IIW Guideline for
International Welding Engineers, Technologists,
Specialists and Practitioners

Personnel with Qualification for Welding Coordination

Minimum Requirements for the Education, Examination and Qualification

IAB-252r6-26 - Part 1

MINIMUM REQUIREMENTS FOR THE EDUCATION, TRAINING, EXAMINATION, AND QUALIFICATION

PERSONNEL WITH QUALIFICATION FOR WELDING COORDINATION

(as described in ISO 14731 and other International and National Standards)

International Welding Engineer (IWE)
former: Doc. IAB-002-2000/EWF-409 Rev. 2

International Welding Technologist (IWT)
former: Doc. IAB-003-2000/EWF-410 Rev. 2

International Welding Specialist (IWS)
former: Doc. IAB-004-2000/EWF-411 Rev. 1

International Welding Practitioner (IWP)
former: Doc. IAB-005-2002/EWF-451 Rev. 1

Part 1 of the Guideline - General information for the public and organisations that implement these qualifications

For more information regarding the Qualifications System, the IAB/EWF Management Team or the National ANB should be contacted
(see in the IIW or EWF site the ANB contacts)

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Preface

This document is based upon the European Welding Engineer/ Technologist/ Specialist/ Practitioner Guidelines as developed by the European Federation for Welding, Joining and Cutting (EWF), through an Agreement first signed 19 July, 1997, at the Annual Meeting of the International Institute of Welding (IIW) in San Francisco, California, USA and which has been renewed and further developed since then. It has been established in that Agreement that the International Welding Engineer/ Technologist/ Specialist/ Practitioner Diploma is equivalent to the European Welding Engineer/ Technologist/ Specialist/ Practitioner Diploma.

The International Institute of Welding IIW has delegated the responsibility for the management of the qualification and certification systems to the International Authorisation Board (IAB).

This guideline for the international education, training, examination and qualification of welding personnel has been prepared, evaluated and formulated by Group A "Education, Training and Qualification" of the IAB.

Any EWF Authorised National Body ANB is permitted to issue EWF diplomas equivalent to IIW ones that have been issued by the same ANB (Automatic Route).

Copies of this document are available from the EWF/IAB Secretariat or the national ANB's.

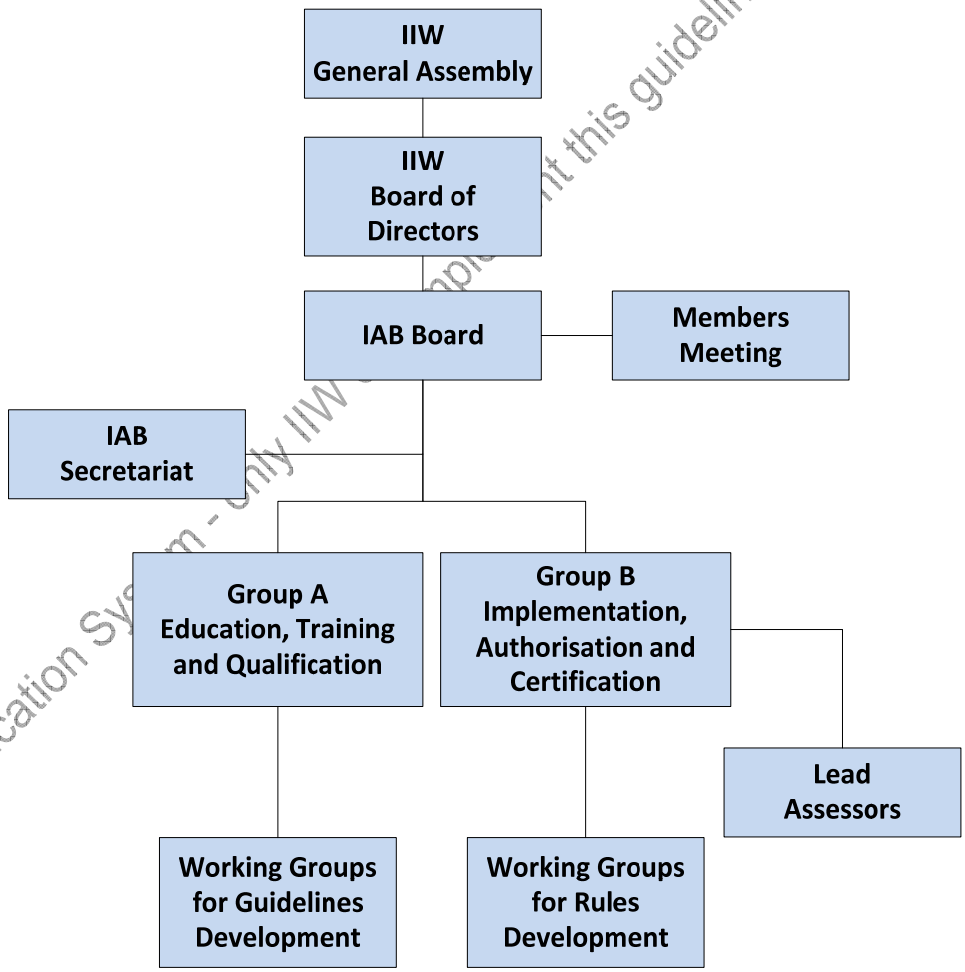

Figure 1: Organisation of the IAB

MINIMUM REQUIREMENTS FOR THE EDUCATION, TRAINING, EXAMINATION AND QUALIFICATION OF PERSONNEL

1 Introduction

Section I of the guideline covers the minimum requirements for education and training, which have been agreed upon by all IAB - ANBs, in terms of objectives, scope, Learning Outcomes and the contact (teaching) hours to be devoted to achieving them. It will be revised periodically by IAB Group A to take into account changes to reflect the "state of the art". Students successfully completing a course of education and examinations will be expected to be capable of applying the welding technology at a level consistent with the qualification diploma.

The modular course contents are given in the following structure (overview):

Competence Units	Contact Hours											
	IWE			IWT			IWS			IWP		
	CUT	P3	P1	CUT	P3	P1	CUT	P3	P1	CUT	P3	P1
Module 1 - Welding processes and equipment												
CU 1- Introduction to Welding Technology and Arc Power Source	0	0	0	4	0	4	1	1	0	7	4	3
CU 2 - Welding and Cutting Conventional Processes	4	4	0	19	8	11	13	10	3	21	6	15
CU 3 – Advanced Welding Processes	5	5	0	12	12	0	10	10	0	0	0	0
Subtotal CU 1 to CU 3	**9**	9	0	**35**	20	15	**24**	21	3	**28**	10	18
Cumulated Subtotal	**96**	60	36	**87**	51	36	**52**	31	21	**28**	10	18
Module 2 - Materials and their behaviour during welding												
CU 4- Introduction to Metallic Materials	0	0	0	8	0	8	0	0	0	8	0	8
CU 5- Steels and Their Weldability	9	9	0	20	14	6	18	15	3	10	6	4
CU 6 - Wear, Corrosion, Fractures and Application of Structural and High Strength Steels	1	0	1	7	5	2	4	3	1	3	3	0
CU 7 - Other Materials Then Steel	4	4	0	4	4	0	3	3	0	2	2	0
Subtotal CU 4 to CU 7	**14**	13	1	**39**	23	16	**25**	21	4	**23**	11	12
Cumulated Subtotal	**101**	68	33	**87**	55	32	**48**	32	16	**23**	11	12
Module 3 - Construction and design												
CU 8 - Design for Welding & Brazing	**18**	18	0	**20**	15	5	**18**	14	4	**6**	6	0
Cumulated Subtotal	**62**	53	9	**44**	35	9	**24**	20	4	**6**	6	0
Module 4 - Fabrication, applications engineering												
CU 09 – General features for Quality Management	7	7	0	7	7	0	7	7	0	9	9	0
CU 10- Quality Assurance /Quality Control on welded Joints	4	4	0	6	6	0	6	6	0	8	8	0
CU 11– Tests used for the Quality Control of weld Joints	9	9	0	10	10	0	9	9	0	8	8	0
CU 12 – Case Studies	12	12	0	14	14	0	14	14	0	0	0	0
Subtotal CU 9 to CU 12	**32**	32	0	**37**	37	0	**36**	36	0	**25**	25	0
Cumulated Subtotal	**130**	130	0	**98**	98	0	**61**	61	0	**25**	25	0
Subtotal Per Level	**73**	72	1	**131**	95	36	**103**	92	11	**82**	52	30
Cumulated Subtotal	**389**	311	78	**316**	239	77	**185**	144	41	**82**	52	30
Fundamental Practical Skills (Part 2)	**60**	----	----	**60**	----	----	**60**	----	----	**60**	----	---
Total	**449**	----	----	**376**	----	----	**245**	----	----	**142**	----	---
WORKLOAD **												
Per Level	**146**	----	----	**262**	----	----	**206**	----	----	**164**	----	---
Total	**778**	----	----	**632**	----	----	**370**	----	----	**164**	----	---

* Contact Hours are the minimum for the Standard Route, see 2.6;
** Workload is the amount of self-study hours;
*** The Part 1 duration stated on the above table for IWE and IWT, does not include the P1 of these levels when for the levels IWS and IWP the same subjects are referred as P3, e.g. for IWE P1 for subject 1.10 - SAW has the duration for IWT P1 + IWP P3 = 6h, see the detailed information under the Section I
CUT = Competence Unit Total (Part 1 + Part 3);
P1 = Part 1; P3 = Part 3
Figures under P1 are given for the Standard Route (see Section I).

The modular approach of IAB regarding the welding coordination education and training is based on the following aspects:

a. The training syllabus (detailed information is given in IAB-252 Part 2, latest edition) is divided in Competences Units (CU);
b. Each CU has the aim to provide the necessary knowledge, skills, autonomy and responsibility regarding specific welding coordination tasks and responsibilities;
c. Each CU is independent;
d. The education and training of the welding coordinators is now developed aiming to enable upgrading from a lower qualification level to a higher level/diploma without the need to attend the same training content. The student will attend only parts of the same CU providing a deeper knowledge, skills, autonomy and responsibility. For better understanding this approach an example is given:
    - IWE qualification applicant to be awarded the IWE diploma he/she must attend the training syllabus defined for the CUs and perform the related exams regarding: IWP + IWS + IWT + IWE.
    - From the above table it is shown for each qualification level the duration "subtotal per level" in the case for IWE this means the duration of the specific training syllabus only for the IWE level, and the "Cumulated Subtotal", is the sum of all lower' qualification levels, see figure 1 below;

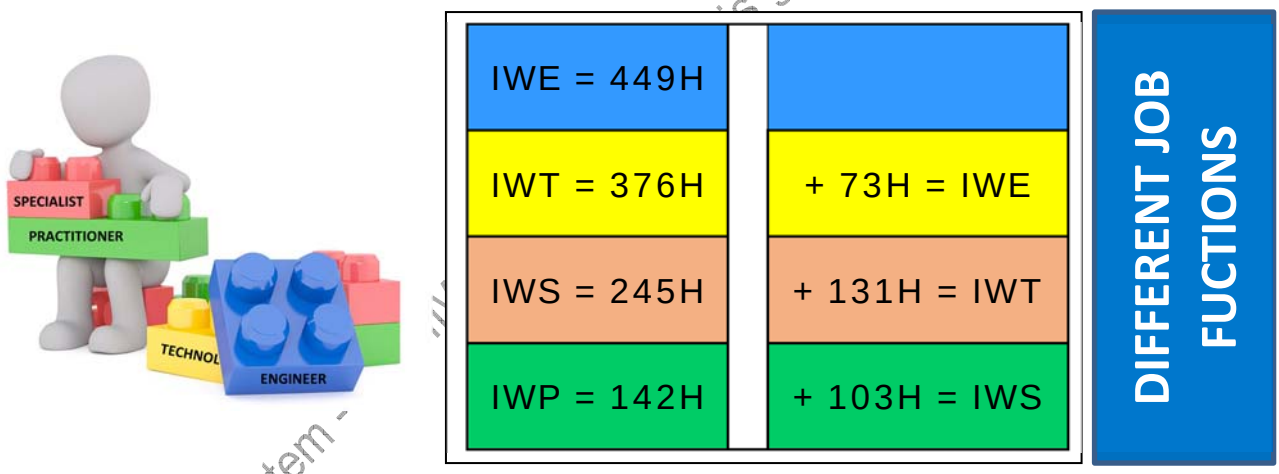

Figure 2 – IIW-IAB Modular-Competence Units System (Cumulative Training "Lego") - CUs approach

It is to be noted that the overall structure of the syllabus for all levels (IWE, IWT, IWS, and IWP) is similar, but some topics are not considered in all levels of qualification. These topics are indicated by 0 hours in this guideline. The depth of knowledge and skills to achieve is specified for all levels and all competence units (see I.2) and will be reflected in the scope and depth of the examination.

The expected results are described in two ways: generic outcome descriptors for each level, organized in knowledge, skills, autonomy and responsibility; and in detail for each level and competence unit, organized in job function, knowledge and skills.

Additionally, a classification for all levels is also assigned, reflecting the IIW-IAB/EWF Systems Framework (see Appendix IV) levels and its correlation with the European Qualifications Framework for Lifelong Learning (EQF).

The text on the following page is the IIW-IAB view of the relevant **Task Descriptions** and should be considered only as guidance to explain the level of knowledge, competence and skills, for each qualification level under this guideline.

Task Descriptions: Knowledge, skills and competence levels achieved for each qualification level and their correlation with ISO 14731

IWE – Knowledge, Competence and Management
A candidate completing the IWE training under this program is expected to acquire advanced knowledge and critical understanding of welding technology application.
He / she shall have advanced competence and skills at a level that is required in the field of welding technology which demonstrate:

- technology mastery and required innovation
- being able to solve high-level complex and unpredictable problems
- the ability to manage high complex technical and professional activities or projects related to welding applications
- taking responsibility for decision making in unpredictable work or study context
- taking responsibility for managing professional development of individuals and groups

IWT – Knowledge, Competence and Management
A candidate completing the IWT training under this program is expected to acquire an overall knowledge and understanding of welding technology application.
He / she shall have competence and skills at a level that is required in the field of welding technology which demonstrate:

- being able to solve low-level complex problems
- the ability to manage in detail the welding applications and related professional activities or projects
- taking responsibility for decision making in low-level complex work or study context
- taking responsibility to define the tasks of welding or related personnel
- being able to manage professional development of individuals and groups

IWS – Knowledge, Competence and Management
A candidate completing the IWS training under this program is expected to acquire a specialized and factual knowledge in the field of welding technology.
He / she shall have competence and skills at a level that is required in the field of welding technology which demonstrate:

- being able to develop solutions on common/regular problems
- being able to manage and supervise common or standard welding applications and related professional activities
- taking responsibility for decision making in common or standard work
- taking responsibility to supervise the tasks of welding and related personnel.

IWP – Knowledge, Competence and Management
A candidate completing the IWP training under this program is expected to acquire a basic knowledge in the field of welding technology.
He / she shall have competence and skills at a level that is required in the field of welding technology which demonstrate:

- being able to develop solutions on basic and specific problems
- being able to supervise basic welding applications and related professional activities
- taking responsibility for decision making in basic work
- taking responsibility to supervise the tasks of welding and related personnel

In correlation with essential coordination tasks as detailed in EN ISO 14731, the previous mentioned competences and skills will enable the candidate to effectively perform the following tasks:

Type of Construction concerned	IWE	IWT	IWS	IWP
	Any type	With a low level of complexity	Regular and common	Basic specific works
Welding construction contract requirements	able to review			not able to perform
Technical review of the welding construction	able to perform the task			not able to perform
Subcontracting activities	able to specify requirements and assessment protocol, to supervise implementation and monitor			able to supervise implementation and monitor
Welding personnel and related personnel needs and competences/ skills;	able to specify, supervise and manage			able to supervise the welding personnel and monitor
Equipment and means needed for the construction;	able to specify, validate and manage the equipment, including the calibration if needed			able to understand and supervise the proper use
Manufacturing plan;	able to specify, develop, validate and manage			able to monitor and implement
Welding procedures needed for the construction;	able to specify, develop, evaluate, validate and manage			able to understand, implement
Working instructions;	able to specify, develop, evaluate and manage			able to understand, implement
Base materials and welding consumables;	able to specify, validate and manage			able to monitor and supervise the proper use
Inspection Testing Plan;	able to specify, review, develop, evaluate, validate and manage			able to understand, implement and monitor
Heat treatments;	able to specify, develop, evaluate, validate and manage			able to understand, implement, supervise and monitor
Corrective actions to solve welded construction non-conformances;	able to specify, review, develop, evaluate, validate and manage			able to implement, monitor and control
Identification and traceability used in welding manufacturing;	able to specify, develop, evaluate, validate and manage processes			able to understand, control and supervise
Construction quality records.	able to specify, develop, evaluate, validate and manage processes related to monitor and control			able to collect, control, perform and supervise

2 Routes to Qualification

Three distinct routes to gaining the qualifications described in this document have been agreed.

1. The Standard Route
2. The Alternative Route
3. Distance Learning Route
4. The Experiential Route
5. Transition Route

2.1 The Standard Route

The Standard Route requires successful completion of IIW-IAB approved courses which are designed to meet all the requirements in this Guideline. This is the route (Path 1 in diagrams 1, 2, 3, and 4) recommended by IIW-IAB as offering the fastest, most comprehensive manner in which the syllabus may be covered.

The Standard Route also allows a limited amount of prior learning (Part 1 of each qualification course, see Section I) to be taken into account, for example during University or College courses or by blended learning (Path 2 in diagrams 1, 2, 3, and 4). This prior learning shall be approved by the ANB.

2.2 The Alternative Route

The Alternative Route is aimed at individuals who may already have experience of the job function at a particular level without holding the appropriate qualification diploma. These individuals will have already gained full or part knowledge of the syllabus defined in this guideline and can demonstrate their capability to proceed to examination either directly without compulsory attendance at an ANB approved training course or by attending only part of such a course.

For more detailed information about the Alternative Route see document IAB-442 (latest edition).

2.3 Distance Learning Route

The Part 1 theory Competence Units may be taught in Blended Learning Programs under control of the ANB.

When the Part 1 and Part 3 theory Competence Units are combined or the Part 3 theory Competence Units are taught separately the requirements of the latest edition of the Distance Learning Guideline IAB-195 (latest edition) shall be followed.

2.4 The experiential Route or "The Career Development Route"

The Experiential Route allows considering whether professional experiential learning can be recognised for career progression either from IWP diploma holders to IWS or IWS diploma holders to IWT courses who do not satisfy the relevant general access conditions. By this route it is possible to run a career path from the welder through the IWP and IWS up to the IWT, more detailed information is given on items 0 and 0.

2.5 The Transition Route

Each country's specific Transition Arrangements are approved by the IAB Group B and may be obtained from each Authorised Nominated Body.

An ANB can offer Transitional Arrangements with indefinite closing date according to the Rules IAB-001, paragraph 1.12 – latest edition

Practising Welding Engineers, Technologists, Specialists and Practitioners will be eligible for the award of the European Welding Engineer, Technologist, Specialist and Practitioner Diploma, if they can demonstrate to the ANB that their combination of education, training and experience in welding technology has provided a level of knowledge equivalent to the current IAB requirements and if they fulfil the ANB requirements defined in the Transition Arrangement Directory.

Two additional general rules shall be observed when applying the Transitional Arrangements:

1. Applicants shall possess the basic qualification and experience defined in relevant guideline and in the Access Condition Directory, Doc. IAB-020- (see latest edition).
2. Diplomas may be awarded under Transitional Arrangements in the following cases:

   a) by the ANB in the country in which the applicant received his/her welding qualification OR
   b) by the ANB in the country in which the applicant is currently practising, in contact with the ANB of the country in which the original qualification was issued.

2.6 Contact hours

The meaning of the contact hours is the following:

Standard Route:	minimum number of hours devoted to the subject
Alternative Route:	recommended number of hours devoted to the subject
Distance Learning:	recommended number of hours devoted to the subject
Part 1 (P1):	maximum number of hours devoted to the subject in Part 1
Part 3 (P3):	minimum or recommended number of hours devoted to the subject in Part 3

A "contact hour" shall contain at least 50 minutes of direct teaching time.

3 General Access Conditions

For any qualification stated on this guideline, the access conditions are referred below for each qualification. The below mandatory access conditions for each qualification level, shall be followed by the ANBs.

ANBs are not authorised to create more restrictive access conditions and shall accept any applicant that complies with the access conditions stated on the below tables for each qualification level.

The following general conditions shall be applied to all courses:

1. Students who have successfully passed the intermediate examination (Part 1) of the course are allowed to attend Part 2 and Part 3 of the course;

2. The implementation of the access conditions is the responsibility of the ANB.

In following parts of chapter 3 and in Special Requirements in chapter 4 of the guideline, diagrams are used for schematic illustration of the text. It should be noted that it is the text which is binding

3.1 International Welding Engineer - IWE

The access conditions for IWE, are defined on the Appendix III of this document all ANBs are binding to apply the access conditions as defined on the Appendix III. The IAB Group B will decide on conflicting cases between Applicants and ANBs about Access Condition.

In case of co-operation arrangements, e.g. with universities, according to which the IWE Part 1 (IWE 1) of the syllabus with scope, objectives, and learning outcomes (see Section I) is presented under careful control of the ANB, the participant is allowed to enter the IWE course through the Path 2 (see item 2.1 and the diagram 1 below).

The following additional conditions shall be observed for the different routes through the IWE course:

1. Students who have authenticated evidence that they have passed the examinations in all subjects of their Bachelor engineering degree studies but still have to complete a thesis are allowed to attend Part 2 (IWE 2) and Part 3 (IWE 3) of the IWE course and the corresponding written parts of the final examination;

2. Students shall present their degree diploma to the Board of Examiners before being allowed to take the final oral examination for IWE.

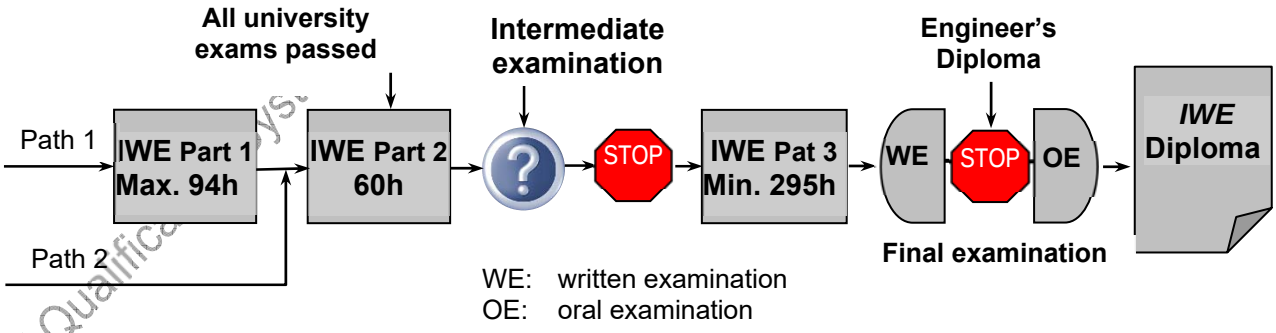

Diagram 1: IWE Route

3.2 International Welding Technologist - IWT

The access conditions for IWT, are defined on the Appendix IV of this document all ANBs are binding to apply the access conditions as defined on the Appendix IV. The IAB Group B will decide on conflicting cases between Applicants and ANBs about Access Condition.

In case of co-operation arrangements, e.g. with technical colleges, according to which the IWT Part 1 of the curriculum structure (see Section I) is presented under careful control of the ANB, the participant is allowed to enter the IWT course through Path 2 (see item 2.1 and the diagram 2 below).

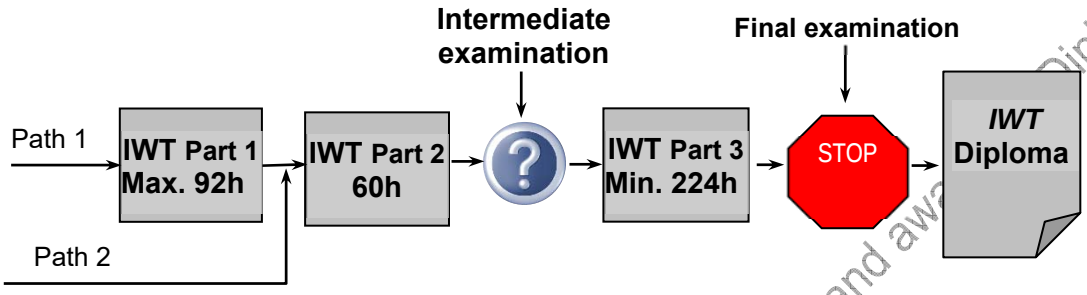

Diagram 2: IWT-Route

Applicants who have gained relevant industrial experience may take the Experiential Route to meet the General Access Conditions for IWT:

1. CIWS with a minimum of two years' experience, post certification, as responsible for welding coordination for a welded product manufacturer working in full compliance with the Standard Quality Requirements of ISO 3834-3 or above
   or

2. Six years of experience working at Technologist level, after gaining the IWS diploma and within the preceding eight years.

All Experiential Route applicants will be required to attend the IWT Part 3 taught course and pass all Technologist level examinations to gain the IWT diploma

3.3 European Welding Specialist IWS

It is agreed that entry to the program through Path 1 and 2 should be on the basis of a specific technical education below that required for the European Welding Technologist but higher than a professional worker, e.g. a relevant qualification from an accredited program:

- in accordance with the Dublin Accord for the professional qualification of engineering technicians, or
- an engineering qualification at EQF Level 4,
- or equivalent.

In case of co-operation arrangements, e.g. with technical colleges, according to which the IWS Part 1 of the curriculum structure (see Section I) is presented under careful control of the ANB, the participant is allowed to enter the IWS course through Path 2 (see item 2.1 and the diagram 3 below).

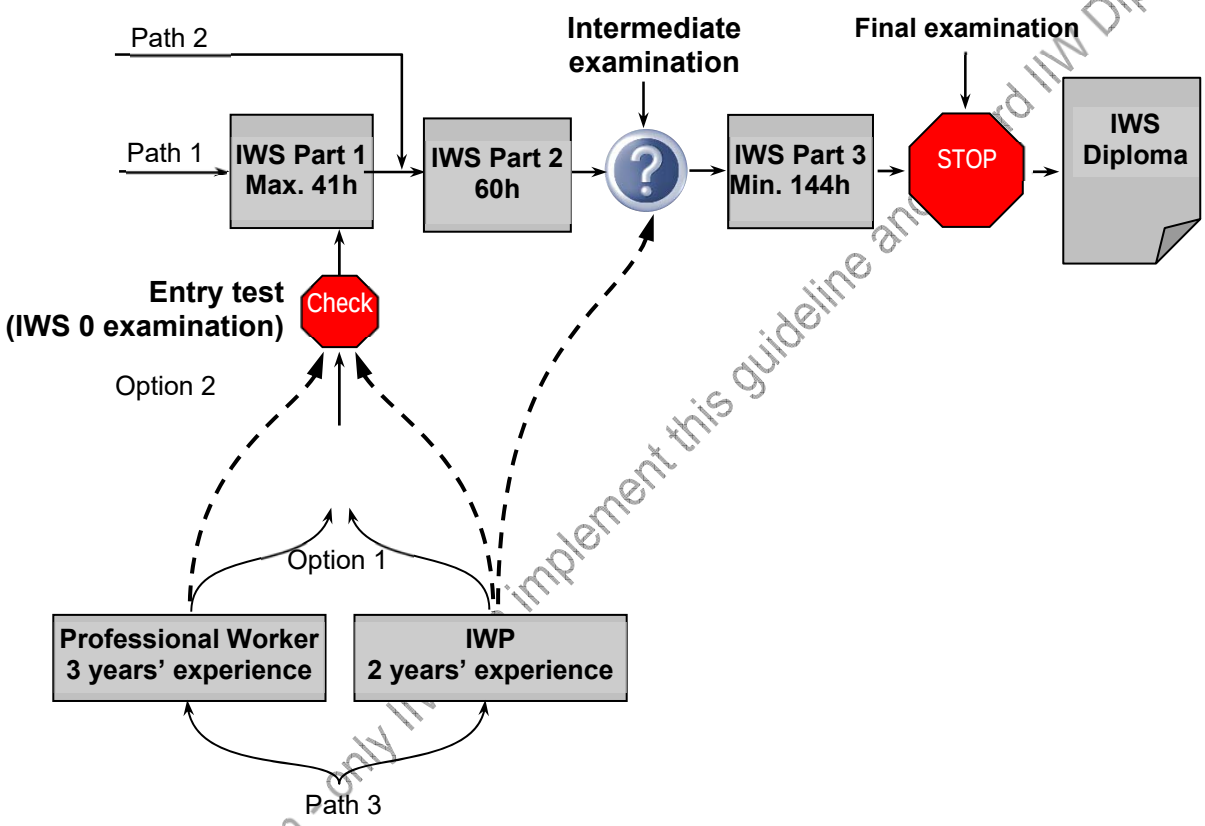

Diagram 3: IWS-Route

The following additional conditions shall be observed for the different routes through the IWS course:

1. Path 1 and 2: a minimum of 2 years job related experience is required;

2. Path 3: For the access to the Competence Unit 0: Basic Technical Knowledge the minimum requirements are:

   - European Welding Practitioner (IWP) and minimum 2 years' experience (see on above diagram option 1) OR
   - Qualification of a professional worker (with diploma after examination) in metalworking professions at EQF Level 3, or equivalent and minimum 3 years' experience in welding related activities,
   - The education National definitions for a professional worker are given in the Directory of Access Conditions (see on above diagram 3, option 1).

3a. A qualified professional worker (as stated above) not fulfilling the IWS National Access Requirements should be allowed to go directly to the IWS Part 0 examination if they can prove that they have achieved the knowledge prescribed by the CU 0 – Basic Technical Knowledge (see on above diagram 3, option 2).

3b. An IWP Diploma holder not fulfilling the IWS National Access Requirements should be allowed to go directly to the IWS CU0-BasicTechnical Knowledge examination if they can prove that they have achieved the knowledge prescribed by the IWS CU0-BasicTechnical Knowledge (see on above diagram option 2), if the applicant has success on this exam, he/she may skip the IWS Part 1 and only perform the IWS Part 1 intermediate exam. At the discretion of the ANB a partial or full exemption from Part 2 may be granted. (see diagram 3, option 2 and 4)

4. If the IWP Diploma holder fulfils the IWS National Access Requirements, he may skip the entry test (IWS Part CU0-Basic Technical Knowledge examination) and IWS Part 1 and only perform the IWS Part 1 intermediate exam (see on above diagram 3 option 3). At the discretion of the ANB a partial or full exemption from Part 2 may be granted.

3.4 International Welding Practitioner - IWP

In order to enter the European Welding Practitioner course, participants are required to be skilled in practical welding and to have had experience as a welder in industry.
The course is intended to build theoretical knowledge and practical welding skills.

In case of co-operation arrangements, e.g. with technical colleges, according to which the IWP Part 1 of the curriculum structure (see Section I) is presented under careful control of the ANB, the participant is allowed to enter the IWP course through the Route 2 (see item 2.1 and the diagram 4 below).

The following standard access conditions are applicable to the IWP course. Applicants are required to

1. Hold a valid pipe welder qualification certificate in accordance with ISO 9606-1/-2 H-L045 ss nb or J-LO45 ss nb or the combination PC and PH ss nb in the same material group;

Or

2. Hold a valid plate welder qualification certificate in accordance with ISO 9606-1 for the conditions PE ss nb or PC and PF ss nb, or in accordance with ISO 9606-2 for the conditions PE bs or PC and PF bs;

Or

3. Hold an alternative national welder qualification with the same range of qualification as that in 1 or 2 above;

And

4. Have, a recommended minimum of, 2 years job-related experience as plate or pipe welder.

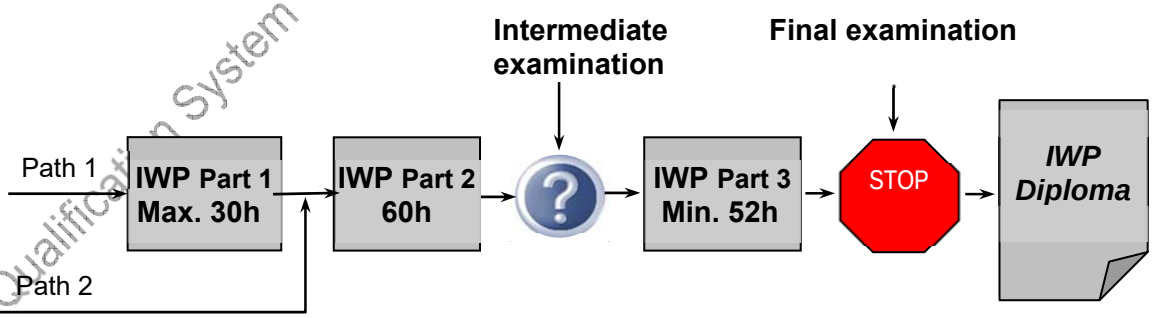

Diagram 4: IWP-Route

4 Special Requirements

4.1 Standard and Blended Learning Route

Applicants (excluding guests) shall satisfy the ANB access conditions. If the ANB decides that the access conditions are adequately met, the applicants are then required to attend a training course conducted by an Approved Training Body (ATB) giving as a minimum the hours of instruction detailed in this Guideline as contact hours. There will be written and oral examinations (where applicable) for the award of the applicable IIW Diploma.

The maximum amount of hours of the lectures, which can be included in Part 1 are given in the table included in Chapter 1 above.

It is not obligatory to follow exactly the order of the Competence Units given in this guideline and choice in the arrangement of the syllabus is permitted, with the exception that **training must conclude with Competence Units 10, 11 and 12. These Competence Units are part of Part 3.**

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

The objectives of the education, training and examinations in terms of learning outcomes are described in two ways: generically for each level (see Introduction); and more specifically and in more detail under the heading of 'Expected Result' in each section of the Syllabus.

The rules for the conduct of the final examination by the ANB are prescribed under Examination and Qualification in this guideline Part 2 (latest edition, not public).

4.2 Alternative Route

Applicants shall submit an application form to the ANB together with the appropriate documents indicated on the document IAB-442 (latest edition, not public).

The ANB shall check the documentation submitted to ensure the applicant meets the national Access Conditions (see doc IAB-020 - latest edition or the Appendix III for IWE). In addition, the ANB check should evaluate and verify the applicant's experience, training, education and practice of the job function in welding at the relevant qualification level. The result of this assessment shall determine if the applicant is suitable for further detailed assessment.

The Alternative Route, ANB evaluation process is describe in detailed on the document IAB-442 (latest edition, not public).

Section I: Theoretical and Practical Education – Qualification Descriptors and Learning Outcomes

I.1. Qualification Outcome Descriptors

QUALIFICATION	EQF/ EWF LEVEL	KNOWLEDGE	SKILLS	AUTONOMY AND RESPONSIBILITY
IWE	**7 / EXPERT**	Highly specialised and forefront knowledge including original thinking, research and critical assessment of theory, principles and applicability of welding related technologies.	Highly specialised problem- solving skills including critical and original evaluation, allowing to define or develop the best technical and economical solutions, when applying welding processes and related technologies, in complex and unpredictable conditions.	Manage and transform the welding processes and related technologies in a highly complex context. Act as the full responsible person for the definition and revision of the welding and related personnel's tasks.
IWT	**6 /ADVANCED**	Advanced knowledge and critical understanding of the theory, principles and applicability of welding and related technologies.	Advanced problem-solving skills including critical evaluation, allowing to choose the proper technical and economical solutions, when applying welding and related technologies, in complex and unpredictable conditions.	Manage the applications of welding and related technologies in a highly complex context. Act autonomously as the responsible person for the decision making and the definition of the welding and related personnel's tasks.
IWS	**5/SPECIALIZED**	Specialised, factual and theoretical knowledge of the theory, principles and applicability of the welding and related technologies.	Specialised range of cognitive and practical skills, allowing to develop solutions or choose the appropriate methods, when applying welding and related technologies, in common/regular problems.	Manage and supervise common or standard welding applications and related technologies, in an unpredictable context. Take responsibility with limited autonomy for decision making in common or standard work and supervise the welding and related personnel's tasks.
IWP	**4/INDEPENDENT**	Factual and theoretical knowledge (basic understanding) in the field of welding technology	Fundamental/basic cognitive and practical skills required to develop proper solutions on simple and specific welding problems.	Self-manage of professional activities and simple standard applications. Take responsibility for supervising routine welding tasks and related personnel, as well as for decision making in basic work.

Part 1 (P1) – for all levels, CUs, subjects duration

IWE level

CUs	Subjects	Duration
CU1/2/3	1.1	3
	1.2	2
	1.3	2
	1.4	3
	1.5	4
	1.6	2
	1.7	5
	1.8.1	8
	1.8.2	2
	1.9	6
	1.10	6
	1.13	4
	Total	47h

CUs	Subjects	Duration
CU4/5/6/7	2.1	4
	2.2	4
	2.3	5
	2.4	4
	2.5	4
	2.7	4
	2.8	4
	2.9	4
	Total	33h

CUs	Subjects	Duration
CU8	3.1	4
	3,2	6
	3.3	4
	Total	14h

Total Part 1 (P1) for IWE – 94h

IWT level

CUs	Subjects	Duration
CU1/ 2/3	1.1	3
	1.2	2
	1.3	2
	1.4	3
	1.5	4
	1.6	2
	1.7	5
	1.8.1	8
	1.8.2	2
	1.9	6
	1.10	6
	1.13	4
	Total	47h

CUs	Subjects	Duration
CU4/5/6/7	2.1	4
	2.2	4
	2.3	5
	2.4	4
	2.5	4
	2.7	2
	2.8	4
	2.9	4
	Total	31h

CUs	Subjects	Duration
CU8	3.1	4
	3,2	6
	3.3	4
	Total	14h

Total Part 1 (P1) for IWT – 92h

IWS level

CUs	Subjects	Duration
CU1/ 2/3	1.1	1
	1.2	1
	1.3	2
	1.6	1
	1.7	4
	1.8.1	6
	1.8.2	2
	1.9	4
	Total	21h

CUs	Subjects	Duration
CU4/5/6/7	2.1	2
	2.2	2
	2.3	3
	2.4	2
	2.5	2
	2.7	1
	2.8	2
	2.9	2
	Total	16h

CUs	Subjects	Duration
CU8	3.2	4
	Total	4h

Total Part 1 (P1) for IWS – 41h

IWP level

CUs	Subjects	Duration
CU1/ 2/3	1.1	1
	1.2	1
	1.3	2
	1.6	1
	1.7	2
	1.8.1	5
	1.8.2	2
	1.9	4
	Total	18h

CUs	Subjects	Duration
CU4/5/6/7	2.1	2
	2.2	2
	2.3	1
	2.4	2
	2.5	2
	2.8	1
	2.9	2
	Total	120

CUs	Subjects	Duration
CU8	3.3	2
	Total	2h

Total Part 1 (P1) for IWP – 30h

I.2. Competence Units Learning Outcomes

Competence Unit 1: Introduction to Welding Technology and Arc Power Source

CU 1- INTRODUCTION TO WELDING TECHNOLOGY AND ARC POWER SOURCE	CONTACT HOURS											
SUBJECT TITLE (the subjects code - ref.: IAB-252r5-19)	**IWE**			**IWT**			**IWS**			**IWP**		
	P1+P3	**P3**	**P1**	**P1+P3**	**P3**	**P1**	**P1+P3**	**P3**	**P1**	**P1+P3**	**P3**	**P1**
(1.1) General introduction to welding technology (P1 for all levels)	0	0	0	2	0	2	0	0	0	1	0	1
(1.3) Electrotechnics, a review (P1 for all levels)	0	0	0	0	0	0	0	0	0	2	0	2
(1.4) The arc (P1 only for IWE and IWT)	0	0	0	2	0	2	0	0	0	1	1	0
(1.5) Power sources for arc welding (P1 only for IWE and IWT)	0	0	0	0	0	0	1	1	0	3	3	0
Subtotal Per Level	**0**	0	0	**4**	0	4	**1**	1	0	**7**	4	3
Cumulated Subtotal	**12**	5	7	**12**	5	7	**8**	5	3	**7**	4	3
WORKLOAD												
PER LEVEL	**0**	----	----	**8**	----	----	**2**	----	----	**14**	----	----
CUMULATED	**24**	----	----	**24**	----	----	**16**	----	----	**14**	----	----
Important Note: When for a certain qualification level is allocate the P1 hours, this means for the same subject for that level the total duration of P1 hours is the sum of the P1 hours stated for the qualification level plus the hours for the same subject of the lower levels, e.g. for IWE P1 for subject 1.4 the duration is IWT P1 + IWP P3 = 3h												

QUALIFICA-TION	EQF/ EWF LEVEL	JOB FUNCTIONS AND ACTIVITIES - INTRODUCTION TO WELDING TECHNOLOGY AND ARC POWER SOURCES (high levels can perform lower level functions)	CON-TACT HOURS	WORK-LOAD
IWE	**7 / EXPERT**	IWE same as IWT	----	----
IWT	**6 /ADVANCED**	1. Manage arc welding conditions to minimize arc instability and arc blow 2. Manage and specify the most suitable power sources for a given application and/or environment	4	8
IWS	**5/SPECIALIZED**	1. Chose the most suitable power sources for a given application and/or environment	1	2
IWP	**4/INDEPENDENT**	1. Determine solutions to solve basic and simple arc welding instability and arc magnetic deflection problems 2. Check if the welders are using the proper power source for a given application	7	14

LEARNING OUTCOMES – INTRODUCTION TO WELDING TECHNOLOGY AND ARC POWER SOURCES				
Qualification	**IWE**	**IWT**	**IWS**	**IWP**
KNOWLEDGE	IWE same as IWT	Advanced knowledge and critical understanding of the theory, principles and applicability of: Welding technology The arc Power sources for arc welding Consumables, standards, storage and handling	Specialised and theoretical, principles and applicability of: Welding technology The arc Power sources for arc welding Consumables, standards, storage and handling	Factual and broad of: Welding technology The arc Power sources for arc welding Consumables, standards, storage and handling
SKILLS	IWE same as IWT	**Skills defined for IWP and IWS shall be added to the IWT and IWE bellow skills** • Describe the join/bound techniques (mechanical, adhesive, welding) enumerating the differences between them and types of energy used to generate the join/bound. • Justify in detail all the differences between each major type of welding process (e.g. fusion arc, resistance, flame, forge, etc.). • Explain in detail the fundamental physics of an electrical arc including the arc characteristics (e.g. the plasma, temperature profiles, radiation and electrical features' as all arc welds contain these aspects), arc parameters influencing arc stability and arc blow. • Explain in detail the arc characteristics for DC and AC including control and limitations. • Choose the most suitable power source for a certain arc welding application and/or environment, and implement its correct use, including the definition of the welding cables and workpiece clamps.	**Skills defined for IWP shall be added to the IWS bellow skills** • Describe the influence of magnetic field in welding. • Outline for each type of arc welding power source the various static characteristic, operation point and control of arc stability. • Identify the difference between conventional power sources, CPU controlled of power sources and inverter power sources. •	• Associate the most common welding processes to their common abbreviation and their identification code, applications, advantages and disadvantages. • Apply and fluently use the welding terminology /glossary on daily activities. • Outline the relation between current, voltage and electrical resistance, defining each electrical parameter. • Describe an electrical arc, naming its main areas and their importance to welding, arc stability and how the heat is generated in the arc. • Give assistance to welders and check with limited autonomy arc welding implementation with the goal of minimising arc instability factors and arc blow during arc welding. • List the major functions of the most important components of welding power sources. • List the major differences between DC and AC current referenced in applications to different welding processes. • List the most important power source electrical characteristics, such as: open circuit voltage, arc voltage short circuit current, duty cycle of a power source, voltage losses, and current to cable section relationship.

Competence Unit 2: Welding and Cutting Conventional Processes

CU 2- Welding and Cutting Conventional Processes	CONTACT HOURS											
SUBJECT TITLE (the subjects code - ref.: IAB-252r5-19,)	IWE			IWT			IWS			IWP		
	P1+P3	P3	P1	P1+P3	P3	P1	P1+P3	P3	P1	P1+P3	P3	P1
(1.2) Oxy-gas Welding and related processes (P1 for all levels)	0	0	0	1	0	1	0	0	0	1	0	1
(1.6) Introduction to gas shielded arc welding (P1 for all levels)	0	0	0	1	0	1	0	0	0	1	0	1
(1.7) TIG Welding (P1 for all levels)	0	0	0	1	0	1	2	0	2	2	0	2
(1.8.1) MIG/MAG (P1 for all levels)	0	0	0	2	0	2	1	0	1	5	0	5
(1.8.2) Flux Cored Arc Welding (P1 for all levels)	0	0	0	0	0	0	0	0	0	2	0	2
(1.9) MMA Welding (P1 for all levels)	0	0	0	2	0	2	0	0	0	4	0	4
(1.10) Submerged-Arc Welding (P1 only for IWE and IWT)	0	0	0	2	0	2	0	0	0	4	4	0
(1.13) Cutting, Drilling and other edge preparation processes (P1 only for IWE and IWT)	0	0	0	2	0	2	0	0	0	2	2	0
(1.15) Fully mechanised processes and robotics	2	2	0	2	2	0	4	4	0	0	0	0
(1.16) Brazing and soldering	0	0	0	2	2	0	2	2	0	0	0	0
(1.19) Welding laboratory	2	2	0	4	4	0	4	4	0	0	0	0
Subtotal Per Level	**4**	4	0	**19**	8	11	**13**	10	3	**21**	6	15
Cumulated Subtotal	**57**	28	29	**53**	24	29	**34**	16	18	**21**	6	15
WORKLOAD												
PER LEVEL	**8**	----	----	**38**	----	----	**26**	----	----	**42**	----	----
CUMULATED	**112**	----	----	**104**	----	----	**66**	----	----	**42**	----	----
Important Note: When for a certain qualification level is allocate the P1 hours, this means for the same subject for that level the total duration of P1 hours is the sum of the P1 hours stated for the qualification level plus the hours for the same subject of the lower levels, e.g. for IWE P1 for subject 1.10 the duration is IWT P1 + IWP P3 = 6h												

QUALIFICA-TION	EQF/ EWF LEVEL	JOB FUNCTIONS AND ACTIVITIES - WELDING AND CUTTING CONVENTIONAL PROCESSES (high levels can perform lower level functions)	CON-TACT HOURS	WORK-LOAD
IWE	**7 / EXPERT**	1. Choose for high complex constructions the appropriate welding, brazing and cutting process including the parameters and filler materials 2. Decide on meccanization, automation and or robot methods for welding and cutting applications and all necessary means for implementation 3. Analyse weld beads and cut surfaces on high complex constructions, in order to determine process problems 4. Manage and specify welding consumables (shielding gases, filler materials and electrodes) for any kind of application	**4**	**8**
IWT	**6 /ADVANCED**	1. Manage the activities regarding the implementation of the most common welding and cutting processes and potential problems to be overcome	**19**	**38**

		2. Choose for complex constructions the appropriate welding, brazing and cutting process including the parameters and filler materials 3. Decide on meccanization, automation and or robot methods for welding and cutting applications 4. Analyse weld beads and cut surfaces on complex constructions, in order to determine process problems 5. Manage and specify welding consumables (shielding gases, filler materials and electrodes) for any kind of application		
IWS	**5/SPECIALIZED**	1. Supervise the activities regarding the implementation of the most common welding and cutting processes and potential problems to be overcome 2. Choose for basic constructions the appropriate welding, brazing and cutting process including the parameters range and filler materials 3. Recommend meccanization, automation and or robot methods for welding and cutting applications 4. Analyse weld beads and cut surfaces on basic constructions, in order to determine process problems 5. Manage and specify welding consumables (shielding gases, filler materials and electrodes) for regular applications	**13**	**26**
IWP	**4/INDEPENDENT**	1. Verify the activities regarding the implementation of the most common welding and cutting processes and potential problems to be overcome 2. Choose for simple constructions the appropriate welding and cutting process including the parameters range and filler materials 3. Supervise the use of welding consumables	**21**	**42**

LEARNING OUTCOMES – WELDING AND CUTTING CONVENTIONAL PROCESSES				
Qualification	**IWE**	**IWT**	**IWS**	**IWP**
KNOWLEDGE	Highly specialised knowledge and critical assessment of theory, principles and applicability of: Conventional welding/cutting/brazing/soldering processes working principles, welding/cutting parameters, most common applications, advantages and disadvantages Fully mechanised processes and robotics applications, advantages and disadvantages	Advanced knowledge and critical understanding of the theory, principles and applicability of: Conventional welding/cutting/brazing/soldering processes working principles, welding/cutting parameters, most common applications, advantages and disadvantages Fully mechanised processes and robotics applications, advantages and disadvantages	Specialised and theoretical, principles and applicability of: Conventional welding/cutting/brazing/soldering processes working principles, welding/cutting parameters, most common applications, advantages and disadvantages Fully mechanised processes and robotics applications, advantages and disadvantages	Factual and broad of: Conventional welding/cutting processes working principles, welding/cutting parameters, most common applications, advantages and disadvantages

SKILLS	**Skills defined for IWP, IWS and IWT shall be added to the IWE bellow skills** • Review different applications for each welding, cutting and gouging process. • Review different applications for each welding process when applied to narrow gap or orbital welding. • Predict the best solution for higher productivity in welding using robotics, automation and mechanisation. • Evaluate weld beads and cut surfaces, in order to predict process problems.	**Skills defined for IWP and IWS shall be added to the IWT bellow skills** For the following cutting and gouging processes: electron beam, laser, and water jet cutting For the following welding processes: Oxi-gas, TIG, MIG/MAG, Flux Cored, SAW, MMA For brazing and soldering processes For each process • Characterise the Oxy-gas fuel gases, Flame combustion reactions and flame temperature distribution. • Interpret arc characteristics associated with each type of shielding gas used for each process. • Explain the factors and predict the influence on the weld bead shape and morphology (internal and external) or cutting surface, according to the welding/cutting parameters used. • Manage and assess the activities regarding the choice of gases, filler materials, electrodes and fluxes for arc welding processes. • Explain in detail the principles of each welding process, including arc ignition methods, their application and problems to be overcome. • Select and justify for each welding process for a certain application: the appropriate type of current, polarity, shielding gas, electrode (specific for TIG, electrode choices associated with dopants, thermionic emission and correct tip shapes), filler material and fluxes. • Describe the various settings and switches on different welding process power sources and their effects on the welded joint. • Determine the range of application for joint preparations and joint fit up and potential problems to be overcome.	**Skills defined for IWP shall be added to the IWS bellow skills** For brazing and soldering processes For the following welding processes: TIG, MIG/MAG, SAW, MMA • Recognize the influence of the process parameters on the weld bead shape, cutting/gouging surface, choosing the appropriate range of values for welding/cutting/gouging parameters for a certain application. • Indicate the range of application, appropriate joint preparations and potential problems to be overcome. • Define the appropriate electrode type, size and correct tip shapes, gas cups and the use of gas lenses for a particular application (for TIG only). • Identify MIG/MAG special techniques and their applications: electro-gas welding, high efficiency processes, spot welding, single wire and multiple wire techniques, flat wire, brazing, electronic stability control (arc and wire feed), etc. • Identify the several types of MMA electrodes covering, their application, the functions of the electrodes coating and rod. • Identify the relationship between MMA electrode diameter, current range, rod material, electrode length and welding position to be applied. • Identify the influence of the SAW wire-flux combination regarding the characteristics of deposited material. • Outline SAW single-wire and multi-wire applications and specific problems to overcome. • Describe the different techniques and standards operating procedures identifying the main variables for brazing and soldering techniques.	For the following welding processes: Oxi-gas, TIG, MIG/MAG, Flux Cored, SAW, MMA For the following cutting and gouging processes: Oxi-flame, Plasma, carbon arc, oxi-arc, shielded metal arc For each process, either welding or cutting/gouging: • Outline its working principles, including arc ignition methods (when applicable), their most common applications, advantages and disadvantages. • Outline the characteristics of the electrical arc or the flames types due to the type of gases and current (when applicable). • Identify the required equipment for each process referencing the purpose and working principle of the main components of the equipment and accessories. • Outline the role of gases (for flame applications and for shielding, differentiate inert and active), filler materials, electrodes and fluxes in given applications. • Identify gases, filler materials, electrodes and fluxes according to the related standards classifications. • Detail the backing methods an backing gases used for one side welding. • Outline the basic rules to select consumables (filler materials, electrodes, gases and fluxes). • Identify the metal transfer modes for MIG/MAG and relate them with the welding application, e.g. thickness and position. • Identify the process parameters on the weld bead shape, cutting/gouging surface, choosing the appropriate range of values for welding/cutting/gouging parameters for a certain application.

		• Deduce welding parameters range for welding processes application and its influence on the weld bead. • Explain the principles of MIG/MAG welding including metal transfer modes and their application. • Interpret and apply the appropriate standards that classify the welding consumables (gases, filler materials, electrodes and fluxes) to be choose for a particular material, polarity and current. • Detail the influence of the MMA electrode coating constituents on the arc stability and on the droplet transfer and weld metal properties, the slag-metal and gas-metal reactions on weld metal properties. • Select the correct MMA electrode-coating classification and diameter, current and materials for a certain material to be weld and the welding attitude (position). • Detail the backing methods used for one side welding. • Explain the influence on the SAW of the slag-metal and gas-metal reactions on weld metal properties, justifying all the influencing factors and their particular effects. • Select flux-wire classification and materials used for Submerged-Arc Welding. • Explain in detail the principles of working and delimit the range of application for the following cutting and gouging process: mechanical, flame, arc, plasma, electron beam, laser, and water jet cutting. • Discuss the influence of each parameter for the above-mentioned processes on the edge surface quality. • Predict the potential risks, hazards for Cutting, Drilling and other edge preparation processes.	• Outline the influence of surface preparation, types and characteristics of consumables and fluxes employed on brazing and soldering techniques. • Outline the advantages and disadvantages of robotics, automation and mechanisation of welding processes pointing out the techniques used for seam tracking and their differences. • Indicate the features of the most common industrial applications (e.g. narrow gap and orbital welding). • Outline potential risks, hazards and methods of safe handling and working related with automatic, mechanised and robotics in welding processes. • Supervise the implementation of solutions for higher productivity in welding using robotics, automation and mechanisation.	• Describe the welding/cutting/gouging techniques methods for a given application and potential problems to overcome. • Indicate the potential hazards and simple methods of safe handling, storage and working practices.

LEARNING OUTCOMES – WELDING AND CUTTING CONVENTIONAL PROCESSES				
Qualification	**IWE**	**IWT**	**IWS**	**IWP**
		• Explain the differences between off-line and on-line programming. • Explain the principle, benefits and application of each type of seam tracking system and of narrow gap and orbital welding. • Select solutions for higher productivity in welding using robotics, automation and mechanisation. • Deduce the different applications for each brazing and soldering techniques, including joint preparations and potential problems to be overcome.		

Competence Unit 3: Advanced Welding Processes

CU 3- Advanced Welding Processes	CONTACT HOURS											
SUBJECT TITLE (the subjects code - ref.: IAB-252r5-19,)	**IWE**			**IWT**			**IWS**			**IWP**		
	P1+P3	**P3**	**P1**	**P1+P3**	**P3**	**P1**	**P1+P3**	**P3**	**P1**	**P1+P3**	**P3**	**P1**
(1.11) Resistance Welding (Spot welding, seam welding, projection welding, flash and upset welding, percussion welding)	0	0	0	3	3	0	3	3	0	0	0	0
(1.12.1) Laser; Electron Beam; Plasma (welding and cutting except for plasma only welding)	3	3	0	3	3	0	2	2	0	0	0	0
(1.12.2) Other Welding Processes (for example explosion welding, ultrasonic welding, friction welding, diffusion welding, stud welding, magnetically impaled arc welding, etc.)	2	2	0	2	2	0	2	2	0	0	0	0
(1.14) Surfacing and Spraying	0	0	0	1	1	0	1	1	0	0	0	0
(1.17) Joining processes for plastics	0	0	0	2	2	0	2	2	0	0	0	0
(1.18) Joining processes for ceramics and composites	0	0	0	1	1	0	0	0	0	0	0	0
Subtotal Per Level	**5**	5	0	**12**	12	0	**10**	10	0	**0**	0	0
Cumulated Subtotal	**27**	27	**0**	**22**	2	**0**	**10**	10	0	**0**	0	0
WORKLOAD												
PER LEVEL	**10**	----	----	**24**	----	----	**20**	----	----	**0**	----	----
CUMULATED	**54**	----	----	**44**	----	----	**20**	----	----	**0**	----	----

QUALIFICA-TION	EQF/ EWF LEVEL	JOB FUNCTIONS AND ACTIVITIES - ADVANCED WELDING PROCESSES (high levels can perform lower level functions)	CON-TACT HOURS	WORK-LOAD
IWE	**7 / EXPERT**	1. Choose for high complex constructions the appropriate advanced welding processes including the parameters and filler materials 2. Analyse weld beads and cut surfaces on high complex constructions, in order to determine process problems	**5**	**10**
IWT	**6 /ADVANCED**	1. Manage the activities regarding the implementation of advanced welding processes and potential problems to be overcome 2. Choose for complex constructions the appropriate advance welding processes, including the parameters and filler materials 3. Analyse weld beads and cut surfaces on complex constructions, in order to determine process problems	**12**	**24**
IWS	**5/SPECIALIZED**	1. Supervise the implementation of the activities regarding the application of the joining processes 2. Under limited guidance, verify the parameters and settings of the welding processes, spraying and surfacing	**10**	**20**
IWP	**4/INDEPENDENT**	----------		

LEARNING OUTCOMES – ADVANCED WELDING PROCESSES				
Qualification	**IWE**	**IWT**	**IWS**	**IWP**
KNOWLEDGE	Highly specialised knowledge and critical assessment of theory, principles and applicability Advanced welding processes, processes parameters, applications, advantages and disadvantages. Methods for surfacing and spraying, characteristics of each method, applications, advantages and disadvantages.	Advanced knowledge and critical understanding of the theory, principles and applicability Advanced welding processes, processes parameters, applications, advantages and disadvantages. Methods for surfacing and spraying, characteristics of each method, applications, advantages and disadvantages.	Specialised and theoretical, principles and applicability of Advanced welding processes, processes parameters, applications, advantages and disadvantages. Methods for surfacing and spraying, characteristics of each method, applications, advantages and disadvantages.	----------
SKILLS	**Skills defined for IWP, IWS and IWT shall be added to the IWE bellow skills** For the following welding processes: Laser, laser- hybrid, Electron Beam, Plasma, ceramics and composites • Deduce the influence of the welding parameters on the weld bead, defining appropriate joint preparations and potential problems to be overcome for each process for a given application. • Describe the various types and characteristics of consumables and activators employed for joining ceramics and composites.	**Skills defined for IWP and IWS shall be added to the IWT bellow skills** For the following welding processes: Laser, laser- hybrid, Electron Beam, Plasma electro-slag, friction; friction stir, magnetically impelled arc butt (MIAB); magnetic pulse welding, ultrasonic; explosive; diffusion; aluminothermic; high-frequency; stud, cold-pressure welding, resistance welding, surfacing and spraying, joining processes for plastics • Explain for each process the purpose and functions of the typical equipment's, accessories, main welding parameters and their influence on the weld and surface preparation characteristics. • Explain the influence of the welding parameters to achieve a sound weld/join. • For resistance welding, detail how to control the process, the systems monitoring, parameters measuring, and specific tests used to evaluate the weld. • For surfacing and spraying, state the pre-processing precautions that should be taken prior to surfacing to ensure integrity. Interpret the appropriate standards for the electrodes, filler materials and gases (when applicable) associated with consumable selection, testing and processing variables.	For the following welding processes: Laser, Electron Beam, Plasma, Electro-slag, friction; friction stir, magnetically impelled arc butt (MIAB); magnetic pulse welding, ultrasonic; explosive; diffusion; aluminothermic; high-frequency; stud, cold-pressure welding, resistance welding, surfacing and spraying, joining processes for plastics • Outline the operating principles and range of application of the welding processes in the different industrial fields´. • Compare the applicability of the welding processes (Laser, Electron Beam and Plasma) • Outline the criteria for the selection of the correct pressure and current cycles. • Indicate for each process, the typical equipment's, main welding parameters and their influence on the weld. • List the typical consumables for each process (when applicable). • Describe the influence of the surface characteristics (for welding resistance, spraying and surfacing) on the final quality of the joints and the causes of the common discontinuities and their prevention. • Recognise potential hazards and methods of safe handling and working.	----------

Competence Unit 4: Introduction to Metallic Materials

CU 4- Introduction to Metallic Materials	CONTACT HOURS											
SUBJECT TITLE (the subjects code - ref.: IAB-252r5-19,)	IWE			IWT			IWS			IWP		
	P1+P3	P3	P1	P1+P3	P3	P1	P1+P3	P3	P1	P1+P3	P3	P1
(2.1) Structure and properties of metals (P1 for all levels)	0	0	0	2	0	2	0	0	0	2	0	2
(2.2) Phase Diagrams and Alloys (P1 for all levels)	0	0	0	2	0	2	0	0	0	2	0	2
(2.4) Manufacture and classification of steels (P1 for all levels)	0	0	0	2	0	2	0	0	0	2	0	2
(2.5) Behaviour of structural steels in fusion welding (P1 for all levels)	0	0	0	2	0	2	0	0	0	2	0	2
Subtotal Per Level	**0**	0	0	**8**	0	8	**0**	0	0	**8**	0	8
Cumulated Subtotal	**16**	0	16	**16**	0	16	**8**	0	8	**8**	0	8
WORKLOAD												
PER LEVEL	**0**	----	----	**16**	----	----	**0**	----	----	**16**	----	----
CUMULATED	**32**	----	----	**32**	----	----	**16**	----	----	**16**	----	----
Important Note: When for a certain qualification level is allocate the P1 hours, this means for the same subject for that level the total duration of P1 hours is the sum of the P1 hours stated for the qualification level plus the hours for the same subject of the lower levels, e.g. for IWE P1 for subject 2.1 the duration is IWT P1 + IWP P1 = 4h												

QUALIFICATION	EQF/ EWF LEVEL	JOB FUNCTIONS AND ACTIVITIES - INTRODUCTION TO METALLIC MATERIALS (high levels can perform lower level functions)	CONTACT HOURS	WORKLOAD
IWE	**7 / EXPERT**	Same as IWT	**0**	**0**
IWT	**6 /ADVANCED**	1. Specify a steel inspection certificate for a certain construction 2. Specify steels for a certain construction according to their standards designation 3. Specify the welding conditions to ensure the weld joint will achieve the proper level of mechanical properties	**8**	**16**
IWS	**5/SPECIALIZED**	Same as IWP	**0**	**0**
IWP	**4/INDEPENDENT**	1. Interpret inspection certificates (i.e EN 10204) of steels. 2. Apply standards for steel designation and standards on rolling products 3. Supervise the welding of steels ensuring the weld joint will achieve the proper level of mechanical properties	**8**	**16**

LEARNING OUTCOMES – INTRODUCTION TO METALLIC MATERIALS				
Qualification	**IWE**	**IWT**	**IWS**	**IWP**
KNOWLEDGE	Same as IWT	Advanced knowledge and critical understanding of the theory, principles and applicability of: Structure and properties of metals; Classification of steels; Behaviour of structural steels.	Same as IWP	Factual and broad of: Structure and properties of metals; Classification of steels; Behaviour of structural steels.

LEARNING OUTCOMES – INTRODUCTION TO METALLIC MATERIALS				
Qualification	**IWE**	**IWT**	**IWS**	**IWP**
SKILLS	Same as IWT	**Skills defined for IWP and IWS shall be added to the IWT bellow skills** • Describe the structures of pure metals and alloys. • Explain the effect of loading conditions and temperature on the mechanical properties of metallic materials. • Deduce the mechanical properties of metallic materials according to their structures. • Describe the differences between elastic, plastic, cold and hot deformation that can occur in metals. • Explain the advantages and disadvantages of metals recrystallization, work hardening and strain ageing. • Predict the changes in the crystallographic structures of metals following welding. • Interpret crystalline lattice distortion from given alloying elements and subsequent structural changes. • Compare the mechanisms of precipitation, types of precipitates and their location within the microstructure. • Explain, in detail, the principles of transformation and conditions of structure under which it occurs. • Interpret in detail the phase diagrams information on steels, Stainless Steels, Aluminium alloys and Nickel Alloys and apply phase diagrams to define microstructures, mechanical properties and alloys. • Explain in detail the steel making possible processes. • Compare the influence of impurities and chemical composition on basic mechanical properties. • Explain how steel is processed by rolling and casting . • Decide on acceptance methods and types of inspection documents regarding steels. • Differentiate the weldability of steels, based on the factors (e.g. heat input, carbon equivalent, metal structure, cooling rate, weld pool solidification, single run, multi run) that will influence the weldability. • Predict the effects of heat input, cooling rate and multi- pass operation on weld metal solidification and the microstructure formed for a single-pass weld versus a multi-pass weld. • Deduce the influence of the heat input and thermal cycle management in order to obtain the best mechanical properties and avoid cracking on the weld joint. • Discuss in detail binary and ternary alloy diagrams including the microstructures.	Same as IWS	• Identify the basic mechanical properties of metals. • Outline the effect of loading conditions and temperature on the mechanical properties of metallic materials. • Outline a typical weld solidification structure and the most common principles of strengthening mechanisms. • Outline alloys and binary phase diagrams identifying alloy microstructures from given phase diagrams. • Describe steel making and processing of steel products (rolling and casting). • Identify the most common properties of a steel and types of steel. • Outline the influence of the weld thermal cycle, the peak temperature and the cooling rate when welding steels on the mechanical properties of a weld joint. • Identify on the weld joint the major regions, the HAZ sub regions, the reasons for grain size and microstructure changes and their effects on properties for a single pass weld versus a multi-pass weld including the microstructure formed during welding. • Recognize the weldability of steels, based on the factors (e.g. heat input, carbon equivalent, metal structure, cooling rate, weld pool solidification, single run, multi run) that will influence the weldability.

Competence Unit 5: Steels and Their Weldability

CU 5 - Steels and their Weldability	CONTACT HOURS											
SUBJECT TITLE (the subjects code - ref.: IAB-252r5-19,)	IWE			IWT			IWS			IWP		
	P1+P3	P3	P1	P1+P3	P3	P1	P1+P3	P3	P1	P1+P3	P3	P1
(2.3) Iron – carbon alloys (P1 for all levels)	0	0	0	2	0	2	2	0	2	1	0	1
(2.9) Structural (unalloyed) steels (P1 for all levels)	0	0	0	2	0	2	0	0	0	2	0	2
(2.10) High strength steels	2	2	0	4	4	0	3	3	0	1	1	0
(2.12) Creep and creep resistant steels	1	1	0	1	1	0	2	2	0	0	0	0
(2.13) Steels for cryogenic applications	1	1	0	1	1	0	2	2	0	0	0	0
(2.15) Stainless and heat resistant steels	3	3	0	4	4	0	3	3	0	2	2	0
(2.6) Cracking phenomena in welded joints	2	2	0	2	2	0	2	2	0	2	2	0
(2.8) Heat treatment of base materials and welded joints	0	0	0	2	0	2	1	0	1	1	0	1
(2.22) Joining dissimilar materials	0	0	0	2	2	0	1	1	0	1	1	0
(2.17) Cast irons and steels	0	0	0	0	0	0	2	2	0	0	0	0
Subtotal Per Level	**9**	9	0	**20**	14	6	**18**	15	3	**10**	6	4
Cumulated Subtotal	**57**	57	0	**48**	42	13	**28**	21	7	**10**	6	4
WORKLOAD												
PER LEVEL	**18**	----	----	**40**	----	----	**36**	----	----	**20**	----	----
CUMULATED	**114**	----	----	**96**	----	----	**56**	----	----	**20**	----	----
Important Note: When for a certain qualification level is allocate the P1 hours, this means for the same subject for that level the total duration of P1 hours is the sum of the P1 hours stated for the qualification level plus the hours for the same subject of the lower levels, e.g. for IWE P1 for subject 2.3 the duration is IWT P1 + IWS P1 + IWP P1 = 5h												

QUALIFICA-TION	EQF/ EWF LEVEL	JOB FUNCTIONS AND ACTIVITIES - STEELS AND THEIR WELDABILITY (high levels can perform lower level functions)	CON-TACT HOURS	WORK-LOAD
IWE	**7 / EXPERT**	1. Define and manage the appropriate welding processes and filler materials for any type of steel 1. Define and manage post weld heat treatments for any type of welded construction	**9**	**18**
IWT	**6 /ADVANCED**	1. Define and manage the appropriate welding processes and filler materials for each type of steel 2. Evaluate weld joints and select options that may be applied to control the welding variables to avoid cracking 3. Define and select tests to verify crack susceptibility in steels 4. Define and manage post weld heat treatments. 1. Define and manage the process and consumable type to achieve quality requirements for dissimilar metal welds	**20**	**40**
IWS	**5/SPECIALIZED**	1. Evaluate weld joints and, under limited guidance, select options that may be applied to control the welding variables to avoid cracking	**18**	**36**

		1. Select, under limited guidance, the process and consumable type to achieve quality requirements for a given dissimilar metal weld in a given application		
IWP	**4/INDEPENDENT**	1. Implement the appropriate welding processes and filler materials for each type of steel 2. Apply with limited autonomy basic procedures to eliminate cracking phenomena. 1. Supervise with limited autonomy post weld heat treatment.	**10**	**20**

LEARNING OUTCOMES – STEELS AND THEIR WELDABILITY				
Qualification	**IWE**	**IWT**	**IWS**	**IWP**
KNOWLEDGE	Highly specialised knowledge and critical assessment of theory, principles and applicability of steels (including cast steels and iron): Weldability Main causes of cracking and how to avoid Types and goals of heat treatment techniques Joining dissimilar materials	Advanced knowledge and critical understanding of the theory, principles and applicability of steels (including cast steels and iron): Weldability Main causes of cracking and how to avoid Types and goals of heat treatment techniques Joining dissimilar materials	Specialised and theoretical, principles and applicability of steels (including cast steels and iron): Weldability Main causes of cracking and how to avoid Types and goals of heat treatment techniques Joining dissimilar materials	Factual and broad of steels (including cast steels and iron): Weldability Main causes of cracking and how to avoid Types and goals of heat treatment techniques Joining dissimilar materials

SKILLS	**Skills defined for IWP, IWS and IWT shall be added to the IWE bellow skills** For the following types of steels: unalloyed, low, high alloy steels (including stainless), cast iron and steels. For the following type of steels applications: structural, creep, heat resistant, cryogenic and corrosion. • Explain in detail the different methods to obtain fine-grained steels, including the effects of micro-alloying, relating grain refinement to mechanical properties. • Decide the type of heat treatments requirements for a certain weld joint, inferring the heat treatment conditions (depending of the type and thickness of steel), the application and the code. • Define the welding conditions for a certain weld joint taking into account the material weldability, t 8/5 concept, preheat and interpass temperature, CE, and influence of welding process on HAZ (microstructure, properties). • Analyse stainless steels, their weldability and applications (fully austenitic, ferrite-containing steels, ferritic, martensitic, precipitation hardened, duplex stainless steels, chemically resistant, creep resistant, heat resistant steels, superferritic, supermartensitic and superaustenitic stainless steel e.g. duplex and lean duplex stainless steel). • Discuss and predict how to prevent Knifeline attack, 475 °C-embrittlement in a certain application or weld joint. • Predict creep life by use of tests such as Creep sensitivity, step cooling (Temper embrittlement) to decide the use of a certain creep material in a certain application or the influence of the weld in the creep life.	**Skills defined for IWP and IWS shall be added to the IWT bellow skills** For the following types of steels: unalloyed, low, high alloy steels (including stainless), cast iron and steels. For the following type of steels applications: structural, creep, heat resistant, cryogenic and corrosion. • Predict the microstructure of a steel (Fe-C system) from a TTT or CCT diagram. • Compare the influences of alloying elements and cooling rate on steels and casts microstructure. • Explain the process and consequences on steels of grain growth and grain refinement, comparing the mechanical properties achieved through grain refinement or when there has grain growth. • Explain in detail the different methods to obtain fine-grained steels, including the effects of micro-alloying. • Compare the main grades and properties of unalloyed, low and high alloyed steels (including stainless) and cast iron and cast steels. • Predict the effect of welding process and filler metal selection on weld HAZ properties. • Explain in detail the fundamental aspects of the phenomena and phases of creep, relating the effects of alloying elements and steel structure to creep resistance. • Predict remaining creep life by use of the most common methods. • Explain the effect of nickel on crystallographic structure, comparing the effect of differing levels of nickel content on weldability of cryogenic steels. • Explain methods of toughness testing and the parameters affecting toughness, relating the creep and cryogenic steels microstructure to toughness.	**Skills defined for IWP shall be added to the IWS bellow skills** For the following types of steels: unalloyed, low, high alloy steels (including stainless), cast iron and steels. For the following type of steels applications: structural, creep, heat resistant, cryogenic and corrosion. • Read simple TTT and CCT diagrams. • Describe the different methods to obtain fine-grained steels. • Classify the different types of: stainless, high strengths, cast steels and cast irons. • Describe the Fe - C phase diagram with particular attention to carbon content over 2%, comparing the different types of cast irons and steels, their chemical composition and crystallographic structures. • Categorise the weldability, describing the common problems of the several types of steels and casts, applying the appropriate welding processes and filler materials and specific measures to overcome weldability problems for each type of steel and casts. • List the range of possible industrial applications for steels and casts. • Outline the aspects of the creep phenomena and phases of creep. • Describe the rules and principles governing corrosion phenomena. • Identify heat treatment conditions (in particular temperature) for given welding processes and steel grades and casts, associating code requirements. • Recognise the type and cause of cracking from study of fractured material and its history. • Describe the main weldability aspects involved when joining dissimilar materials. • Choose appropriate consumables based on given Schaeffler / De Long /WRC diagrams.	For the following types of steels: unalloyed, low, high alloy steels (including stainless). For the following type of steels applications: structural, creep, heat resistant, cryogenic and corrosion. • Identify phases in the Fe-C diagram, outlining the most relevant aspects of the Fe-C diagram (types of Fe-C alloys). • Recognise the effects of alloying elements on the steel and steel properties. • Recall the main types, grades and properties of unalloyed, low and high alloyed steels (including stainless). • Outline the relationship between grain refinement and mechanical properties of steels. • List the ways to prevent grain coarse on steels. • Compare hardness of steels according to their composition and cooling rate, hardenability, identifying carbide forming elements. • Point out the most common problems regarding the weldability of the several types of steels. • Outline the major heat treatments and their objectives used for based materials and on the welded joints. • List the necessary conditions/requirements needed to perform heat treatment after welding depending of the type and thickness of steel, the application and the product standards and/or construction codes and the code. • Identify the several types of cracking and the reason for its occurrence: cold cracking, hot cracking, and lamellar tearing. • Identify appropriate precautions that will reduce or eliminate the occurrence of cold cracking, hot cracking, and lamellar tearing in welded fabrication. • Outline the most common weldability aspects involved when joining dissimilar materials.

		• Assess the weldability of creep, heat resistant steels, and cryogenic steels considering appropriate welding processes and types of consumables. • Explain the structures of the various types of stainless steels; parent metal, HAZ and weld metal. • Interpret the Fe-Cr-Ni phase diagram for a given high alloy welds with various carbon contents. • Explain the rules and principles governing embrittlement phenomena. • Explain the rules and principles governing in detail corrosion phenomena. • Compare heat resistance relative to the effects of alloying elements. • Explain the microstructural phenomena occurring in materials at high temperature • Compare the properties of creep resistant and heat resistant steels. • Infer welding metallurgical phases from Schaeffler / De Long /WRC diagram, considering the limitations of using Schaeffler / De Long /WRC diagrams, selecting the welding process and consumables for each type of stainless steel using different diagrams. • Explain in detail for each type of cracking (cold cracking, hot cracking, reheat cracking and lamellar tearing): the mechanisms, the factors that influence it and prevention and control methods to avoid cracking. • Compare in detail, for each type of cracking, the weld joint susceptibility (type of materials, thickness, etc.), the effects of inclusions, joint configuration, stress and fatigue. • Infer the type and cause of cracking from study of fractured material and its history. • Select suitable tests that will assist in finding the solution of cracking problems. • Assess appropriate precautions to avoid cracking, appraising a welded joint and se-		

LEARNING OUTCOMES – STEELS AND THEIR WELDABILITY				
Qualification	**IWE**	**IWT**	**IWS**	**IWP**
		lecting options that may be applied to determine and control the welding variables to avoid cracking • Explain and compare in detail, the effect of each heat treatment on steels and casts microstructure • Interpret the code requirements for a certain heat treatment, predicting the heat treatment conditions after welding depending of the type and thickness of steel, the application and the code. • Predict the mechanical property outputs after heat treatment taking in consideration of hardenability, mass effects and rolling sections. • Explain the metallurgical and weldability aspects involved when joining dissimilar materials		

Competence Unit 6: Wear, Corrosion, Fractures and Application of Structural and High Strength Steels

CU 6 - WEAR, CORROSION, FRACTURES AND APPLICATION OF STRUCTURAL AND HIGH STRENGTH STEELS	CONTACT HOURS											
SUBJECT TITLE (the subjects code - ref.: IAB-252r5-19,)	IWE			IWT			IWS			IWP		
	P1+P3	P3	P1	P1+P3	P3	P1	P1+P3	P3	P1	P1+P3	P3	P1
(2.7) Fractures and different kinds of fractures	1	0	1	2	0	2	1	0	1	0	0	0
(2.11) Application of structural and high strength steels	0	0	0	0	0	0	0	0	0	2	2	0
(2.14) Introduction to corrosion	0	0	0	2	2	0	1	1	0	1	1	0
(2.16) Introduction to wear and protective layers	0	0	0	3	3	0	2	2	0	0	0	0
Subtotal Per Level	**1**	0	1	**7**	5	2	**4**	3	1	**3**	3	0
Cumulated Subtotal	**15**	11	4	**14**	11	3	**7**	6	1	**3**	3	0
WORKLOAD												
PER LEVEL	**2**	----	----	**14**	----	----	**8**	----	----	**6**	----	----
CUMULATED	**30**	----	----	**28**	----	----	**14**	----	----	**6**	----	----
Important Note: When for a certain qualification level is allocate the P1 hours, this means for the same subject for that level the total duration of P1 hours is the sum of the P1 hours stated for the qualification level plus the hours for the same subject of the lower levels, e.g. for IWE P1 for subject 2.7 the duration is IWE P1 + IWT P1 + IWS P1 = 4h												

QUALIFICATION	EQF/ EWF LEVEL	JOB FUNCTIONS AND ACTIVITIES - WEAR, CORROSION, FRACTURES AND APPLICATION OF STRUCTURAL AND HIGH STRENGTH STEELS (high levels can perform lower level functions)	CONTACT HOURS	WORKLOAD
IWE	**7 / EXPERT**	Same as IWT	**1**	**2**
IWT	**6 /ADVANCED**	1. Manage if the welding procedure is suitable for a certain job. 2. Define measures to avoid brittle fractures during welding and implement corrective actions for eliminating brittle fractures 3. Define measures to avoid corrosion problems due to the execution of welds 1. Define procedures and solutions for material wear problems with protective layers	**7**	**14**
IWS	**5/SPECIALIZED**	1. Verify if the welding procedure is suitable for a certain job. 2. Implement under supervision measures to minimize corrosion. 1. Implement under supervision, solutions for material wear problems with protective layers.	**4**	**8**
IWP	**4/INDEPENDENT**	1. Identify the need for passivation and measures to minimize overall corrosion	**3**	**6**

LEARNING OUTCOMES – WEAR, CORROSION, FRACTURES AND APPLICATION OF STRUCTURAL AND HIGH STRENGTH STEELS				
Qualification	**IWE**	**IWT**	**IWS**	**IWP**
KNOWLEDGE	**Same as IWT**	**Knowledge defined for IWS and IWP shall be added to the IWT bellow knowledge** Advanced knowledge and critical understanding of the theory, principles and applicability of: Fractures and different kinds of fractures Application of structural and high strength steels Types of corrosion and methods to control corrosion Types of wear and protective layers	**Knowledge defined for IWP shall be added to the IWS bellow knowledge** Specialised and theoretical, principles and applicability of: Fractures and different kinds of fractures Application of structural and high strength steels Types of corrosion and methods to control corrosion Types of wear and protective layers	Basic knowledge to understand and identify: Application of structural and high strength steels Overall corrosion and the need for passivation

LEARNING OUTCOMES – WEAR, CORROSION, FRACTURES AND APPLICATION OF STRUCTURAL AND HIGH STRENGTH STEELS				
Qualification	**IWE**	**IWT**	**IWS**	**IWP**
SKILLS	Same as IWT	**Skills defined for IWS shall be added to the IWT bellow skills** • Explain in detail the differences between cracks and fractures comparing the formation mechanisms of different types of fractures. • Assess fracture types given fracture surface information. • Apply Failure Assessment Diagrams (FADs) to a fracture case study, identify the type of fracture and predict its likely cause. • Explain in detail the chemical and electrochemical phenomena involved in corrosion. • Explain how welding of dissimilar metals, and formation of carbides and intermetallic compounds during welding creates electrode potentials that may cause corrosion coupling (galvanic cells). • Discuss the different mechanisms of the different types of corrosion. • Select corrosion protection methods. • Exemplify wear situations involving each of the mechanisms for the different types of wear. • Compare the methods and results of tests to define wear resistance. • Interpret the precautions and procedures designed to avoid excessive wear. • Explain methods of resolving problems with different types of protective layer. • Assess the selection of materials used in weldment design with protective layers. • Predict the potential problems associated with different types of protective layer.	**Skills defined for IWP shall be added to the IWS bellow skills** • Describe the differences between cracks and fractures recognising the differences between ductile and brittle fractures. • Identify the type of fracture in a given case study and, under limited guidance, select the possible causes. • Show, using examples, the practical application of structural and high strength steels in design of bridges, cranes, pressure vessels, automotive equipment, buildings (architectures), ships, and pipelines etc. • Classify the most common types of corrosion, identifying the chemical and electrochemical phenomena involved in corrosion. • Identify wear situations that involve the mechanisms of the different types of wear. • Recognise the advantages and disadvantages of the various techniques for applying protective layers. • Categorise the problems associated with each method of applying protective layers.	• Identify the need for passivation and measures to minimize overall corrosion

Competence Unit 7: Other Materials then Steel

CU 7 - Other Materials then Steel	CONTACT HOURS											
SUBJECT TITLE (the subjects code - ref.: IAB-252r5-19,)	IWE			IWT			IWS			IWP		
	P1+P3	P3	P1	P1+P3	P3	P1	P1+P3	P3	P1	P1+P3	P3	P1
(2.18) Copper and copper alloys	0	0	0	1	1	0	1	1	0	0	0	0
(2.19) Nickel and nickel alloys	1	1	0	0	0	0	1	1	0	0	0	0
(2.20) Aluminium and aluminium alloys	2	2	0	2	2	0	0	0	0	2	2	0
(2.21) Titanium and other metals and alloys	1	1	0	1	1	0	1	1	0	0	0	0
Subtotal Per Level	**4**	4	0	**4**	4	0	**3**	3	0	**2**	2	0
Cumulated Subtotal	**13**	13	0	**9**	9	0	**5**	5	0	**2**	2	0
WORKLOAD												
PER LEVEL	**8**	----	----	**8**	----	----	**6**	----	----	**4**	----	----
CUMULATED	**22**	----	----	**18**	----	----	**10**	----	----	**4**	----	----

QUALIFICATION	EQF/ EWF LEVEL	JOB FUNCTIONS AND ACTIVITIES - OTHER MATERIALS THEN STEEL (high levels can perform lower level functions)	CONTACT HOURS	WORKLOAD
IWE	**7 / EXPERT**	1. Define methods to avoid or prevent the cracking mechanisms	**4**	**8**
IWT	**6 /ADVANCED**	1. Define welding procedures to achieve the necessary quality level of weld joints 2. Select methods to avoid or prevent the cracking mechanisms	**4**	**8**
IWS	**5/SPECIALIZED**	1. Implement welding procedures to achieve the necessary quality level of weld joints 2. Implement methods to avoid or prevent the cracking mechanisms	**6**	**12**
IWP	**4/INDEPENDENT**	1. Outline welding procedures to achieve the necessary quality level of weld joints 2. Outline methods to avoid or prevent the cracking mechanisms	**2**	**4**

LEARNING OUTCOMES – OTHER MATERIALS THEN STEEL				
Qualification	**IWE**	**IWT**	**IWS**	**IWP**
KNOWLEDGE	Highly specialised knowledge and critical assessment of theory, principles and applicability of: Copper, nickel, aluminium, titanium, magnesium, tantalum and zirconium weldability Main causes of cracking and how to avoid Types and goals of heat treatment techniques Joining dissimilar materials	Advanced knowledge and critical understanding of the theory, principles and applicability of: Copper, nickel, aluminium, titanium, and magnesium weldability Main causes of cracking and how to avoid Types and goals of heat treatment techniques Joining dissimilar materials	Specialised and theoretical, principles and applicability of: Copper, nickel, aluminium, titanium, and magnesium weldability Main causes of cracking and how to avoid Types and goals of heat treatment techniques Joining dissimilar materials	Factual and broad theoretical, principles and applicability of: Aluminium weldability Main causes of cracking and how to avoid

LEARNING OUTCOMES – OTHER MATERIALS THEN STEEL				
Qualification	**IWE**	**IWT**	**IWS**	**IWP**
SKILLS	**Skills defined for IWP, IWS and IWT shall be added to the IWE bellow skills** For the following metals and alloys: copper, nickel, aluminium, titanium, magnesium, tantalum, zirconium and dissimilar joints: • Interpret the weldability of a certain material, including dissimilar joints. • Discuss the welding process application, recommending heat input, filler materials and shielding gases to achieve quality requirements for a specific construction. • Recommend methods to avoid hot cracking and solid-state microfissures in welding of various materials, providing alternatives where necessary.	**Skills defined for IWP and IWS shall be added to the IWT bellow skills** For the following metals and alloys: copper, aluminium, titanium, magnesium and dissimilar joints: • Define methods to avoid or prevent the cracking mechanisms. • Define heat treatment procedures for specific applications. • Interpret the weldability of a certain material, including dissimilar joints. • Discuss the welding process application recommending heat input, filler materials and shielding gases to achieve quality for a specific construction. • Explain in detail the metallurgical and weldability aspects involved when joining dissimilar materials. • Infer welding metallurgical phases from Schaeffler / De Long /WRC diagram. • Select the correct welding process and filler material for dissimilar metal welds.	**Skills defined for IWP shall be added to the IWS bellow skills** For the following metals and alloys: copper, nickel, aluminium, titanium, magnesium and dissimilar joints: • Identify the factors that promote hot or solidification cracking and liquation cracking in weld metal and in HAZ. • Classify weldability giving examples of specific applications. • Select, under limited guidance, the welding process, filler material and shielding gas to achieve quality requirements for a given joining process. • Outline the most common weldability aspects involved when joining dissimilar materials and welding methods to minimize simple problems. • Choose appropriate consumables based on given Schaeffler / De Long /WRC diagrams.	For Aluminium joints: • Outline for Aluminium the most common weldability aspects involved when joining

Competence Unit 8: Design for Welding & Brasing

CU 8 - Design for Welding & Brazing	CONTACT HOURS											
SUBJECT TITLE (the subjects code - ref.: IAB-252r5-19,)	IWE			IWT			IWS			IWP		
	P1+P3	P3	P1	P1+P3	P3	P1	P1+P3	P3	P1	P1+P3	P3	P1
(3.1) Basic theory of structural systems (P1 only for IWE and IWT)	0	0	0	2	0	2	2	2	0	0	0	0
(3.2) Fundamentals of the strength of materials (P1 for all levels)	0	0	0	2	0	2	4	0	4	0	0	0
(3.3) Joint design for Welding and Brazing (P1 only for IWE and IWT)	0	0	0	1	0	1	1	1	0	2	2	0
(3.4) Basics of weld design	0	0	0	2	2	0	4	4	0	0	0	0
(3.5) Behaviour of welded structures under different types of loading	2	2	0	1	1	0	1	1	0	0	0	0
(3.6) Design of welded structures with predominantly static loading	3	3	0	2	2	0	1	1	0	2	2	0
(3.7) Behaviour of welded structures under cyclic loading	3	3	0	3	3	0	1	1	0	1	1	0
(3.8) Design of cyclic loaded welded structures	4	4	0	2	2	0	2	2	0	0	0	0
(3.9) Design of welded pressure equipment	2	2	0	2	2	0	1	1	0	1	1	0
(3.10) Design of aluminium alloys structures	2	2	0	1	1	0	1	1	0	0	0	0
(3.11) Introduction to fracture mechanics	2	2	0	2	2	0	0	0	0	0	0	0
Subtotal Per Level	**18**	18	0	**20**	15	5	**18**	14	4	**6**	6	0
Cumulated Subtotal	**62**	53	9	**44**	35	9	**24**	20	4	**6**	6	0
WORKLOAD												
PER LEVEL	**36**	----	----	**40**	----	----	**36**	----	----	**12**	----	----
CUMULATED	**124**	----	----	**88**	----	----	**48**	----	----	**12**	----	----

Important Note: When for a certain qualification level is allocate the P1 hours, this means for the same subject for that level the total duration of P1 hours is the sum of the P1 hours stated for the qualification level plus the hours for the same subject of the lower levels, e.g. for IWE P1 for subject 3.1 the duration is IWT P1 + IWS P3 = 4h

QUALIFICA-TION	EQF/ EWF LEVEL	JOB FUNCTIONS AND ACTIVITIES - DESIGN FOR WELDING & BRASING (high levels can perform lower level functions)	CON-TACT HOURS	WORK-LOAD
IWE	**7 / EXPERT**	1. Define methods for improvement of the fatigue life of welded joints. 2. Define the type of joint according to S-N diagrams for a construction 3. Define the types of joints and joints position to be used in a metallic structure or pressure equipment 1. Define the testing and assessment methods regarding fracture mechanics for a certain application.	**18**	**36**
IWT	**6 /ADVANCED**	1. Define and select the weld joints and joint fit up for a certain application 2. Define which welding symbols should be used in a certain application 3. Calculate in detail weld size, nominal stresses and combined stresses in welds 4. Verify if the weld design used is suitable for the construction 5. Select appropriate materials for specific applications using design data and appropriate calculations complying with strength / temperature requirements	**20**	**40**

QUALIFICATION	EQF/ EWF LEVEL	JOB FUNCTIONS AND ACTIVITIES - DESIGN FOR WELDING & BRASING (high levels can perform lower level functions)	CONTACT HOURS	WORKLOAD
		6. Select methods for improvement of the fatigue life of welded joints. 7. Select the type of joint according to S-N diagrams for a construction 8. Select the types of joints and joints position to be used in a metallic structure or pressure equipment 1. Select the testing and assessment methods regarding fracture mechanics for a certain application.		
IWS	**5/SPECIALIZED**	1. Calculate simple basic weld size 2. Recommend methods for improvement of the fatigue life of simple welded joints. 3. Recommend the type of joint according to S-N diagrams for a simple construction 1. Recommend the types of joints and joints position to be used in a simple metallic structure or pressure equipment	**18**	**36**
IWP	**4/INDEPENDENT**	1. Supervise the weld joint and joint fit up according to the drawings 2. Interpret welding symbols on the drawings 3. Carry out the implementation of recommendations for fatigue improvement of welded joints. 4. Assess weld joints to determine if notches or weld defects will decrease or not the fatigue life of the weld joint	**6**	**12**

LEARNING OUTCOMES – DESIGN FOR WELDING & BRASING				
Qualification	**IWE**	**IWT**	**IWS**	**IWP**
KNOWLEDGE	Highly specialised knowledge and critical assessment of theory, principles and applicability of: Welding drawings interpretation and calculation of simple welding joints Specification of weld joint types and fit up based on drawings interpretation Behaviour of welded structures under different types of loading Methods to improve the fatigue strength of welded joints	Advanced knowledge and critical understanding of the theory, principles and applicability of: Welding drawings interpretation and calculation of simple welding joints Specification of weld joint types and fit up based on drawings interpretation Behaviour of welded structures under different types of loading Methods to improve the fatigue strength of welded joints	Specialised and theoretical, principles and applicability of: Welding drawings interpretation and calculation of simple welding joints Specification of weld joints types and fit up based on drawings interpretation Methods to improve the fatigue strength of welded joints	Factual and broad of: Welding drawings and symbols Identification of weld joints types and fit up based on drawings interpretation Identification of factors that influence the fatigue strength of welded joints

SKILLS	**Skills defined for IWP, IWS and IWT shall be added to the IWE bellow skills** • Explain in depth the requirements of different types of loading and temperatures. • Deduce for a certain application the materials that meet strength/temperature requirements. • Predict appropriate materials for use in specific applications. • Explain in depth the principles of design of different connection zones. • Predict the stresses in frames and the stresses in welds of frames based on known or predicted forces. • Explain in depth the advantages and disadvantages of different types of welds under different types of loading. • Appraise, with full autonomy, alternative design solutions for welded metallic structure and pressure equipment fabrication. • Draw, interpret and explain in depth S-N diagram and the goal for their use. • Interpret appropriate standards for design and fabrication. • Design welded joints in accordance with given details. • Explain in depth the principles of linear-elastic and elastic-plastic fracture mechanics. • Predict the influence factors for linear-elastic and elastic-plastic fracture mechanics. • Explain in depth the use of fracture mechanics for dynamically loaded structures. • Determine the testing and assessment methods regarding fracture mechanics for a certain application.	**Skills defined for IWP and IWS shall be added to the IWT bellow skills** • Explain in detail, the composition of forces, resolution of forces, the equilibrium conditions and the equilibrium of structural systems. • Explain in depth bearings, constraints and the basic types of connections. • Explain in depth the difference between a statically determinate and a statically indeterminate system. • Calculate internal forces and moments of simple statically determinate systems. • Interpret, using sketches, the shearing force and bending moment diagram of simple statically determinate systems. • Explain in depth and calculate the different types of stresses resulting from internal forces and moments in a weld joint. • Calculate the different types of cross section variables and nominal stresses in sections. • Analyse specific applications and verify if the calculation methods and results for a construction are suitable. • Detail different types of welded joints, according to ISO 9692 or national standard. • Interpret appropriate standards to determine the shape and size of weld required. • Appraise, autonomously, a certain welded fabrication project, analysing it to define the type and size of weld. • Produce a drawing showing the weld design required to achieve a specified performance. • Explain the requirements of different types of loading and temperatures. • Explain the design of different connection zones. • Define the stresses in frames and nominate the stresses of welds in frames. • Using specified material data calculate the relevant weld stresses and the appropriate	**Skills defined for IWP shall be added to the IWS bellow skills** • Outline the composition and resolution of forces and the equilibrium conditions of structural systems. • Recognise bearings, constraints and the basic types of connections used on construction design. • Outline different types of stresses and stress-strain relationships in welded joints. • Identify the stresses resulting from internal forces and moments. • Calculate internal forces and moments of simple basic statically determinate systems. • Identify different types of welded joints, according to ISO 9692 or national standards. • Interpret, correctly, weld symbols to identify the shape, size and position of joints. • Outline the requirements for the construction regarding different types of loading and temperatures. • Identify groups of materials which meet strength / temperature requirements. • Identify the materials groups that meet the construction requirements defined for a project. • Identify the different connections zones and verify that the weld geometry is appropriate to maximise integrity and safety. • Use an S-N diagram. • Identify possible modifications on the weld joint or weld surface to improve fatigue performance. • List the most import precautions when welding a metallic structure or a pressure equipment. • Identify some typical applications of aluminium and describe the advantages compared to steel construction. • Identify typical aluminium joints and respective joint preparations.	• Outline different types of welded and brazed joint, according to ISO 9692, CEN, and national standards. • Choose the correct design welding symbol according to ISO2553, making proper use of welded joints symbols. • Identify in the fabrication drawings the welding symbols and relating them to the specific weld joints. • Outline the most common joint geometrical form/shape, surface and types under static loading. • Outline the most common methods for improving fatigue strengths value of the welded joint. • Interpret the effect of the most common notches and weld defects on quality and lifetime of welded details. • Point out the characteristics phenomenon of cyclic load of welded structures. • Show the correct use of weld joints according to the design of metallic structures, pressure equipment.

LEARNING OUTCOMES – DESIGN FOR WELDING & BRASING				
Qualification	**IWE**	**IWT**	**IWS**	**IWP**
		weld geometry and position to maximise integrity and safety. • Explain the methods applied to welds for improved fatigue performance. • Define the influence of notches and weld defects on the classification of welded joints. • Draw and use an S-N diagram and define its limitations with respect to accuracy. • Design welded joints in accordance with given details. • Calculate from a known level of stress the most appropriate circumferential and longitudinal joint size and advise on any positional or geometrical modifications. • Differentiate between the design requirements for steel and aluminium welded structures. • Explain the principles of linear-elastic and elastic-plastic fracture mechanics. • Define the influence factors for linear-elastic and elastic-plastic fracture mechanics. • Explain the use of fracture mechanics for dynamically loaded structures.		

Competence Unit 9: General Features for Quality Management

CU 9 - General features for Quality Management	CONTACT HOURS											
SUBJECT TITLE (the subjects code - ref.: IAB-252r5-19,)	IWE			IWT			IWS			IWP		
	P1+P3	P3	P1	P1+P3	P3	P1	P1+P3	P3	P1	P1+P3	P3	P1
(4.3) Residual Stresses and Distortion	2	2	0	2	2	0	0	0	0	2	2	0
(4.4) Plant facilities, welding jigs and fixtures	0	0	0	0	0	0	2	2	0	2	2	0
(4.5) Health and Safety	0	0	0	2	2	0	0	0	0	2	2	0
(4.6) Measurement, Control and Recording in Welding	0	0	0	0	0	0	3	3	0	1	1	0
(4.9) Economics and Productivity	4	4	0	2	2	0	1	1	0	1	1	0
(4.10) Repair Welding	0	0	0	1	1	0	0	0	0	1	1	0
(4.11) Reinforcing-steel welded joints	1	1	0	0	0	0	1	1	0	0	0	0
Subtotal Per Level	**7**	7	0	**7**	7	0	**7**	7	0	**9**	9	0
Cumulated Subtotal	**30**	30	0	**23**	23	0	**16**	16	0	**9**	9	0
WORKLOAD												
PER LEVEL	**14**	----	----	**14**	----	----	**14**	----	----	**9**	----	----
CUMULATED	**51**	----	----	**37**	----	----	**23**	----	----	**9**	----	----

QUALIFICA-TION	EQF/ EWF LEVEL	JOB FUNCTIONS AND ACTIVITIES - GENERAL FEATURES FOR QUALITY MANAGMENT (high levels can perform lower level functions)	CON-TACT HOURS	WORK-LOAD
IWE	**7 / EXPERT**	1. Determine the welding costs, recommending methods for minimising the cost of welding and estimating the improvements. 2. Define and select the proper welding procedure to be applied in a certain welded reinforcement steels joint including all necessary measures to achieve the necessary level of quality	**7**	**14**
IWT	**6 /ADVANCED**	1. Define procedures to minimise distortion and stress in complex fabrication predicting the contraction and distortion in joints and structures. 2. Define the plant facilities and design of the layout to maximise productivity, safety and ergonomic benefits in welding manufacturing, including the selection of fixtures, jigs and positioners, heat treatment and temperature control equipment for a certain weld job. 3. Define the procedures for joint fit up and tack welding. 4. Perform risk assessment and formulate the management actions to mitigate the risks. 5. Define procedures for monitoring and measuring of welding parameters and temperatures 6. Define procedures for calibration and validation of testing and measuring equipment and monitoring of welding operations 7. Select and define working procedures for the correct measurement and control of welding parameters and heat treatments operations. 8. Define and select welding repair procedures for a certain job	**7**	**14**
IWS	**5/SPECIALIZED**	1. Define simple procedures to minimise distortion and stress	**7**	**14**

		2. Select the fixtures, jig or positioner, and auxiliary equipment and cables, heat treatment and temperature control that will improve productivity, safety and comfort. 3. Supervise joint fit up and tack welding implementation 4. Check if testing and measuring equipment need calibration and or validation 5. Define the conditions to make a weld in reinforcement steels aiming to achieve the necessary quality level.		
IWP	**4/INDEPENDENT**	1. Implement procedures to minimise distortion and residual stress in welded joints. 2. Implement the procedures for monitoring and measuring of welding parameters and temperatures 3. Check welding hazards and implement safe working procedures and regulations relating them to welding hazards. 4. Check and verify the need of calibration and validation of the testing and measuring equipment used in welding fabrication and implement the monitoring procedures to be applied during welding operations. 5. Supervise the implementation of welding repair procedures	**9**	**18**

LEARNING OUTCOMES – GENERAL FEATURES FOR QUALITY MANAGMENT				
Qualification	**IWE**	**IWT**	**IWS**	**IWP**
KNOWLEDGE	Highly specialised knowledge and critical assessment of theory, principles and applicability of: Residual Stresses and Distortion in weld joints Specification of plant facilities, welding jigs and fixtures Measurement, Control and Recording in Welding Productivity, safety and comfort in welding manufacturing assessment and improvement Specification of Repair Welding procedures	Advanced knowledge and critical understanding of the theory, principles and applicability of: Residual Stresses and Distortion in weld joints Specification of plant facilities, welding jigs and fixtures Measurement, Control and Recording in Welding Productivity, safety and comfort in welding manufacturing assessment and improvement Specification of Repair Welding procedures	Specialised and theoretical, principles and applicability of: Residual Stresses and Distortion in weld joints Plant facilities, welding jigs and fixtures Measurement, Control and Recording in Welding Principles to improve productivity, safety and comfort in welding manufacturing Repair Welding specifications	Factual and broad of: Residual Stresses and Distortion in weld joints Plant facilities, welding jigs and fixtures Health and Safety applied to welding and cutting Control of welding parameters Repair Welding specifications

LEARNING OUTCOMES – GENERAL FEATURES FOR QUALITY MANAGMENT				
Qualification	**IWE**	**IWT**	**IWS**	**IWP**
SKILLS	**Skills defined for IWP, IWS and IWT shall be added to the IWE bellow skills** • Define in detail the relationship between the material at a certain temperature and its mechanical characteristics. • Explain in detail the techniques and technologies that can be applied to minimise welded production costs. • Determine the welding costs, recommending methods for minimising the cost of welding and estimating the improvements. • Interpret the design features of types of welded joint used for reinforcing steel in load bearing and non-load bearing locations. • Define and select the proper welding procedure to be applied in a certain welded reinforcement steels joint including all necessary measures to achieve the necessary level of quality.	**Skills defined for IWP and IWS shall be added to the IWT bellow skills** • Explain in detail the origin and influencing factors of residual stress and how the different factors interact between them. • Predict the distribution of residual stresses in a weld (parallel to the weld axis, perpendicular, and through thickness, influence of the material thickness). • Predict how residual stresses may affect the behaviour of a structure in service, selecting solutions to achieve the required level of weld quality and geometrical tolerances. • Explain in detail the health and safety hazards associated with electricity, gases, fumes, fire, radiation and noise, grinding, welding spatter, flame, fire, combustion, oxygen environment enrichment. • Predict the hazards, defining the health and safety requirements and working procedures, including the definition of the necessary PPE. • Explain in detail the methods of measurement used in the control and monitoring of welding. • Identify the factors affecting welding costs, how they are affected by changes in the welding variables (welding processes, parameters, conditions, etc.) comparing options to reduce the cost of welding and estimate the improvements. • Calculate and assess the cost of welding operations.	**Skills defined for IWP shall be added to the IWS bellow skills** • Describe the origin and influencing factors of residual stress and distortion in welded fabrications and its distribution at the welded joint (parallel to the weld axis, perpendicular, and through thickness, influence of the material thickness). • Recognise the principles to improve productivity, safety and comfort in welding manufacturing. • Identify the special requirements for joint fit up and tack welding. • Describe the methods of measurement used in the control and monitoring of welding. • Apply the requirements for calibration, validation and monitoring of welding operations given in working procedures. • Recognise the relevant welding and handling procedures that would reduce the cost of welding, and estimate the improvements calculating simple costs of welding operations. • Associate the types of welded joint used for reinforcing steel in load bearing and non-load bearing locations.	• Outline the origin and influencing factors of residual stress and distortion in welded fabrications and its distribution at the welded joint (parallel to the weld axis, perpendicular, and through thickness, influence of the material thickness). • Identify the relationship between the material at a certain temperature and its most relevant mechanical characteristics. • Identify the most common contraction and distortion in joints and structures. • Outline how residual stresses may affect the behaviour of a structure in service. • List the most common type of fixture, jig and positioner to be used in a certain welded construction. • Identify the type of auxiliary equipment and cables, heat treatment and temperature control equipment to be used in a welded fabrication. • Outline the general precautions related with joint fit up and tack welding. • List the health and safety hazards associated with electricity, gases, fumes, fire, radiation and noise, grinding, welding spatter, flame, fire, combustion, oxygen environment enrichment. • List the most common methods of measurement used in the control of welding. • Identify the elements comprising the cost of welded fabrication. • Outline the most common problems related with repair welds. • Measure and record, welding parameters and temperatures before, during and after welds, when applicable.

Competence Unit 10: Quality Assurance/ Quality Control on Welded Joints

CU 10 - Quality Assurance/ Quality Control on Welded Joints	CONTACT HOURS											
SUBJECT TITLE (the subjects code - ref.: IAB-252r5-1,)	IWE			IWT			IWS			IWP		
	P1+P3	P3	P1	P1+P3	P3	P1	P1+P3	P3	P1	P1+P3	P3	P1
(4.1) Introduction to quality assurance in welded fabrication	0	0	0	4	4	0	2	2	0	2	2	0
(4.2) Quality control during manufacture	4	4	0	2	2	0	4	4	0	6	6	0
Subtotal Per Level	**4**	4	0	**6**	6	0	**6**	6	0	**8**	8	0
Cumulated Subtotal	**24**	24	0	**20**	20	0	**14**	14	0	**8**	8	0
WORKLOAD												
PER LEVEL	**8**	----	----	**12**	----	----	**12**	----	----	**16**	----	----
CUMULATED	**48**	----	----	**40**	----	----	**28**	----	----	**16**	----	----

QUALIFICA-TION	EQF/ EWF LEVEL	JOB FUNCTIONS AND ACTIVITIES - QUALITY ASSURANCE/ QUALITY CONTROL ON WELDED JOINTS (high levels can perform lower level functions)	CON-TACT HOURS	WORK-LOAD
IWE	**7 / EXPERT**	Same as IWT but applicable to high complex construction projects	**4**	**8**
IWT	**6 /ADVANCED**	1. Prepare audit plans considering its influence in welded fabrication quality requirements. 2. Select and define the structure of the quality assurance, quality control and inspection testing plan for a particular quality outcome in welded fabrication 3. Select, define and interpret according to international/national standards how to develop and approve the WPSs/WPQRs/pWPSs BPSs/pBPSs/BPQRs to be used in a certain project 4. Select, define and interpret according to international/national standards how to approve the welders, brazers, welding and brazing operators to work in a certain project 5. Define the necessary conditions for the qualification of welding procedures, and approval of welder/operators for complex construction projects 6. Define the contents of WPSs/BPSs based in WPQRs/BPQRs for complex construction projects	**6**	**12**
IWS	**5/SPECIALIZED**	1. Implement WPSs, WPQRs, BPSs, BPQRs for a certain weld job in a certain 2. Select the standard for the approval of WPQRs, BPQRs and the standard to develop a WPSs and BPSs to be applied in a certain project 3. Select the standard for the approval of welders, brazers, welding and brazing operators to be applied in a certain project 4. Define the necessary conditions for the qualification of welding procedures, and approval of welder/operators for simple construction projects 5. Define the contents of WPSs/BPSs based in WPQRs/BPQRs for simple construction projects	**6**	**12**
IWP	**4/INDEPENDENT**	1. Implement quality control procedures and instructions for a certain project 2. Verify if the WPS and welder/welding operator documents can be used for a certain weld job in a certain project.	**8**	**16**

LEARNING OUTCOMES – QUALITY ASSURANCE/ QUALITY CONTROL ON WELDED JOINTS				
Qualification	**IWE**	**IWT**	**IWS**	**IWP**
KNOWLEDGE	Highly specialised knowledge and critical assessment of theory, principles and applicability of: Quality assurance and control during manufacturing Specification of welders/operator's approvals, WPSs, WPQRs, BPSs, BPQRs	Advanced knowledge and critical understanding of the theory, principles and applicability of: Quality assurance and control during manufacturing Specification of welders/operator's approvals, WPSs, WPQRs	Specialised and theoretical, principles and applicability of: Quality assurance and control during manufacturing Interpretation of welders/operator's approvals, WPSs, WPQRs	Factual and broad of: Quality assurance and control during manufacturing Interpretation of welders/operator's approvals, WPSs, WPQRs
SKILLS	**Skills defined for IWP, IWS and IWT shall be added to the IWE bellow skills** For high complex projects: • Select and define the welding coordination tasks, responsibilities and related personnel matrix. • Select, define and interpret according to international/national standards how to develop and approve the WPSs/WPQRs/pWPSs BPSs/pBPSs/BPQRs to be used in a certain project. • Select, define and interpret according to international/national standards how to approve the welders, brazers, welding and brazing operators to work in a certain project. • Select the requirements of relevant standards for base, filler material and weld joints traceability, defining the essential content of materials procedures and certificates for a certain project.	**Skills defined for IWP and IWS shall be added to the IWT bellow skills** • Design and define the essential elements of quality assurance, quality control procedures and quality plans in relation to welded fabrication quality requirements in a certain project. • Analyse the principles of quality assurance, quality control and inspection testing plan in relation to welded fabrication to realise its specific quality requirements. • Define audit principles, illustrating how each can affect the reliability of results and comparing their impacts on welded fabrication quality requirements. • Explain in detail the influence of personnel and equipment factors that have a major effect on welded fabrication quality. • Explain in detail the activities and responsibilities of the welding coordinator responsible for welded fabrication/ manufacture in relation with the impact of the specific tasks on weld quality. • Interpret Quality Assurance/ Quality Management standards (e.g. ISO 9000, and ISO 3834).	**Skills defined for IWP shall be added to the IWS bellow skills** • List the main differences between quality assurance, quality control and inspection testing plan describing their usage for welded fabrication. • Outline the role of the Welding Specialist in the metalworking manufacturing. • Outline the use and applications of Quality Assurance/ Quality Management standards (e.g. ISO 9000, and ISO 3834). • Provide the necessary inputs after plant quality audits, with the aim to solve the audit findings. • Recognise the main purpose of BPS/pBPS/BPQR and the advantages to the quality of welded fabrication. • Recognise the main variables for a particular WPQR and its range of approval in accordance with National and/or International standards. • Recognise the main variables for a particular welder, brazer, welding and brazing operator approval and its range of approval in accordance with National and/or International standards. • Outline the traceability requirements for base, filler materials and weld joints project.	• Identify the goals and the differences of quality assurance and quality control to the own practice and work. • Outline the most common factors related to personnel and equipment, which influence the quality of a welded construction. • Identify the role of the Welding Practitioner in the metalworking manufacturing. • List the main purpose of WPS/WPQR/pWPS and related them to their advantages to the quality of welded fabrication. • List the main purposes of welder and welding operator approval and relate them to the main advantages to the quality of welded fabrication. • Outline the most common ISO standards used for welder and welding operators approval, welding procedures approval and the content of welding procedures specifications. • Give examples of essential and non-essential variables for a certain WPS qualification. • Give examples of essential and non-essential variables for a certain welder, welding operator qualification.

Competence Unit 11: Tests Used for The Quality Control of Welded Joints

CU 11 - Tests Used for The Quality Control of Welded Joints	CONTACT HOURS											
SUBJECT TITLE (the subjects code - ref.: IAB-252r5-19)	IWE			IWT			IWS			IWP		
	P1+P3	P3	P1	P1+P3	P3	P1	P1+P3	P3	P1	P1+P3	P3	P1
(2.23) Destructive testing of materials and welded joints	0	0	0	6	6	0	5	5	0	3	3	0
(4.7) Imperfections and Acceptance Criteria	1	1	0	1	1	0	1	1	0	1	1	0
(4.8) Non-Destructive Testing	8	8	0	3	3	0	3	3	0	4	4	0
Subtotal Per Level	**9**	9	0	**10**	10	0	**9**	9	0	**8**	8	0
Cumulated Subtotal	**36**	36	0	**27**	27	0	**17**	17	0	**8**	8	0
WORKLOAD												
PER LEVEL	**18**	----	----	**20**	----	----	**18**	----	----	**16**	----	----
CUMULATED	**72**	----	----	**54**	----	----	**34**	----	----	**16**	----	----

QUALIFICATION	EQF/ EWF LEVEL	JOB FUNCTIONS AND ACTIVITIES - TESTS USED FOR THE QUALITY CONTROL OF WELDED JOINTS (high levels can perform lower level functions)	CONTACT HOURS	WORKLOAD
IWE	**7 / EXPERT**	1. Assess if an imperfection is likely to be material related or induced during manufacturing. 2. Assess the need and the appliance of Critical Engineering Assessment 3. Define and select the appropriate acceptance criteria to monitor the results and make the fitness for service decision	**9**	**18**
IWT	**6 /ADVANCED**	1. Select and define the need for special testing to be specified for a certain project recommending specific tests to achieve specified quality requirements 2. Define and select acceptance standards for weld imperfections for a certain job determining the results. 3. Define and select the features of weld design that may prevent or adversely affect application of NDT methods 4. Define and select the type of destructive, non-destructive tests and personnel needed for a certain welded construction	**10**	**20**
IWS	**5/SPECIALIZED**	1. Select the correct acceptance level for welding imperfection for a certain job in basic constructions	**9**	**18**
IWP	**4/INDEPENDENT**	1. Identify the places where welding repair will be made based on the information given on NDT non-destructive tests reports 2. Implement the use of acceptance standards for weld imperfections.	**8**	**16**

LEARNING OUTCOMES – TESTS USED FOR THE QUALITY CONTROL OF WELDED JOINTS				
Qualification	**IWE**	**IWT**	**IWS**	**IWP**
KNOWLEDGE	Highly specialised knowledge and critical assessment of theory, principles and applicability of: Identification of imperfections and specification of acceptance criteria Specification of destructive and non-destructive testing of materials and welded joints	Advanced knowledge and critical understanding of the theory, principles and applicability of: Identification of imperfections and specification of acceptance criteria Specification of destructive and non-destructive testing of materials and welded joints	Specialised and theoretical, principles and applicability of: Identification of imperfections and application of acceptance criteria Identification of destructive and non-destructive testing of materials and welded joints	Factual and broad of: Identification of imperfections and application of acceptance criteria Identification of destructive and non-destructive testing of materials and welded joints
SKILLS	**Skills defined for IWP, IWS and IWT shall be added to the IWE bellow skills** • Justify the need for special testing to be specified for a certain project recommending specific tests to achieve specified quality requirements.	**Skills defined for IWP and IWS shall be added to the IWT bellow skills** • Describe the advanced testing methods [destructive (fracture mechanics, creep, creep fatigue) and non-destructive (digital radiographic, automatic UT, TOFD, Guided Waves, Phased Array, Acoustic emission, Eady Current, etc.)], their purpose and the parameters measured by each of them. • Discuss the significance of imperfection size, morphology and position relative to the effect of the imperfection on structural integrity. • Compare typical methods of Engineering Critical Assessment techniques. • Interpret destructive and non-destructive tests reports.	**Skills defined for IWP shall be added to the IWS bellow skills** • Describe the major testing methods (destructive and non-destructive), their purpose and the parameters measured by each of them. • Interpret the significance of identified imperfections in welded constructions their causes and avoidance and methods of detection. • Outline the features of weld design that may prevent or adversely affect application of NDT methods.	• Outline the objectives and limitations of the most common destructive and non-destructive testing. • List the most common destructive and non-destructive testing. • Outline the functionality, applications, advantages and disadvantages and quantitative or qualitative information from the most common destructive and non-destructive tests. • Identify the content of test reports either for destructive or non-destructive tests. • Identify the significance of the most common weld imperfections relative to their size, location and morphology, as given on acceptance standards. • Recall which NDT method is most suitable for the detection of each imperfection. • Recognise the safety requirements for the main NDT methods.

Competence Unit 12: Case Studies

CU 12 - Case Studies	CONTACT HOURS											
SUBJECT TITLE (the subjects code - ref.: IAB-252r5-19,)	IWE			IWT			IWS			IWP		
	P1+P3	P3	P1	P1+P3	P3	P1	P1+P3	P3	P1	P1+P3	P3	P1
(4.12) Case Studies	12	12	0	14	14	0	14	14	0	0	0	0
Subtotal Per Level	**12**	12	0	**14**	14	0	**14**	14	0	**0**	0	0
Cumulated Subtotal	**40**	40	0	**28**	28	0	**14**	14	0	**0**	0	0
WORKLOAD												
PER LEVEL	**24**	----	----	**28**	----	----	**28**	----	----	**0**	----	----
CUMULATED	**80**	----	----	**56**	----	----	**28**	----	----	**0**	----	----

QUALIFICATION	EQF/ EWF LEVEL	JOB FUNCTIONS AND ACTIVITIES - CASE STUDIES (high levels can perform lower level functions)	CONTACT HOURS	WORKLOAD
IWE	**7 / EXPERT**	1. Define and select for a high complex construction the quality assurance, quality control, inspection and testing plan and welding conditions to achieve the specified level of quality requirements	**12**	**24**
IWT	**6 /ADVANCED**	1. Define and select for a complex construction the quality assurance, quality control, inspection and testing plan and welding conditions to achieve the specified level of quality requirements	**14**	**28**
IWS	**5/SPECIALIZED**	1. Define and select for a basic construction the quality assurance, quality control, inspection and testing plan and welding conditions to achieve the specified level of quality requirements	**14**	**28**
IWP	**4/INDEPENDENT**	----------	**----**	**-----**

LEARNING OUTCOMES – CASE STUDIES				
Qualification	**IWE**	**IWT**	**IWS**	**IWP**
KNOWLEDGE	Highly specialised knowledge and critical assessment of theory, principles and applicability of: Analysis of high complex construction projects	Advanced knowledge and critical understanding of the theory, principles and applicability of: Analysis of complex construction projects Interpretation and evaluation of fractures on butt and fillet welds	Specialised and theoretical, principles and applicability of: Analysis of simple construction projects Interpretation and evaluation of fractures on butt and fillet welds	----------

LEARNING OUTCOMES – CASE STUDIES				
Qualification	**IWE**	**IWT**	**IWS**	**IWP**
SKILLS	**Skills defined for IWP, IWS and IWT shall be added to the IWE skills bellow** • Evaluate high complex construction projects on steel and lightweight structures, boilers and pressure vessels, chemical plants and pipelines, shipbuilding and offshore applications, transportation (automobiles, railways) and aerospace applications to define the best welding conditions to achieve the proper quality requirements.	**Skills defined for IWP, IWS and shall be added to the IWT skills bellow** • Evaluate complex construction projects on steel and lightweight structures, boilers and pressure vessels, chemical plants and pipelines, shipbuilding and offshore applications, transportation (automobiles, railways) and aerospace applications to define the best welding conditions to achieve the proper quality requirements.	• Evaluate basic construction projects on steel and lightweight structures, boilers and pressure vessels, chemical plants and pipelines, shipbuilding and offshore applications, transportation (automobiles, railways) and aerospace applications to define the best welding conditions to achieve the proper quality requirements. • Perform Visual Inspection including interpretation and evaluation of fractures on butt and fillet welds.	----------

I.3 Theoretical Education - Competence Unit 0: Basic Technical Knowledge

The Competence Unit 0: Basic Technical Knowledge aims at teaching basic technical knowledge, which in general is lacking in participants entering via the route 3 when compared to participants entering via routes 1 and 2. It provides the chance for professional workers and European Welding Practitioners to become qualified as European Welding Specialists.

CU 0 - BASIC TECNHICAL KNOWLEDGE	CONTACT HOURS
SUBJECT TITLE	
0.1 Basic Metrology applicable to Welding	4
0.2 Technical Calculation	8
0.3 Technical Drawings	8
0.4 Basics of Electro-technology	2
0.5 Basics of Chemistry	3
0.6 Basics of Materials	3
0.7 Metal Products	2
0.8 Machining of Materials	2
0.9 Technical Mechanics	4
0.10 Joining Elements	2
0.11 Calculation of strength	4
Total	42
WORKLOAD	**84**

The Competence Unit 0: Basic Technical Knowledge as the following Learning Outcomes:

LEARNING OUTCOMES – BASIC TECNHICAL KNOWLEDGE	
Qualification	**IWS**
KNOWLEDGE	Factual and broad of: Metrology applicable to Welding Technical Calculation and Drawings Electro-technology Chemistry Materials Metal Products Machining of Materials Technical Mechanics Joining Elements Calculation of strength

LEARNING OUTCOMES – BASIC TECNHICAL KNOWLEDGE	
Qualifi-cation	**IWS**
SKILLS	List all SI base units and their symbols for length, mass, time, electric current, voltage, temperature, plane angle and other commonly used units related to welding. List all SI derived units and their symbols for area, density, energy, force, frequency, power, pressure, volume, linear velocity, and other commonly used units related to welding. List and describe measuring instruments used in welding Calculate volumes, areas, speed, flow, consumptions and variables including linear and angular measurements and time related to welding Explain the definition of basic trigonometric functions of sine, cosine and tangent in terms of the ratios of the sides of a right-angled triangle. Use conversion tables “Metric versus Imperial system” for the length, speed and gas flow rate units, “Temperature value between Kelvin, Centigrade e Fahrenheit systems”. Read and describe basic technical drawings related to welding technology. Describe the difference between DC and AC current. Outline single-phase and 3-phase, AC power lines, peak value, mean value and RMS value for either AC current or voltage. Outline star (Y) and delta (Δ) connections. Use voltmeters, ammeter, ohmmeters and multi-meters including digital multi-meters applied to welding. Read connection diagrams and simple circuits. List basic chemical elements and their symbols in engineering steel, aluminium, nickel and copper, and their alloys. Outline chemical reaction and its representation by the chemical equation with examples of chemical reactions in steel manufacturing. Identify the chemical compositions of the various types of plain carbon, low alloy and high alloy steels. Identify the main metallic materials used in welding and their classification according to their main physical and mechanical properties. Outline the difference between the main properties of steel, cast iron, aluminium and copper. List the main types of wrought products naming their differences and the correct terms. Identify the most important machining methods describing the difference between cutting and abrasive machining. Calculate the forces found in welding activities including: graphically splitting of forces; the resultant force from more forces through one point; simple bending moments and bending forces and support forces (reactions). List different types of material joining methods Compare dismantling joining types versus welding (non-dismantling one). Identify and describe a tensile test diagram. Calculate and verify stresses, section modules, moment of inertia and cross-section area.

I.4. Practical Education – Part 2

I.4.1 For the IWE; IWT, and IWS

This part does not aim at providing practical skills to the welding engineer/technologist/specialist but on gaining knowledge on the control of the different welding processes. The students shall become as familiar as possible with the problems and typical defects associated with incorrect use of the different welding methods. During their exercises the students are guided by skilled welding teachers.

Practical Training	**hours:**
Oxygas welding and cutting	6
MMA	8
TIG	8
MIG/MAG + Flux Cored Arc Welding	16

It is possible to use the advantages of Virtual Weld Training systems but maximum to 50% of the practical training hours!

	hours:
Demonstration or video presentations of processes	22
Gouging	
Brazing	
Plasma welding	
Plasma cutting	
Submerged-arc welding	
Resistance welding	
Friction welding	
Electron beam welding	
Laser welding	
Other processes	
Total:	60

It is strongly recommended that ATBs provide demonstrations instead of videos wherever possible.

Candidates may be exempted by the ATB from the practical training, on a process by process basis, if they can demonstrate practical experience and/or training in the process concerned.

The laboratory exercises contained in the foregoing modules 1 to 4 of the theoretical part are additional and given usually at a later stage of the education.

I.4.2 For the IWP

The practical training has to be done on an individual basis.

The main processes are: MMA, MIG/MAG, FCAW, TIG and Gas Welding. 40 hours shall be reserved to broaden the student's skill in other relevant materials within his welder qualification/s. This training shall end with a practical examination in more than one process or more than one group of material (according ISO 9606 or national standards). For MIG welding only material group 22 and for Gas welding only material groups 1.1 and 1.2 are relevant.

If a student can demonstrate existing practical skill in and an understanding of the welding of different materials, it is accepted that he can sit for the practical examination in these processes and materials without prior practical training.

Typical test pieces and positions are given in Table 1. The test pieces shall be welded as single side welding without backing, except for aluminium, where backing is allowed. Each ANB will work to a similar table based on comparable national standards.

Valid national certificates are accepted as replacements for the practical examinations with test pieces in Table 1.

Table 1: Recommended test pieces and positions for practical examinations:
The dimensions given in the table are recommended/proposed, but not mandatory, other dimensions are accepted.

Welding process		Practical Test		
ISO 9606	**ISO 9606**	**Material Group (ISO TR 15608)**	**Welding Position**	**Test Dimension(s) Diameter/Thickness**
MMA	111	1	PF/BW	6,0 – 13,0
		3	PF/BW	6,0 – 13,0
		4, 5, 6	H-L045/BW	∅60,3 – ∅114.3/ 3.9 – 7.11
		7	PF/BW	6,0 – 13,0
		8	PB/FW	6,0 – 13,0
TIG	141	1	H-L045/BW	∅60,3 – ∅114.3 3.9 – 7.11
		3	PF/BW	2,0 – 6,0
		4, 5, 6	H-L045/BW	∅60,3 – ∅114.3 3.9 – 7.11
		7	PF/BW	2,0 – 6,0
		8	H-L045/BW	∅60,3 – ∅114.3 3.9 – 7.11
		22	PF/BW	2,0 – 6,0
MIG	131	22	PF/BW	6,0 – 13,0
MAG (and/or metal cored)	135 (136)	1	PF/BW	6,0 – 13,0
		8	PB/FW	6,0 – 13,0
FCAW (flux cored only)	136	1	PF/BW	6,0 – 13,0
		8	PF/BW	6,0 – 13,0
		3	PA/FW	6,0 – 13,0
GAS	311	1	H-L045/BW	∅60,3 – ∅114.3 3.9 – 7.11

Twenty hours shall be reserved to give the student basic understanding of the possibilities and limitations of the other processes mentioned in Table 1. The purpose of this training is only to demonstrate the possibilities and limitations of these processes, and no practical examination is required. If the student can demonstrate to the training establishment skill in and understanding of the other processes, he may be exempted from this training.

Acceptance criteria for the practical examination:

The quality of welding shall comply with ISO 9606, or comparable quality levels defined in National welder's qualification standards used by EWF Group A countries. A welder qualification certificate may be issued.

Appendix I: Abbreviations for Processes

The following abbreviations used in the document show the relation between the ISO designation, the process abbreviations used in Europe and those used in the USA.

ISO 4063	European (EA) and American (AA) abbreviations		Full name
111	EA	MMA	Manual Metal Arc Welding
	AA	SMAW	Shielded Metal Arc Welding
114	EA	FCAW	Self-shielded tubular cored arc
	AA	FCAW	Self-shielded tubular cored arc welding
12	EA	SAW	Submerged Arc Welding
	AA	SAW	Submerged Arc Welding
13	EA	GMAW	Gas Shielded Metal Arc Welding
	AA	GMAW	Gas Metal Arc Welding
131	EA	MIG	MIG welding with solid wire electrode
	AA	GMAW	Gas metal arc welding using inert gas and solid wire electrode
132	EA	MIG	MIG welding with flux cored electrode
	AA	FCAW	Flux cored arc welding
135	EA	MAG	MAG welding with solid wire electrode
	AA	GMAW	Gas metal arc welding using active gas with solid wire electrode
136	EA	MAG	MAG welding with flux cored electrode
	AA	FCAW	Gas metal arc welding using active gas and flux cored electrode
138	EA	MAG	MAG welding with metal cored electrode
	AA	FCAW	Gas metal arc welding using active gas and metal cored electrode
141	EA	TIG	TIG welding with solid filler material (wire/rod)
	AA	GTAW	Gas tungsten arc welding using inert gas and solid filler material (wire/rod)
142	EA	TIG	Autogenous TIG welding
	AA	GTAW	Autogenous gas tungsten arc Welding using inert gas
21	EA		Resistance spot welding
	AA	RSW	Spot Welding
25	EA		Resistance Butt Welding
	AA	RSEW	Upset Welding
3	EA		Gas Welding
	AA	OFW	Oxy-fuel Gas Welding
311	EA		Oxy-acetylene Welding
	AA	OAW	Oxy-acetylene Welding
42	EA	FW	Friction Welding
	AA	FW	Friction Welding
43	EA	FSW	Friction Stir Welding
	AA	FSW	Friction Stir Welding
81	EA		Flame Cutting
	AA	OFC	Oxygen Cutting, oxyfuel cutting
86	EA		Flame Gouging
	AA		Thermal Gouging

Appendix II: List of Referenced Standards

Standard (-series)	Title
ASME IX	American Society of Mechanical Engineers; Boiler and Pressure Vessel Code, Section IX: Welding and Brazing Qualifications
ISO/TR 581	Weldability – Metallic Materials, Definitions
ISO/TR 17671-1 (EN 1011-1)	Welding - Recommendations for welding of metallic materials - Part 1: General guidance for arc welding
ISO/TR 17671-2 (EN 1011-2)	Welding - Recommendations for welding of metallic materials - Part 2: Arc welding of ferritic steels
ISO 17639	Destructive tests on welds in metallic materials - Macroscopic and microscopic examination of welds
ISO 14732	Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials
EN 1708	Welding - Basic weld joint details in steel (series)
ISO 2553	Welded, brazed and soldered joints - Symbolic representation on drawings
ISO 3834	Quality requirements for fusion welding of metallic materials (series)
ISO 4063	Welding and allied processes - Nomenclature of processes and reference numbers
ISO 5817	Welding - Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) - Quality levels for imperfections
ISO 9000	Quality management systems (series)
ISO 9606	Approval testing of welders - Fusion welding (series)
ISO 9692	Welding and allied processes - Recommendation for joint preparation (series)
ISO 9712	Non-destructive testing - Qualification and certification of personnel
ISO 10042	Welding - Arc-welded joints in aluminium and its alloys - Quality levels for imperfections
ISO 17635	Non-destructive examination of welds - General rules for metallic materials
ISO 13916	Welding - Guidance on the measurement of preheating temperature, interpass temperature and preheat maintenance temperature
ISO 13920	Welding - General tolerances for welded constructions - Dimensions for lengths and angles - Shape and position
ISO 14731	Welding coordination - Tasks and responsibilities
ISO/TR 15135	Welding - Design and non-destructive testing of welds
ISO/TR 15235	Welding - Methods for assessing imperfections in metallic structures
ISO/TR 15481	Welding of reinforcing steel - Tack weldability - Test methods and performance requirements
ISO 15607	Specification and qualification of welding procedures for metallic materials - General rules
ISO/TR 15608	Welding - Guidelines for a metallic material grouping system
ISO 15609	Specification and qualification of welding procedures for metallic materials – Welding procedure specification (series)
ISO 15610	Specification and qualification of welding procedures for metallic materials - Qualification based on tested welding consumables
ISO 15611	Specification and qualification of welding procedures for metallic materials - Qualification based on previous welding experience
ISO 15612	Specification and qualification of welding procedures for metallic materials - Qualification by adoption of a standard welding procedure
ISO 15613	Specification and qualification of welding procedures for metallic materials - Qualification based on pre-production welding test
ISO 15614	Specification and qualification of welding procedures for metallic materials - Welding procedure test (series)
ISO/TR 16060	Destructive tests on welds in metallic materials — Etchants for macroscopic and microscopic examination
ISO 17660	Welding - Welding of Reinforcing Steel (series)
ISO 17662	Welding - Calibration, verification and validation of equipment used for welding, including ancillary activities
ISO 17663	Welding - Guidelines for quality requirements for heat treatment in connection with welding and allied processes

Appendix III: IWE Access Conditions

The IWE access Conditions here stated have been approved by the at the IAB Group B meeting held on the 24th of June 2025.

The Access Conditions to be specified in the Guideline in a unique and objective way, in the shape of a mandatory rules/requirements, not needing a specific interpretation by the different ANBs, meaning the National Access Conditions Directory, for IWE, doc IAB-020r44-25, it is withdrawn and superseded by the Access Conditions that will be sated on the Guideline.

It is agreed that entry to the Programme shall be in accordance with the following Table

<table>
<tr><td rowspan="4">IWE</td><td colspan="2">Mandatory Access condition required – ISCED Level</td></tr>
<tr><td>6</td><td>7</td></tr>
<tr><td>665</td><td>766
767</td></tr>
<tr><td>Bachelor’s or equivalent level (6), Orientation unspecified (6), First-degree programme, 3 to 4 years (5).</td><td>Master’s or equivalent level (7), Orientation unspecified (6), Long first-degree programme (6).

Master’s or equivalent level (7), Orientation unspecified (6), Second- or further-degree programme, following a Bachelor’s or equivalent programme (7)</td></tr>
<tr><td colspan="2">Access Conditions - Remarks

1) Participants shall have a primary bachelor’s degrees (reference: UNESCO ISCED Level 6 – International Standard Classification of Education - 3 years of study after Upper/Higher Secondary Education) recognised by the Appropriate Ministry (e.g. Education, Labour, etc.) of national government.
And
2) The bachelor’s degrees can be issued by Universities, College, Vocational Schools and Technical Institutes.
And
3) The bachelor’s degrees shall be in an any Science, Technology, Engineering and Mathematics (STEM) discipline provided it covers at least the following subjects: maths, physics, chemistry, electrotechnics, materials.
Or
4) STEM bachelor’s degrees that do not cover all the previous mentioned subjects can be accepted if applicants have at least 3 years of experience in metalworking or in the welding field in the last 5 years before the application.
Or
5) In case an Applicant provide a ISCED level 6 “certified” by a national government body gained not through a formal education (3 years of study after Upper/Higher Secondary Education, recognised by the Appropriate Ministry e.g. Education, Labour, etc. of national government), the application can be accepted after attendance to the IWE0 Programme and relevant examination

Footie note: Access conditions mandatory: 1 and 2 and 3; or 1 and 2 and 4; or 1 and 3 (note: item 3 only regarding STEM not regarding bachelor’s degree) and 5

- The ANB shall have documented evidence in his management system documentation (Table 1 of OP 18 applies) of the National type of bachelor’s degrees and relevant discipline which complies with the requirements stated above. ANBs are not allowed to define more stringent requirements than the ones stated above.

- IAB Group B will decide on conflicting cases between Applicants and ANBs about Access Condition.</td></tr>
</table>

Appendix VI: IWT Access Conditions (1 of 2)

The IWT access Conditions here stated have been approved by the at the IAB Group B meeting held on the 21st of January 2026.

The Access Conditions is specified in this Guideline in a unique and objective way, in the shape of a mandatory rules/requirements, not needing a specific interpretation by the different ANBs, meaning the National Access Conditions Directory, for IWE, doc IAB-020r44-25, it is withdrawn and superseded by the Access Conditions that it is sated on this Guideline.

It is agreed that entry to the Programme shall be in accordance with the following Table

IWT	***Mandatory Access condition required – ISCED Level***
	3XX
	Upper Secondary Education of any category and any subcategory
	Access Conditions - Remarks: *1) The Education shall be gained at College, Schools, Vocational Schools and Technical Institutes, recognised by the Appropriate Ministry (e.g. Education, Labour, etc.) of national government* *And* *2) The Education shall be in an any Science, Technology and Mathematics (STM) discipline provided it covers at least the following subjects: maths, physics, chemistry.* *Or* *3) STM Education that does not cover the subjects of physics and chemistry (mathematics must be covered by the level 3 education program, with direct access to programmes at ISCED levels 6 or 7), can be accepted if applicants have at least 2 years of experience in metalworking or in the welding field in the last 5 years before the application.* *Or* *4) Others than STM Education can be accepted if applicants have at least 5 years of experience in metalworking or in the welding field in the last 8 years before the application. These Applicants shall be made aware that mathematics is an import basic subject to understand the IWT training programme. It is recommended that these Applicants attend the IWS 0 before attending the IWT programme. Applicants shall pass the IWS 0 exam to be accepted on the IWT training programme.* *Foot note: Access conditions mandatory: 1 and 2; or 1 and 3; or 1 and 4* - The ANB shall have documented evidence in his management system documentation (Table 1 of OP 18 applies) of the National type of bachelor's degrees and relevant discipline which complies with the requirements stated above. ANBs are not allowed to define more stringent requirements than the ones stated above. - IAB Group B will decide on conflicting cases between Applicants and ANBs about Access Condition.

Appendix VI: IWT Access Conditions (2 of 2)

Below is given a table with recommended (not mandatory) access conditions for IWT.

Further recommendations, to be considered as informative only, are specified in the table below This recommendation should be considered by Applicants to better understand the level of complexity and difficulty of the IWT training programme.

	IWT Recommended Access condition – Only for information for Applicants - ISCED Level		
	3	4	5
	344 354	444 454	544 554
IWT	Upper secondary education **(3)**, General / academic **(4)**, Recognised successful completion of programme is sufficient for completion of ISCED level and with direct access to programmes at ISCED level 6 or 7 **(4)**. Upper secondary education **(3)**, Vocational / professional **(5)**, Recognised successful completion of programme is sufficient for completion of ISCED level and with direct access to programmes at ISCED levels 6 or 7 **(4)**	Post-secondary non-tertiary education **(4)**, General / academic **(4)**, Recognised successful completion of programme is sufficient for completion of ISCED level and with direct access to programmes at ISCED level 6 or 7 **(4)**. Post-secondary non-tertiary education **(4)**, Vocational / professional **(5)**, Recognised successful completion of programme is sufficient for completion of ISCED level and with direct access to programmes at ISCED levels 6 or 7 **(4)**	Short cycle tertiary education **(4)**, General / academic **(4)**, Recognised successful completion of programme is sufficient for completion of ISCED level and with direct access to programmes at ISCED level 6 or 7 **(4)**. Short cycle tertiary education **(4)**, Vocational / professional **(5)**, Recognised successful completion of programme is sufficient for completion of ISCED level and with direct access to programmes at ISCED levels 6 or 7 **(4)**
	Remarks: 1. Education gained at College, Schools, Vocational Schools and Technical Institutes recognised by the Appropriate Ministry (e.g. Education, Labour, etc.) of national government. And 2. Education in an any Science, Technology and Mathematics (STM) discipline provided it covers at least the following subjects: maths, physics, chemistry.		

Appendix IV: IIW-IAB/EWF Systems Framework & Correspondence to EQF

FIELD OF ACTIVITIY		EQF LEVEL	IIW/EWF LEVEL	KNOWLEDGE	SKILLS	AUTONOMY AND RESPONSIBILITY	IIW-IAB/EWF QUALI-FICA-TION SYSTEM
INSPECTORS &SUPERVISORS/ COORDINATORS/MANAG-ERS	WELDERS & OPERATORS	7	EXPERT	Highly specialised and forefront knowledge including original thinking, research and critical assessment of theory, principles and applicability of welding related technologies.	Highly specialised problem- solving skills including critical and original evaluation, allowing to define or develop the best technical and economical solutions, when applying welding related technologies, in complex and unpredictable conditions.	Manage and transform the welding and related technologies processes in a highly complex context. Fully responsible for the definition and revision of personnel's tasks.	WELDING
		6	ADVANCED	Advanced knowledge and critical understanding of the theory, principles and applicability of metal additive manufacturing or welding and related technologies.	Advanced problem-solving skills including critical evaluation, allowing to choose the proper technical and economical solutions, when applying metal additive manufacturing or welding and related technologies, in complex and unpredictable conditions	Manage the applications of metal additive manufacturing or welding and related technologies in a highly complex context. Act autonomously in decision making and definition in the definition of the metal additive manufacturing or welding and related personnel's tasks.	
		5	SPECIALIZED	Advanced knowledge and critical understanding of the theory, principles and applicability of welding and related technologies.	Advanced problem-solving skills including critical evaluation, allowing to choose the proper technical and economical solutions, when applying welding and related technologies, in complex and unpredictable conditions	Manage the applications of welding and related technologies in a highly complex context. Act autonomously in decision making and definition in the definition of the welding and related personnel's tasks.	
		4	INDEPENDENT	Factual and broad concepts in the field of metal additive manufacturing or welding technology	Fundamental cognitive and practical skills required to develop proper solutions and application of procedures and tools on simple and specific metal additive manufacturing or welding problems.	Self-manage of professional activities and simple standard applications of metal additive manufacturing or welding and related technologies in predictable contexts but subject to change. Supervise routine tasks and similar function workers, as well as take responsibility for decision making in basic work.	
		3	BASIC	Basic facts, principles, processes and general concepts of welding, joining and related technologies	Be able to check and follow the information on the welding procedure specification, to produce butt and fillet welds in plates and or tubes, and or profiles in a variety of geometries and positions to the required quality and of specified dimensional accuracy	Work under supervision, taking personal responsibility for own actions and for the quality and accuracy of the work produced.	
		2	ELEMENTARY	Elementary principles of welding, joining and related technologies	Able to check and follow the information on the welding procedure or adhesive bounding specification, and to produce weld/joints in a variety of geometries and positions to the required quality and of specified dimensional accuracy	Work under supervision.	

General reference descriptors transversal to all qualifications. Each Qualification has its own specific descriptors in terms of Knowledge, skills, autonomy and responsibility.