 2, Evaluating a work order			
Content	**General Learning outcomes**	**Specific Learning Outcomes**	**Competence**
Through this CU the students will face the following situation: A work order has been released. The welder will get appropriate drawings and Welding Procedures t be used during his/her work. The student will evaluate the work order to see if all relevant information's are available	- Understand the basic terms of welding - Know the range of welder's certificate - Know the basic requirements for a welder's test for certificate	- Understand the validity of a welder's certificate - Understand the range of approval and the requirements for renewal of certificates - Understand which regulations will be required for the HMS	The student will know how to: - Follow up the validity of the welder's certificate according to ISO 9606 and ISO 14732 - Understand which standards that will be important for the job - Understand his/hers responsibility for reporting according ISO 6520 and ISO 5817
Connection to ILO (IIW Guideline – International Welder)	A1 (1, 2), A9 (1, 2)		

IIW Guideline – INTERNATIONAL WELDER connection to Competence Units

CU 3, Planning for starting the work order			
Content	**General Learning outcomes**	**Specific Learning Outcomes**	**Competence**
Through this CU the students will carry out planning activities for the work-order that has been given. This will include both the welding equipment for the job as well as the welding parameters and how to define any defects as a result of the work.	- Basic knowledge of welding on steel structures and piping - Identifying materials according to ISO/TR 20172 - Identify the main joint types according to ISO 9692 - Learn the welding symbols according to ISO 2553 - Understand the company's quality plan for this order	- The effect of welding parameters on the weld geometry - How to avoid magnetic arc blow - Know the different types of imperfections according to ISO 6520 - Describe the major components of the welding equipment	The student will know how to: - Identify joint types according to ISO 9692 - Report defects and imperfections according to ISO 5817 - Identify and verify materials according to ISO/TR 20172 - Read welding drawings and understand the meaning of welding symbols
Connection to ILO (IIW Guideline – International Welder)	Basic: A2 (1, 2, 3), A7 (1, 2, 3, 4, 5, 6), A8 (1, 2, 3)		

IIW Guideline – INTERNATIONAL WELDER connection to Competence Units

CU 4, Verification of HES before, during and after starting the work			
Content	**General Learning outcomes**	**Specific Learning Outcomes**	**Competence**
Through this CU the students will be able to verify the requirements for HMS on a personal level as well as the influence of the HES for the working environment. The student should be aware of the HES requirements for personal protection equipment, but also the need for protection of the workplace in order to ensure that the other employees are not affected by the work.	- Know the dangerous situations that can arise from the use of the welding equipment - Know how to ensure that the workplace is safe with the necessary marking for escape routes and so forth - How to ensure that the other employees have a safe working environment based on the welding activities - Know how to work in confined spaces	- Know the specific hazards in the working shop - Know the needs for ventilation - Know the measures to prevent noise hazards - Know how to prevent fire du to hot work - Know how to handle gas cylinders	The student will know how to: - Understand the hazards and basic safety regulations when welding - Perform welding operations in the workshop in a safe manner - Use personal protection equipment
Connection to ILO (IIW Guideline – International Welder)	Basic: A3 (1, 2, 3, 4, 5, 6, 7), A4 (1, 2, 3, 4)		

IIW Guideline – INTERNATIONAL WELDER connection to Competence Units

CU 5, Preparing the welding equipment and consumables			
Content	**General Learning outcomes**	**Specific Learning Outcomes**	**Competence**
The students will learn how the basic functions of the welding equipment as well as how to handle the welding consumables. This includes how to dry and store consumables in a correct way according to the manufacturer's guideline. Learn to work with a WPS and the influence of the welding parameters to the results of the weld pool.	- Know the use, types and function of the welding consumables (ISO 2560) - Know the different welding positions according to ISO 6947 - Know the different joints and the surface finish	- Identify the fillet welds and its size and shapes - Identify undercut and overlap in fillet welds - Daily maintenance of the welding equipment - Handling of gas bottles	The student will know how to: - Use a WPS in production - Perform welding operations in the workshop and to adjust the welding parameters - Maintain the welding equipment and report deviations - Handle gas bottles and safety procedures for gas equipment
Connection to ILO (IIW Guideline – International Welder)	Basic: A5 (1, 2, 3), A2 (1)		

IIW Guideline – INTERNATIONAL WELDER connection to Competence Units

CU 6, Assembly and tack welding			
Content	**General Learning outcomes**	**Specific Learning Outcomes**	**Competence**
The CU covers the topic of assembling the material and tack weld before final welding operations. The importance of correct assembly according to drawings and learn the consequences of a bad assembly will be covered.	- Have the basic knowledge of welding consumables for MIG/MAG tack welding - Know the typical parameters for MIG/MAG - Know the basic safety requirements for MIG/MAG	- Learn to know the different types of power sources and guns, earth cables and clamps - Learn to know the application of different wire sizes and gas - Selection of shielding gases - Verify that the tack weld has the same quality as the main weld - Droplet transfer (weld material transfer)	The student will know how to: - Assemble the materials in a correct manner and learn the consequences of a bad fit-up - Perform tack welding operations in the workshop - Evaluate the safety procedures for the tack welding - Apply the correct HMS measures when tack welding
Connection to ILO (IIW Guideline – International Welder)	Basic: SM-1 (1, 2, 3, 4), SM-2 (1), SM-3 (1)		

IIW Guideline – INTERNATIONAL WELDER connection to Competence Units

CU 7, Welding in position plate to plate			
Content	**General Learning outcomes**	**Specific Learning Outcomes**	**Competence**
The CU covers fillet weld on plates in position PA, PB, PD, PF according ISO 6947. This CU covers mainly practical tests and examinations on small plates in order to build competence in the welding process	- Adjust the welding parameters according fillet weld in different positions - Create sound fillet welds with the appropriate characteristics specified in the WPS - Create both single run and multi-run fillet welds - Carry out visual inspection on the welds	- Learn how the adjust the welding parameters to obtain the best fillet weld profile - Learn how to measure the fillet weld to ensure it complies with the WPS requirements	The student will know how to: - To carry out fillet welds on plates in the specified welding positions - Carry out single pass as well as multi-pass fillet welds - Take appropriate actions if the fillet weld is not correct - Adjust the welding parameters according to the welding positions
Connection to ILO (IIW Guideline – International Welder)	Basic: SM-4 (1, 2, 3, 4) M-2		

IIW Guideline – INTERNATIONAL WELDER connection to Competence Units

CU 8, Welding in position tube to plate			
Content	**General Learning outcomes**	**Specific Learning Outcomes**	**Competence**
The CU covers fillet weld on tube to plates in position PB, PH and PD. The CU covers both single pass as well as multi-pass fillet weld Through this CU the students will get basic	- Adjust the welding parameters according fillet weld in different positions - Create sound fillet welds with the appropriate parameters specified in the WPS - Create both single run and multi-run fillet welds - Carry out visual inspection on the welds	- Learn how the adjust the welding parameters to obtain the best fillet weld profile - Learn how to measure the fillet weld to ensure it complies with the WPS requirements	The student will know how to: - To carry out fillet welds on plates in the specified welding positions - Carry out single pass as well as multi-pass fillet welds - Adjust the welding parameters according to the welding positions - Take appropriate actions if the fillet weld is not correct
Connection to ILO (IIW Guideline – International Welder)	Basic: M-3, A7, B8, B9		

IIW Guideline – INTERNATIONAL WELDER connection to Competence Units

CU 9, Visual Inspection and Documentation after welding			
Content	**General Learning outcomes**	**Specific Learning Outcomes**	**Competence**
The students will be able to visually inspect the fillet welds and report their own work and to document any deviations. They will be able to use the most common tools for visual inspection and verification of the fillet welds. Implications of failure and the product reliability will be highlighted.	- Know why a weld will fail - Know the consequences of a failed weld - Know how to visually inspect a fillet weld	- Create visual inspection ow the welds - Document the results of visual inspection - Learn to use the tools for visual inspection - Implication of failure and product liability	The student will know how to: - Carry out visual inspection on single-pass and multi-pass fillet welds - Create a visual report as well as non-conformance report of fillet welds
Connection to ILO (IIW Guideline – International Welder)	Basic: C3		

IIW Guideline – INTERNATIONAL WELDER connection to Competence Units

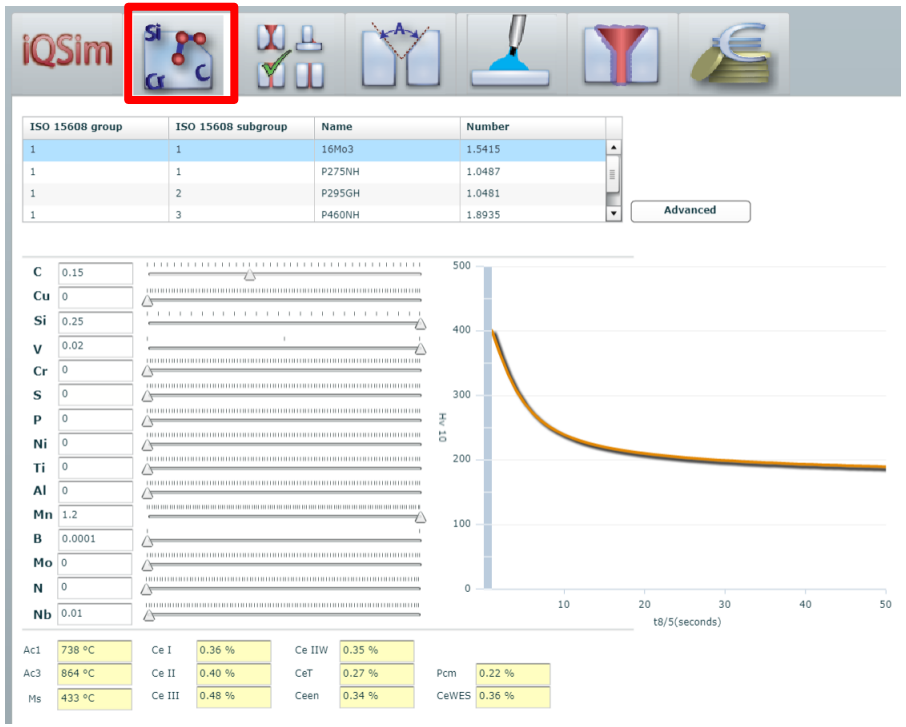
CU 10, Course summary, examination			
Content	**General Learning outcomes**	**Specific Learning Outcomes**	**Competence**
Product delivery and acceptance. This part of the course will be focusing on delivery of the product to the next production step. It also focuses on how to create non-conformance notice and corrective actions. It will be a summary of the course and for the preparation of final assessment of the course itself	- Understand the consequences of a product recall or reclamation. - Understand the knowledge and competence requirements for the final assessment	- Be able to verify and document own work - Be able to report according requirements in a work order	The student will know how to: - Submit a set of welds according to specifications and drawings with the required quality - Create a set of documentation for own work
Connection to ILO (IIW Guideline – International Welder)	Preparation for examination, both theoretical and practical tests Summary of course		

IQSIM

The idea behind the IQSim project is that the teachers and students need to evaluate a set of parameters in order to find out which parameters are the most important to focus on, in a given context.
The IQSim tool is consequently a dynamic tool to be used in an evaluation process. The tools should be used asking questions like: What happen if I select that parameter instead of another? IQSim is foreseen as an effective tool for the blended learning tool for IIW Fillet Welder where a combination of online and in-person instruction that allows for greater flexibility and customization in the learning experience

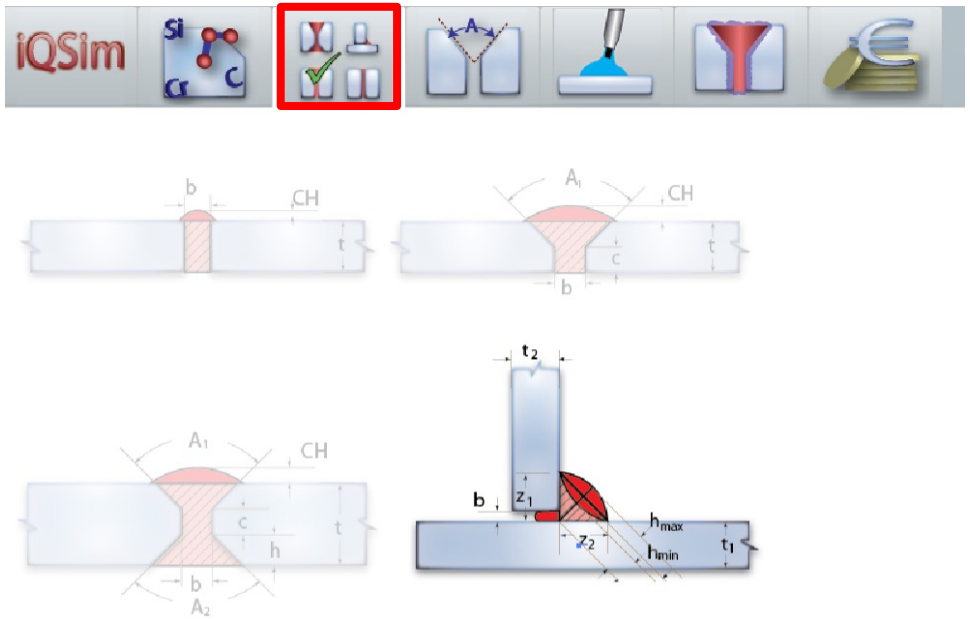
The IQSIM software, in its current version, includes the following modules, with options to select sequences and combine tasks.

Material Composition
Evaluate the consequences of alteration of the chemical compositions of the base material for CE, PCM values, etc

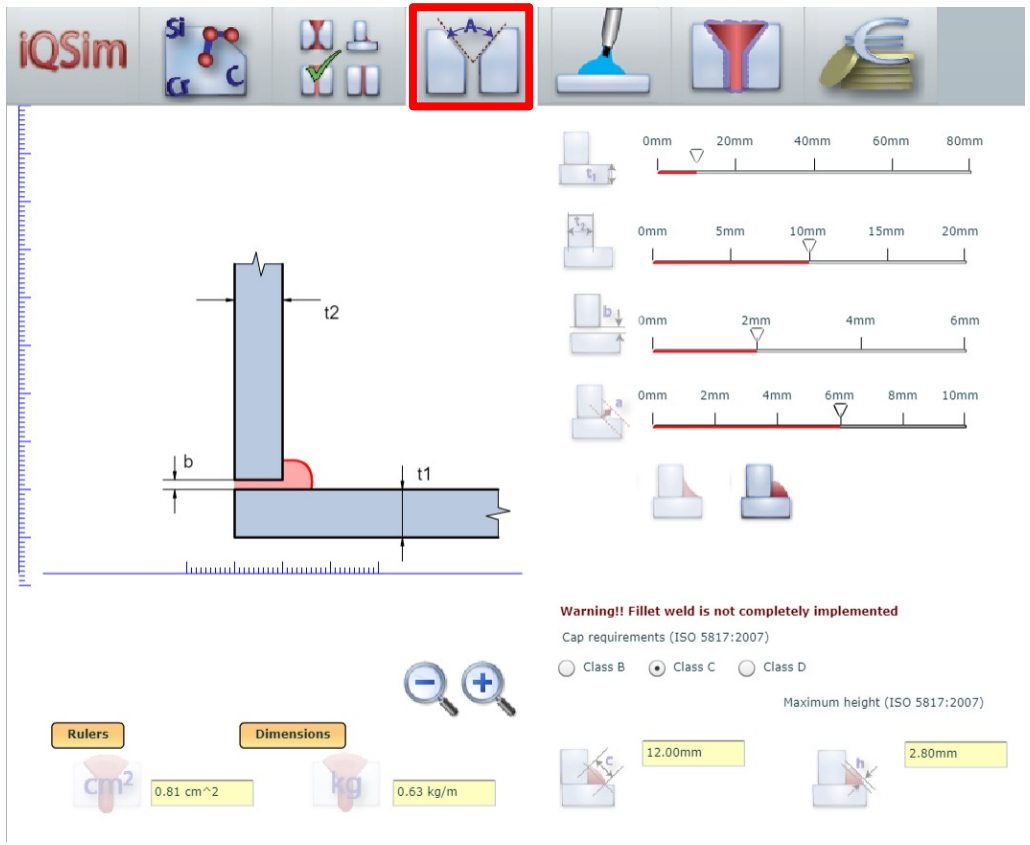


IQSIM

Joint type
In this section the joint type/configuration is selected

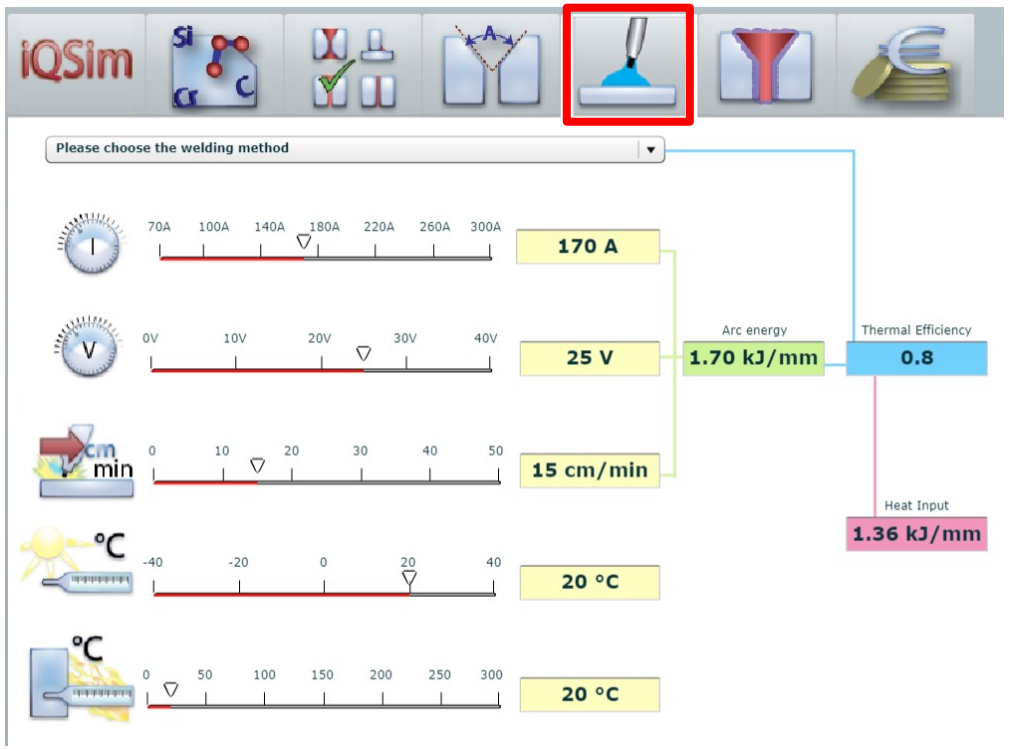


Joint type: weld dimensions and geometrical properties of the weld

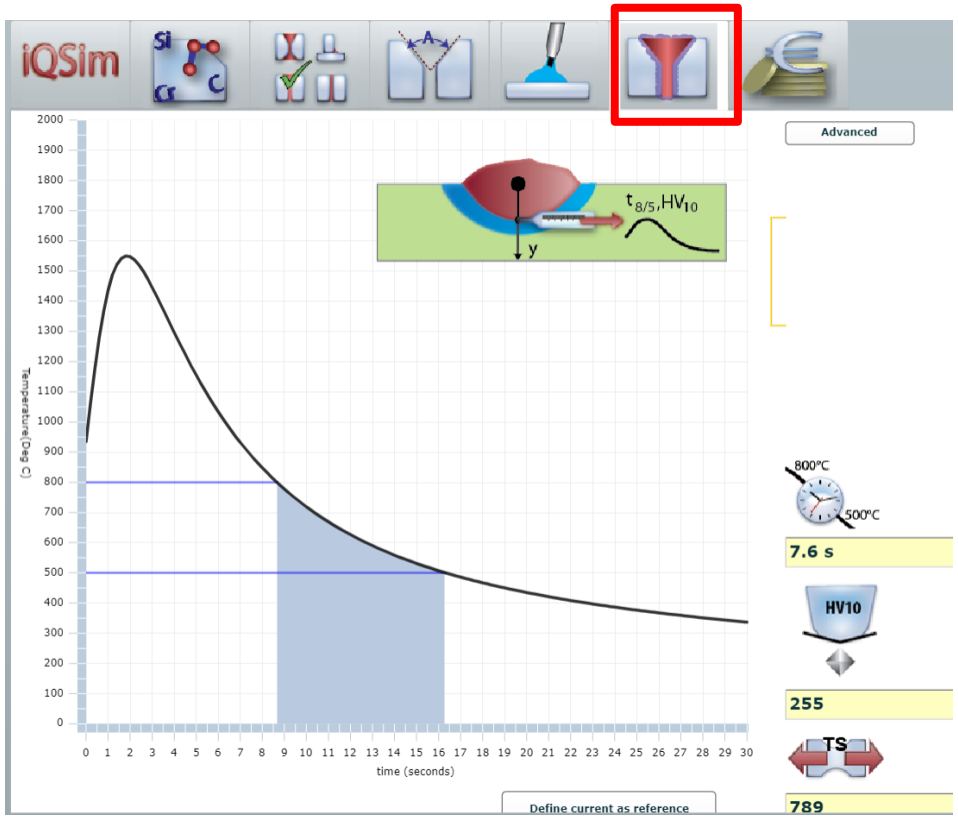


IQSIM

Welding method and process parameter



Hardness, cooling time and initial mechanical properties



IQSIM

Economical simulation and cost estimation