

IIW Guideline INTERNATIONAL WELDER



Minimum Requirements for the Education, Examination and Qualification



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**MINIMUM REQUIREMENTS FOR THE EDUCATION, TRAINING,
EXAMINATION AND QUALIFICATION OF:**

INTERNATIONAL WELDER
(IW)

**This Guideline, part I and II, replaces document IAB-089-
2003/EFW-452-467-480-481, Rev 3 January 2005**

Guideline of the International Institute of Welding

INTERNATIONAL AUTHORISATION BOARD (IAB)

Prepared by IAB Group A, WG A3a

Part I

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EFW above mentioned guidelines
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**Table of contents Part I**

Preface.....	6
Part I	7
1 Introduction	7
2 Access to the course.....	8
3 Instruction programme	9
4 IW Diploma via the Alternative Route	9
4.1 Entry Requirements.....	9
4.2 Evaluation process	9
4.3 Awarding the IW Diploma.....	10
5 Theoretical education.....	11
5.1 Module A	11
A.1 Using electricity for arc welding (2h).....	11
A.2 Welding equipment (2h).....	11
A.3 Health and Safety (2h).....	12
A.4 Safe working in the fabrication shop (2h)	12
A.5 Welding consumables (2h)	12
A.6 Welding practice (1) (4h).....	13
A.7 Welding practice (2) (2h).....	13
A.8 Introduction to steel (2h).....	13
A.9 Qualification of welders (2h)	14
5.2 Module B	14
B.1 Methods of joint preparation for welding (2h)	14
B.2 Welded joints in plates (2h).....	14
B.3 Weldability of steels (2h).....	15
B.4 Shrinkage, residual stress, distortion (2h)	15
B.5 Weld imperfections (2h).....	15
B.6 Overview of fusion welding processes (2h)	16
B.7 Safe working on site (2h).....	16
B.8 Inspection and testing (2h).....	16
B.9 Quality Assurance in welding (QA) (2h).....	17
5.3 Module C	17
C.1 Welded joints in pipes (2h).....	17
C.2 Materials other than non-alloy steel (2h)	17
C.3 Review and consequences of failures (2h).....	18
C.4 International Welding Standards (1h)	18
6 Modules S, dedicated to one specific welding process.	19
Module SG: Supplementary theoretical education for gas welding (311).	19
SG.1 Construction and maintenance of gas welding equipment	19
& typical welding parameters (3h).....	19
SG.2 Welding consumables (1h)	19
SG.3 Health and safety (1h).....	20
Module SA: Supplementary theoretical education for MMA welding (111).	20
SA.1 Construction and maintenance of MMA welding equipment	20
& typical welding parameters (3h).....	20
SA.2 Covered electrodes (1h)	21
SA.3 Health and safety (1h).....	21
Modules SM: Supplementary theoretical education for MIG/MAG welding (13).	21
SM.1 Construction and maintenance of MIG/MAG equipment (3h).....	21
SM.2 Welding consumables (1h)	22
SM.3 Health and safety (1h).....	22
SM.4 MIG/MAG welding characteristics and typical welding parameters (2h)	22
Module ST: Supplementary theoretical education for TIG welding (141).	23
ST.1 Construction and maintenance of TIG welding equipment (3h)	23
ST.2 Tungsten electrodes and welding consumables (1h)	23
ST.3 Health and safety (1h).....	23



7	Modules P, dedicated to one specific material.	24
	Module PSS: Instruction items for supplemental theoretical education for stainless steel.....	24
	PSS.1 Basics of stainless steel, welding processes and health aspects (2h).....	24
	PSS.2 Weldability, welded joints and distortion of stainless steel (2h)	24
	PSS.3 Welding consumables for stainless steel (2h).....	25
	PSS.4 Corrosion, post weld treatment (2h).....	25
	Module PAL: Instruction items for supplemental theoretical education for aluminium.	26
	PAL.1 Basics of aluminium, welding processes and health aspects (2h).....	26
	PAL.2 Weldability and welding technique (2h).....	26
	PAL.3 Welding consumables for aluminium welding (2h).....	27
	PAL.4 Welding joints and distortion in aluminium alloys (2h)	27
8	Practical Training and Tests	28
	8.1 General.....	28
	8.2 Welding Simulating Systems.....	28
	8.3 All modules.....	28
9	Process 111 (MMA-welding) for ferritic and stainless steel.	29
	9.1 Module E 1	29
	9.2 Module E 2	29
	9.3 Module E 3	29
	9.4 Module E 4	30
	9.5 Module E 5	30
	9.6 Module E 6	30
	9.7 Training and test pieces for MMA welding of steel.	31
10	Process 135, 136 and 138 (MAG-welding) for ferritic and stainless steel.	37
	10.1 Module M 1.....	37
	10.2 Module M 2.....	37
	10.3 Module M 3.....	37
	10.4 Module M 4.....	38
	10.5 Module M 5.....	38
	10.6 Module M 6.....	38
	10.7 Training and test pieces for MAG welding of steel.....	39
11	Process 131 (MIG-welding) for aluminium material groups.....	45
	11.1 Module MAI.1	45
	11.2 Module MAI.2	45
	11.3 Module MAI.3	45
	11.4 Module MAI.4	46
	11.5 Training and test pieces for MIG welding of aluminium material groups.	47
12	Process 141 (TIG-welding) for ferritic and stainless steel.	51
	12.1 Module T 1	51
	12.2 Module T 2	51
	12.3 Module T 3	51
	12.4 Module T 4	52
	12.5 Module T 5	52
	12.6 Module T 6	52
	12.7 Training and test pieces for TIG welding of steel.....	53
13	Process 141 (TIG-welding) for aluminium material groups.	59
	13.1 Module TAI.1	59
	13.2 Module TAI.2	59
	13.3 Module TAI.3	59
	13.4 Module TAI.4	60
	13.5 Module TAI.5	60
	13.6 Module TAI.6	60
	13.7 Training and test pieces for TIG welding of aluminium material groups.....	61
14	Process 311 (Gas-welding) for ferritic steel.....	67
	14.1 Module G 3.....	67
	14.2 Module G 4.....	67
	14.3 Module G 5.....	67
	14.4 Module G 6.....	68
	14.5 Training and test pieces for Gas welding of steel.	69



15	International welder specific requirements	73
15.1	Introduction.....	73
15.2	International Welder Training Requirements	73
15.3	International Welder Teachers/Instructors	73
15.4	ANB Authorised Examiner	74
15.5	International Welder Examinations	74
15.6	Destructive and Non-destructive Examinations	76
15.7	Validity of theoretical examinations.....	76
15.8	Diploma	76
Appendix 1		
	Reference standards.....	77



Preface

This document is based upon the European Welder series (former docs. EWF-452, EWF-467, EWF-480 and EWF-481), as developed by the European Federation for Welding, Joining and Cutting (EWF), through an Agreement first signed in 19 July, 1997, at the Annual Meeting of the International Institute of Welding (IIW) in San Francisco, California, USA, and which has been further developed since then. It is established in that Agreement that the International Welder Diploma is equivalent to the European Welder Diploma within the same scope.

This document – known in the WG#A3a as the 'Bratislava Agreement' - reflects the results of thorough in-depth discussions to the basics of welding technology and skill, and was finally issued after a meeting of the working group in Bratislava, Slovakia.

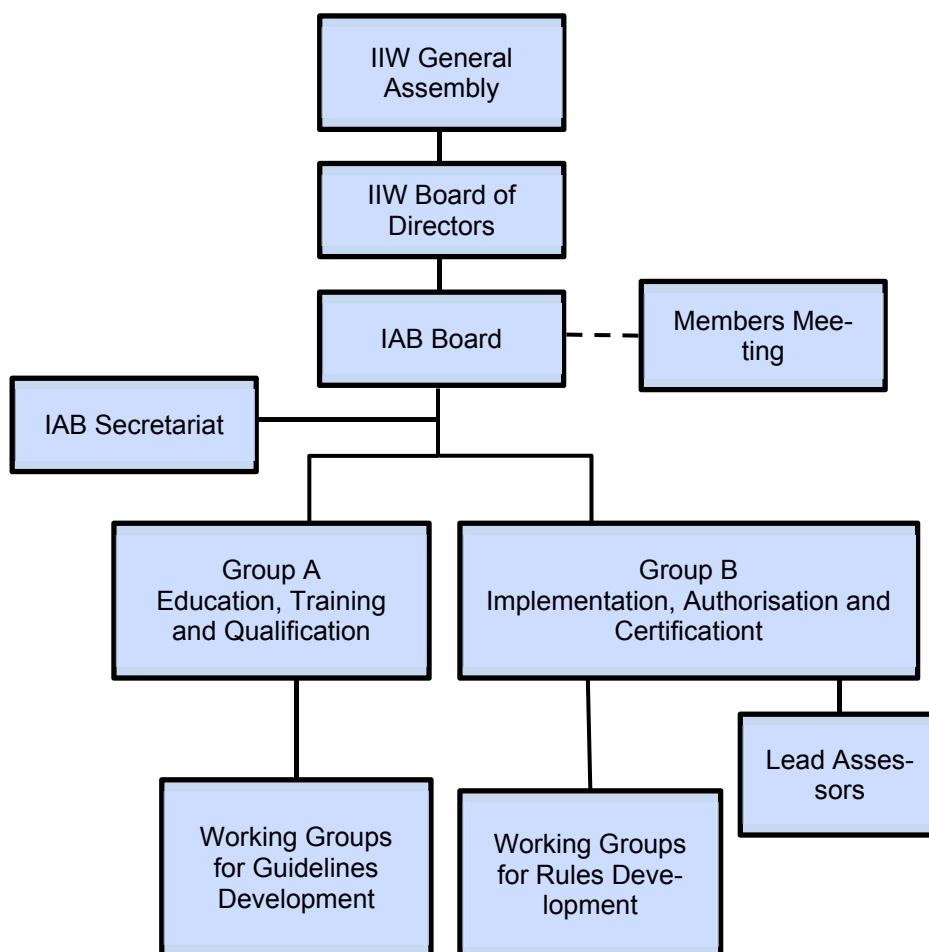
This Guideline is split up into two parts, I and II.

Part I is dealing with the standard scheme for educating welders.

Part II it is optional and provides details on test objects and WPSs to be used for test object examination.

Any EWF 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 IIW IAB Secretariat or their designated distributor.



Organisation of the IAB



Minimum requirements for the Theoretical Education, Practical Training and Examination of International Welders

The use of this Guideline is restricted to organisations approved by the Authorised National Body as Approved Training Bodies (ATB). The requirements for gas welding and arc welding are described in this Guideline in general. Special requirements for welding processes and materials are described in modules.

The practical exercises mentioned in this Guideline applies to steels and aluminium and may be used as a basis for other materials.

Part I

1 Introduction

This Guideline for the international education and training of welders has been prepared, evaluated and formulated by Group A of the International Authorisation Board (IAB) of the International Institute of Welding (IIW). The Guideline seeks to achieve harmonisation in the training, examination and qualification testing of welders in the world. It provides for the assessment of both theoretical knowledge and practical skills, the latter being linked to the requirements of ISO 9606 (or equivalent standard) and test objects if part II of this Guideline is applied.

The ISO 9606- series of International Standards provides a scheme for qualification testing of welders, to evaluate their skill for limited ranges of welding conditions. It serves for quality assurance for a specific job, but does not provide an education and training programme. However, the industry needs welders with more skill for the sake of flexibility in production and this Guideline provides a combination of comprehensive theoretical knowledge and high practical skills, assessed by tests of increasing difficulty, including ISO 9606 qualification tests and by theoretical examinations.

This Guideline takes care of both requirements and gives methods for practical training and theoretical education of fillet, plate and pipe welders.

The education and training programme consists of three theoretical modules “A”, “B” and “C”, which provide basic theoretical knowledge in welding, and six practical modules (3 pairs) corresponding to the three levels of skill. Special requirements for each welding process are given in modules S. Special requirements per material (group) are described in modules P.

For each level of skill, two alternative types of practical examinations can be made. Either ISO 9606 tests only or a combination of ISO 9606 tests and a test object.

It is for the ANB to decide whether it is desirable to add knowledge on specific materials to the course. Such knowledge should be in addition to the basic knowledge as specified in this Guideline.

The Guideline will be revised periodically by Group A of the IAB, to take into account any changes, which may affect the 'state of the art'.

2 Access to the course

Applicants must possess sufficient knowledge of, or education in, metalworking to follow the course. They must also have a level of health, and physical and mental capability, to undergo the training for which they are applying.

Successful completion of one module qualifies for participation in the next module. With existing knowledge and proven skill, the program may be entered at a higher level, provided that the candidate demonstrates a capability (practically and theoretically) to meet the entry requirements as described below (see also figure 1.).

Access to Demonstrate the required level of skill by passing the tests as described in module 1.

Module 2:

Access to Demonstrate the required level of skill by passing the full examination as described in module 2.

Module 3:

Access to Demonstrate the required level of skill by passing the full examination as described in module 2

Module 4: and passing the tests as described in module 3.

Access to Demonstrate the required level of skill by passing the full examination as described in module 2

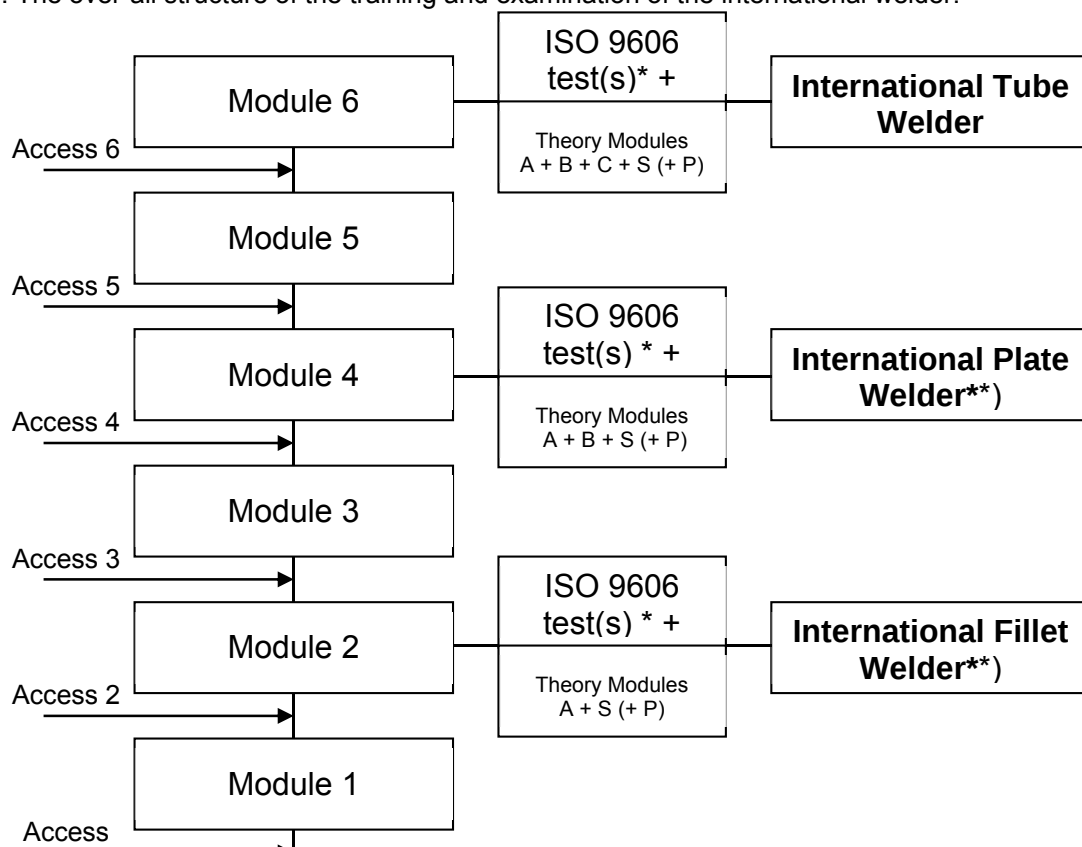
Module 5: and in module 4.

Access to Demonstrate the required level of skill by passing the full examination as described in module 2

Module 6: and in module 4 and by passing the tests as described in module 5.

Practical skill may be proven by adequate and valid ISO 9606 or equivalent certificates. At the discretion of the ANB proof of practical skills at a lower level may be delivered after the completion of the training module involved but before awarding the corresponding diploma.

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



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



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

3 Instruction programme

The full IIW course consists of modules, which are divided into theoretical education, practical training and examination. The practical training - practice in welding and test welding - is based on the relevant instruction and exercise schedules as per this Guideline. It comprises of three levels of education and training: "Fillet welder", "Plate welder" and "Tube welder".

The recommended periods of time given in the modules A to C and P and S and in the practical part represent the average time required to attain the expected level of knowledge. The time needed may vary individually according to the capability of the student. A teaching hour will contain at least 50 minutes of direct teaching time. It is not obligatory to follow exactly the order of the topics given in this Guideline.

The theoretical education given to the students aims at a basic understanding of the appropriate welding process and the materials behaviour including standards and safety regulations. The themes and keywords are given as 'scope' in the module descriptions, together with the 'Objective' and the 'Learning Outcomes'. After each module a theoretical examination is performed.

The practical training advised in this Guideline will bring the students to the comprehensive skill, required for practical work in industry.

At the beginning of a course the students should be informed about the Constitution of IIW and role in the world, the structure of harmonised system from Welder to welding Engineer and the routes from International Welder to Practitioner and Specialist.

4 IW Diploma via the Alternative Route

The Alternative Route allows those who have gained the knowledge and expertise of the instruction programme in this Guideline and who can demonstrate their capability in all respects, to proceed to examination without compulsory attendance at an ANB approved Training Course.

4.1 Entry Requirements

- Any candidate who can show a welder qualification (i.e. ISO 9696) valid under the scope for the Diploma he/she wants.
- 3 years of experience as a welder.

4.2 Evaluation process

- To perform the theoretical examinations, related to the level of the IW Diploma that the candidate is seeking for, e.g.
 - o a candidate for Tube Welder Diploma, must perform examinations Mod. A, B, C, Examination Process related (SX) and the Examination Material related (PSS or PAL).
 - o a candidate for Plate Welder Diploma, must perform examinations Mod. A, B, Examination Process related (SX) and the Examination Material related (PSS or PAL).
 - o a candidate for Fillet Welder Diploma, must perform examinations Mod. A Examination Process related (SX) and the Examination Material related (PSS or PAL).
 - o
- To perform the practical examinations that are defined in the Guideline for the level of the IW Diploma that the candidate is applying for, including the lower levels examinations.
 - o a candidate for Tube Welder Diploma, must perform practical examinations Mod. 2,4,5 and 6
 - o a candidate for Plate Welder Diploma, must perform practical examinations Mod. 2,3 and 4
 - o a candidate for Fillet Welder Diploma, must perform practical examinations Mod. 1 and 2



See figure 1.

- o Re-examination in the case of candidate failure on the theoretical examination(s) or on the practical exam(s):

For theoretical examinations candidates are allowed to have two more attempts (in total three attempts). In case of failure on the third attempt the candidate must take the theoretical module(s) that he/she failed.

For practical exams candidates are allowed to have one more attempt. In case of failure on the second attempt the candidate must take the practical module he/she has failed.

4.3 Awarding the IW Diploma

If the candidate is successful in the theoretical and practical examinations, the IW Diploma shall be awarded.



5 Theoretical education

5.1 Module A

The module A provides theoretical education to the level of the International Fillet Welder. The matters to be dealt with and the recommended hours devoted to them are listed below.

A <u>Items for the theoretical education</u>	<u>teaching hours recommended</u>
A.1 <u>Using electricity for arc welding</u>	(2h)

Objective:

Know the principle of arc welding.

Scope:

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

Learning Outcomes:

1. Describe the principle of arc welding.
2. Understand the basic terms in welding.
3. Brief explanation of the heat generation in the arc.
4. Brief explanation of metal transfer through the arc.
5. Brief explanation of the formation of the weld pool.

A.2 <u>Welding equipment</u>	(2h)
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Objective:

Know the operating principles of welding equipment for arc welding.

Scope:

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

Learning Outcomes:

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

**A.3 Health and Safety****(2h)****Objective:**

Know and understand hazards and basic safety requirements when welding.

Scope:

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

Learning Outcomes:

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

A.4 Safe working in the fabrication shop**(2h)****Objective:**

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

Scope:

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

Learning Outcomes:

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

A.5 Welding consumables**(2h)****Objective:**

Understand the basic principles of the use of welding consumables.

Scope:

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

**Learning Outcomes:**

1. Know use, types and functions of welding consumables.
2. Know why and how to dry, store and handle welding consumables.
3. Identify the designation of welding consumables as used on WPSs of the training program (e.g. according to ISO 636, ISO 2560, ISO 14175, ISO 14341, ISO 17632 ASME Code, etc.).

A.6 Welding practice (1)**(4h)****Objective:**

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

Scope:

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

Learning Outcomes:

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

A.7 Welding practice (2)**(2h)****Objective:**

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

Scope:

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

Learning Outcomes:

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

A.8 Introduction to steel**(2h)****Objective:**

Know the basics of welding steel.

Scope:

- Different types of steels
- Effects of welding on steel
- Material grouping according to ISO/TR 15608 and ISO/TR 20172, ISO/TR/20173 and ISO/TR 20174 as appropriate

Learning Outcomes:

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

**A.9 Qualification of welders****(2h)****Objective:**

Know the basics of welder qualification according to ISO 9606.

Scope:

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

Learning Outcomes:

1. Know the range of qualification in a welder's certificate.
2. Outline the essential variables for a welder qualification test.

Total number of recommended hours for A:**20h****5.2 Module B**

The module B provides in addition to module A, theoretical education to the level of the International Plate Welder. The matters to be dealt with and the recommended hours devoted to them are listed below.

B	Items for the theoretical education	teaching hours recommended
B.1	Methods of joint preparation for welding	(2h)

Objective:

Know the available methods for joint preparation for welding.

Scope:

- Suitable cutting processes for different types of steel to achieve a suitable cutting surface.
- Flame cutting: principles and parameters, cutting blow pipes, cutting machines; quality of cut surfaces (e.g. ISO 9013).
- Arc gouging and gas gouging principles
- Other cutting processes as: plasma, laser, mechanical cutting

Learning Outcomes:

1. Outline methods used for joint preparation and their specific application.
2. Know essential parameters and results of thermal cutting (plasma and flame cutting).
3. Know suitable cutting and gouging processes for the main types of steel.

B.2 Welded joints in plates**(2h)****Objective:**

Know the basics of welded joints and their terminology.

Scope:

- Types of welds: butt and fillet
- Types of joints: butt, "T", lap and corner
- Characteristics of fillet welds; leg length, throat thickness, penetration, number of runs, surface finish
- Characteristics of butt welds; types of joint preparation; single and multi-run welds; excess weld metal; weld profile, penetration, surface finish, permanent and temporary backing
- Examples of welded joints in typical constructions using plates (e.g. structures, tanks, and pressure vessels)

Learning Outcomes:

1. Know butt weld, fillet weld, butt joint, T-joint, lap joint and corner joint.
2. Identify throat thickness, leg length, penetration, and number of runs.
3. Identify single- and multi-run welds, excess weld metal, weld profile.
4. Name different types of joint preparations and their main dimensions.



B.3 Weldability of steels

(2h)

Objective:

Know the specific effects of welding heat on steel.

Scope:

- The concept of weldability
- Effects of composition, thickness and temperature (preheat and interpass)
- Heat input

Learning Outcomes:

1. Name the influence of alloying elements on the properties of weldable steel.
2. Describe the effect of plate thickness on the properties of weldable steel.
3. Mention the carbon equivalent and its use.
4. Calculate the heat input and mention its use.

B.4 Shrinkage, residual stress, distortion

(2h)

Objective:

Know the effect of welding in terms of shrinkage, residual stresses and distortion. And know how to minimise distortion before, during and after welding.

Scope:

- The thermal cycle in welding
- Development of residual stresses due to solidification, cooling and shrinkage
- Effects of restraint on residual stress
- Significance of residual stress
- Preheating, post heating
- Relationship between heat input and shrinkage, residual stress and distortion.
- Development of distortion; effect of heat input, weld size, penetration, and number of runs single- and double-sided fillet welded joints and in butt welds.
- Corrective measures, procedure, welding technique, sequence, joint preparation, pre-setting
- Correction of distortion after welding

Learning Outcomes:

1. Describe the thermal cycle during welding.
2. Describe distortion resulting from shrinkage.
3. Describe residual stresses.
4. Name measures to minimise distortion.
5. Describe the main causes for weld shrinkage.
6. Outline the main effects on a weld due to residual stresses.

B.5 Weld imperfections

(2h)

Objective:

Know about imperfections in welds.

Scope:

- Origin of imperfections: parent metal; welding process; welder; joint preparation
- Survey of specific weld imperfections and their cause
- Influence of weld imperfections on product performance
- Influence of the weld geometry on the fatigue life of the product

Learning Outcomes:

1. Identify and describe the cause of: gas pores, incomplete penetration, lack of fusion and cracks (see also the specific modules “S” on welding processes).

**B.6 Overview of fusion welding processes****(2h)****Objective:**

Have an overview of the most frequently used fusion welding processes.

Scope:

- Revision of the arc as heat source (A.1)
- Principles of arc welding equipment (A.2)
- Revision of MMA (111) welding
- Revision of MIG/MAG (13) welding
- Principles of Self Shielding Metal Arc (114) welding
- Revision of TIG (141) welding
- Principles of gas welding (311)
- Principles of plasma welding (151)
- Principles of submerged-arc welding (121)

Learning Outcomes:

1. Describe different welding processes: 311, 111, 13, 114, 141, 151, 121.

B.7 Safe working on site**(2h)****Objective:**

Know how to perform welding activities on construction sites in a safe manner.

Scope:

- The site environment; special problems of open air working; working at height for example gantries and fixed staging; poor ground conditions; extremes of heat and cold; wind and rain effects
- Welding in the site environment
- Earthing arrangements
- Protection of other workers from welding hazards

Learning Outcomes:

1. Identify the hazards for welding when working on site.
2. Name basic precautions to be taken.

B.8 Inspection and testing**(2h)****Objective:**

Know the principles of basic NDT methods used in welding.

Scope:

- Review of weld imperfections (ISO 6520-1)
- Review of quality levels (ISO 5817)
- Checking dimensions, surface and distortion
- Surface inspection of cracks and other surface imperfections by visual testing (VT), penetrant testing (PT) and magnetic particle testing (MT)
- Detectability of internal imperfections of welds by radiographic testing (RT) and ultrasonic testing (UT)
- Destructive tests to measure mechanical properties of weld

Learning Outcomes:

1. Perform simple visual inspection of welds according to ISO 17637 and subsequently evaluate to ISO 5817.
2. Know the following destructive and non-destructive methods: bend tests, hardness tests, tensile tests and impact tests, VT, MT, PT, RT and UT.

**B.9 Quality Assurance in welding (QA)****(2h)****Objective:**

Have knowledge about the function of Quality Assurance (QA) in welding.

Scope:

- Role of inspection and Quality control
- Key role of welders in assuring weld Quality
- Key role of inspection and NDT in identifying potentially dangerous weld defects
- Introduction of ISO 3834: Quality Requirements for Welding
- Introduction of ISO 14731: Welding Co-ordination and relationship to IIW qualifications

Learning Outcomes:

1. Explain the need for quality assurance in welding.
2. Know the position of ISO 3834 in connection with the standards for welding personnel and welding procedures.

Total number of recommended hours for B:**18h****5.3 Module C**

The module C provides in addition to modules A and B, theoretical education to the level of the International Tube Welder. The matters to be dealt with and the recommended hours devoted to them are listed below.

C	Items for the theoretical education	teaching hours recommended
C.1	Welded joints in pipes	(2h)

Objective:

Know the different connections in pipe welding.

Scope:

- Butt welds in pipes; in-line and at an angle; the importance of gas backing
- Tube to plate welds
- Branch connections (set-on, set-in and set-through)
- Adaptation of joint preparation methods for pipes

Learning Outcomes:

1. Identify the following joint preparations: I-, V-, X-, and U- preparations.
2. Identify and draft tube to plate welds, branch connections.
3. Describe the different methods for joint preparation of pipes.

C.2 Materials other than non-alloy steel**(2h)****Objective:**

Know about the most important other materials and their behaviour.

Scope:

- Stainless steels and other alloy steels
- Aluminium alloys
- Copper alloys
- Nickel alloys
- Titanium and other special materials
- Typical problems when welding the above materials

Learning Outcomes:

1. Know materials as stainless steels, other alloy steels and aluminium.
2. Outline typical problems when welding stainless steels, other alloy steels and aluminium.



C.3 Review and consequences of failures (2h)

Objective:

Know why welds may fail, what the consequences could be and what the role of the welder might be.

Scope:

- Revision of safety requirements of welded products
- Review of product failures due to bad performance of welding
- Implication of failure; product liability

Learning Outcomes:

1. Give examples of failures and their consequences.
2. Know the key role of the welder in avoiding failures

C.4 International Welding Standards (1h)

Objective:

Have basic knowledge about the harmonised system of International Standards.

Scope:

- Role and operation of CEN and ISO; relationship with National Standards Organisations
- Standards for welding equipment and welding consumables
- Standards for welding practice
- Product Standards which contain welding requirements
- Standards for Quality and Co-ordination in welding

Learning Outcomes:

1. Name the most important International and national standards for welding.

Total number of recommended hours for C: 7h



6 Modules S, dedicated to one specific welding process.

Modules S: dedicated to one specific welding process to be taught after or in parallel to theoretical modules per material required.

Module SG: Supplementary theoretical education for gas welding (311).

SG.1 Construction and maintenance of gas welding equipment & typical welding parameters (3h)

Objective:

Know about the basic construction of welding equipment for gas welding and the influence of the typical gas welding parameters on the final quality of welding.

Scope:

- Properties and storage of acetylene and oxygen
- Supply of workshops with gases
- Standards for gas welding equipment
- Pressure regulators (ISO 2503 / ISO 7291)
- Safety devices (ISO 5175)
- Hoses / hose connection (ISO 3821, EN 560, EN 561, EN 1256)
- Welding blowpipes; sizes and types (ISO 5172)
- Care and maintenance of equipment
- Process of combustion
- Temperature profile
- Flame adjustment
- Typical welding parameters: choice of nozzle in function of weld thickness, welding position.
- "Leftward" and "rightward" welding techniques
- Checking for safe operation
- Welding Procedure Specifications to ISO 15609-2.
- Weld imperfections and possible problems specific to the process.

Learning Outcomes:

1. Check the safety precautions against the standards requirements.
2. Describe the basics of required welding equipment for gas welding.
3. Know the pressure regulators, gas cylinders, blowpipes and safety devices.
4. Describe the process of combustion.
5. Explain the use of "leftward" and "rightward" welding techniques.
6. Can determine and identify the correct nozzle and regulate the correct gas pressure.
7. Identification of the correct WPS and its application in production.
8. Identify the most common imperfections and problems for this process and know how to avoid them.

SG.2 Welding consumables (1h)

Objective:

Have basic knowledge about the specific consumables used with this welding process.

Scope:

- Classification of rods and gases (EN 12536)
- Identification and selection of welding rods for gas welding

Learning Outcomes:

1. Know how to select a welding rod for a specific job.

**SG.3 Health and safety****(1h)****Objective:**

Have basic knowledge about the specific health and safety precautions related to gas welding process.

Scope:

- Gases
- Decomposition of acetylene, cylinder fire, gas cylinder handling
- Fire guard
- Extinguishing substances, fire fighting

Learning Outcomes:

1. Know how to protect the welder against the potential hazards of gas welding.
2. Know what to do when accidents occur.
3. Know how to prevent fires.

Total number of recommended hours for SG:**5h****Module SA: Supplementary theoretical education for MMA welding (111).****SA.1 Construction and maintenance of MMA welding equipment
& typical welding parameters****(3h)****Objective:**

Know about the basics of a power source for MMA welding and the influence of the typical MMA welding parameters on the final quality of the weld.

Scope:

- AC and DC.
- Study of 'electric arc' and its characteristics.
- The AC transformer; windings, core, temperature rise and control
- Primary and secondary circuits; mains protection
- Relationship between arc voltage and welding current; power source characteristics.
- Control of welding current, instruments to be used and validation of measuring instruments
- Power sources for DC welding
- Arc starting aids
- Earthing arrangements, cables, electrode holders
- Maintenance of equipment; condition of cables and connections; cleanliness of contact faces; cleanliness of internal components
- Checking for safe operation
- Typical welding parameters and selection of electrode type and size.
- Weld imperfections and possible problems specific to MMA welding.

Learning Outcomes:

1. Describe the basics of a power source for MMA welding.
2. Know the transformer, electrode holder, earth cable, earth clamp.
3. Know Open Circuit Voltage, AC, DC, polarity.
4. Identify the most common imperfections for MMA welding and how to avoid them.
5. Know how to select a proper type and diameter of covered electrode.
6. Know the main safety requirements in MMA welding.



SA.2 Covered electrodes

(1h)

Objective:

Have basic knowledge about covered electrodes.

Scope:

- Classification of covered electrodes according to the relevant standards.
- Application of different types of covered electrodes.

Learning Outcomes:

1. Check the correct selection of a covered electrode for a specific job (e.g. according to the appropriate WPS).

SA.3 Health and safety

(1h)

Objective:

Have basic knowledge about the specific health and safety precautions related to the MMA process.

Scope:

- Protection during slag removal.
- Welding fumes
- Electrical safety (open circuit voltage (OCV), etc.)

Learning Outcomes:

1. Know how to protect the welder against the potential hazards of MMA welding.

Total number of recommended hours for SA:

5h

Modules SM: Supplementary theoretical education for MIG/MAG welding (13).

SM.1 Construction and maintenance of MIG/MAG equipment

(3h)

Objective:

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

Scope:

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

Learning Outcomes:

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

**SM.2 Welding consumables****(1h)****Objective:**

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

Scope:

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

Learning Outcomes:

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

SM.3 Health and safety**(1h)****Objective:**

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

Scope:

- Fumes
- UV radiation

Learning Outcomes:

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

SM.4 MIG/MAG welding characteristics and typical welding parameters**(2h)****Objective:**

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

Scope:

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

Learning Outcomes:

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

Total number of recommended hours for SM:**7h**



Module ST: Supplementary theoretical education for TIG welding (141).

ST.1 Construction and maintenance of TIG welding equipment (3h)

Objective:

Know about the basic construction of a power source for TIG welding and the influence of the typical TIG welding parameters on the quality of the weld.

Scope:

- The AC transformer; windings, core, temperature rise and control
- Primary and secondary circuits; mains protection
- Control of welding current, instruments to be used and validation of measuring instruments
- Rectifiers for DC welding
- Arc starting devices
- Earthing arrangements, cables, welding torches
- Maintenance of equipment; condition of cables and connections; cleanliness of contact faces; cleanliness of internal components; gas supply and control
- Checking for safe operation
- Grinding of tungsten electrodes
- Weld imperfections specific to TIG welding.

Learning Outcomes:

1. Describe the basics of a power source for TIG welding.
2. Know the transformer, torch, earth cable, and starting device.
3. Know open circuit voltage (OCV), AC, and DC.
4. Describe how to grind a tungsten electrode.
5. Identify the most typical imperfections for TIG welding.

ST.2 Tungsten electrodes and welding consumables (1h)

Objective:

Have basic knowledge about the tungsten electrodes and the specific welding consumables used in TIG-welding.

Scope:

- Classification of tungsten electrodes (ISO 6848)
- Classification of welding rods or wires used for TIG welding
- Classification of shielding and backing gases (ISO 14175)
- Size of rod or wire to be used

Learning Outcomes:

1. Check the correct selection of tungsten electrode, welding rod or wire and shielding gas for a specific job (e.g. according to the appropriate WPS).

ST.3 Health and safety (1h)

Objective:

Have basic knowledge about the specific health and safety precautions related to TIG welding.

Scope:

- Sharpening and handling of tungsten electrodes.
- Proper use of backing gases.

Learning Outcomes:

1. Know how to protect the welder against the potential hazards of TIG welding.

Total number of recommended hours for ST:

5h

7 Modules P, dedicated to one specific material.

Modules P: dedicated to one specific material to be taught after or in parallel to theoretical modules if the sought qualification is for stainless steel or aluminium.

Module PSS: Instruction items for supplemental theoretical education for stainless steel.

PSS.1 Basics of stainless steel, welding processes and health aspects (2h)

Objective:

Know the basics of stainless steel; appropriate welding processes and the health aspects related to welding of stainless steel

Scope:

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

Learning Outcomes:

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

PSS.2 Weldability, welded joints and distortion of stainless steel (2h)

Objective:

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

Scope:

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

Learning Outcomes:

1. Outline the commonly used welding joints and the methods of joint preparation regarding stainless steel
2. Know about the importance of controlling heat input and interpass temperature
3. Name the influence of alloying elements on weld properties.
4. Know the effect of heat input on material properties.
5. Describe the methods of welding dissimilar metals and clad metal



6. Knowing methods to confine distortion of stainless steel caused by welding
7. Know how to control the dilution

PSS.3 Welding consumables for stainless steel

(2h)

Objective:

Know the basics of welding consumables and of backing gas

Scope:

- Welding consumables (filler metals and shielding gases) adequate for stainless steels, standards
- Measurements (ppm) of oxygen on backing gas, requirements for different grades of stainless steels
- Determination of required backing gas, density of gases compared to density of air
- Equipment for backing gas

Learning Outcomes:

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

PSS.4 Corrosion, post weld treatment

(2h)

Objective:

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

Scope:

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

Learning Outcomes:

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

Total number of recommended hours for PSS:

8h



Module PAL: Instruction items for supplemental theoretical education for aluminium.

PAL.1 Basics of aluminium, welding processes and health aspects (2h)

Objective:

Know the basics of aluminium, aluminium alloys, welding processes and the health aspects regarding welding of aluminium alloys

Scope:

- Grades of aluminium and aluminium alloys their characteristics and classification.
- Characteristics of aluminium compared to mild steel and stainless steel.
- Protective oxide film positive for welding?
- Welding processes for aluminium and aluminium alloys.
- Health aspects during welding of aluminium and its alloys.
- Methods for preventing health risks during welding and joint preparation of aluminium, breathing zone, welder's masks with fresh-air filters, hygiene.

Learning Outcomes:

1. Brief explanation of the protective oxide film.
2. Know the grades of aluminium and aluminium alloys their characteristics and classification.
3. Understand the difference of welding aluminium alloys compared to welding unalloyed steel and stainless steel.
4. Give examples of common welding processes for aluminium alloys.
5. Knowing methods for preventing health risks related to welding and joint preparation of aluminium alloys.

PAL.2 Weldability and welding technique (2h)

Objective:

Know the theoretical basics of welding aluminium alloys and common welding technique. Know about weld imperfections, characteristic for welding of aluminium and its alloys.

Scope:

- Weldability of aluminium, heat input, preheating
- Post weld treatment
- Welding technique, TIG and MIG
- Handling of aluminium in the workshop
- Survey of specific imperfections and their cause (porosity, hot cracking, lack of fusion).

Learning Outcomes:

1. Outline the essentials of weldability of aluminium alloys, heat input, preheating, post weld treatment
2. Know about welding technique, TIG and MIG
3. Describe the correct handling of aluminium alloy material in workshop
4. Knowing how to avoid the imperfections characteristic to aluminium.



PAL.3 Welding consumables for aluminium welding

(2h)

Objective:

Know the basics of how to choose filler metals and gases for aluminium welding

Scope:

- Filler metals for aluminium, standards, consumable manufacturers recommendations
- Shielding gases for aluminium welding, standard, consumable manufacturers recommendations
- Handling of welding consumables
- Consumables selection based on required properties of the weld (strength, weldability, corrosion properties and anodising properties.)

Learning Outcomes:

1. Identify the main types, and classification of welding consumables regarding aluminium alloys
2. Understand how to work with standards
3. Identify types of welding consumables in view of requested properties.

PAL.4 Welding joints and distortion in aluminium alloys

(2h)

Objective:

Know about different types of welding joints and distortion caused by welding

Scope:

- Welding joints for aluminium alloys
- Methods of joint preparation in aluminium alloys
- Cleaning before welding
- Distortion caused by welding aluminium alloys compared to steel

Learning Outcomes:

1. Outline the commonly used welding joints and the methods of joint preparation regarding aluminium alloys
2. Knowing methods to confine distortion of aluminium alloys caused by welding

Total number of recommended hours for PAL:

8h



8 Practical Training and Tests

8.1 General

This Guideline applies mainly to ferritic steels (group 1, 2, 3 and 11 according to ISO/TR 15608) and – where applicable – stainless steels (group 8 and 10 according to ISO/TR 15608) and may be used as a basis for other materials until the moment a corresponding Guideline exists. The application of this program to other materials than given with the exercises may require slight changes to the work pieces and / or the positions to be welded. Such changes require principal approval of the ANB.

8.2 Welding Simulating Systems

There are many intelligent computer aided welding simulating systems available. If an existing welding simulation system is suitable to be used in welding training sessions for a special process, they have to be approved by the ANB. In the case of an approved simulation system, the ATB can decide if they will use it.

The recommended training hours depend on each system and can be different from one to another system. The decision about the range of using is up to the ATB, and the ANB must approve it.

8.3 All modules

In all modules the following Learning Outcomes apply:

1. Assemble and tacking the joint.
2. Take the necessary precautions to avoid distortion prior to, during and after welding.
3. Follow the welding symbols and the (p)WPS (related to the proposed weld).
4. Perform safe welding according to the (p)WPS (or welding instruction).
5. Select the appropriate type of consumable and the desired size according to the (p)WPS (or welding instruction).



9 Process 111 (MMA-welding) for ferritic and stainless steel.

9.1 Module E 1

Objective:

To obtain basic experience in process 111 (MMA welding) and to be able to produce fillet welds in plate in PA, PB, PF and PG positions.

Scope:

See table E 1

The average recommended time for the exercises is about 90 h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound fillet welds in different types of joints as specified in table E 1 in single and multi run technique.
4. Perform flame and / or plasma cutting in the range of 3 – 15 mm (not tested).
5. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control.

9.2 Module E 2

Objective:

To obtain experience in process 111 (MMA welding) and produce fillet welds in plate in PD position and in tube-to-plate joints in PB, PD and PH positions.

Scope:

See table E 2

The average recommended time for the exercises is about 50 h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound fillet welds in different types of joints as specified in table E 2 in single and multi run technique.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control

9.3 Module E 3

Objective:

To obtain experience in process 111 (MMA welding) and to be able to produce single and both sided butt welds in PA and PC positions with and without gouging and grinding.

Scope:

See table E 3

The average recommended time for the exercises is about 75 h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound fillet and butt welds in different types of joints in plates as specified in table E 3 in single and multi-run technique.
4. Perform grinding and/or gouging (not tested).
5. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control



9.4 Module E 4

Objective:

To obtain experience in process 111 (MMA welding) and to be able to produce fillet welds in corner joints in PF position, T-butt joints in PB and PF positions, single and both sided welds in PF position and single sided butt welds in plate in PE position.

Scope:

See table E 4

The average recommended time for the exercises is about 75 h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound butt welds in different types of joints in plates as specified in table E 4 in single and multi run technique
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control

9.5 Module E 5

Objective:

To obtain experience in process 111 (MMA welding) and to be able to produce single sided butt welds in pipe in PA, PC and PH positions.

Scope:

See table E 5

The average recommended time for the exercises is about 75 h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound single sided butt welds in different types of joints in pipe as specified in table E 5 in single and multi-run technique.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control

9.6 Module E 6

Objective:

To obtain experience in process 111 (MMA welding) and to be able to produce single sided butt welds in pipe in PH and H-L045 positions.

Scope:

See table E 6

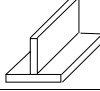
The average recommended time for the exercises is about 75 h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound single sided butt welds in different types of joints in pipes as specified in table E 6 in single and multi-run technique
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control

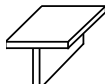
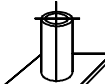
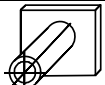
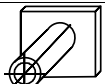
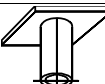
9.7 Training and test pieces for MMA welding of steel.

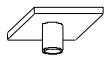
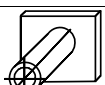
E 1	Practical training				
	Material group 1, 2, 3, 8, 10, 11 (ISO/TR 15608)				
	Process 111				
No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks
1	Introduction				Both rutile and basic electrodes shall be used in both single and multi run welding
2	Bead on plate	Unlimited	PA / PF / PC		
3	Fillet weld, T-joint	$t > 3$	PA		
4	Fillet weld, T-joint	$t > 3$	PB		Welding around the corner
5	Fillet weld, T-joint	$t > 3$	PF		
6	Fillet weld, corner joint	$t > 3$	PB		
7	Fillet weld, T-joint	$t > 8$	PB		Iron powder electrodes Welding around the corner
8	Fillet weld, T-joint	$t > 3$	PG		

Welding and evaluation of test pieces according to the appropriate part of ISO 9606; only visual testing required.

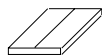
No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks
1	Fillet weld, T-joint	$t > 3$	PB		
2	Fillet weld, T-joint	$t > 8$	PF		



E 2	Practical training					Material group 1, 2, 3, 8, 10, 11 (ISO/TR 15608)
No.	Process 111					
	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks	
1	Introduction				Both rutile and basic electrodes shall be used in both single and multi run welding.	
2	Fillet weld, T-joint	$t > 8$	PD		Welding around the corner	
3	Fillet weld, tube to plate	$t > 3$ $D \geq 40$	PB			
4	Fillet weld, tube to plate	$t > 3$ $D > 150$	PH*			
5	Fillet weld, tube to plate	$t > 3$ $40 \leq D \leq 80$	PH*			
6	Fillet weld, tube to plate	$t > 3$ $D \geq 40$	PD			
*According to ISO 6947:2011 welding position PF for tubes has been changed to test position PH covering PE, PF and PA.						

Qualification tests according to the appropriate part of ISO 9606 examined by an independent authorized examiner.						
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks	
1	Fillet weld, tube to plate	$t > 3$ $D \geq 40$	PD			
2	Fillet weld, tube to plate	$t > 3$ $D \geq 40$	PH*			
For test object examination use the test object for fillet weld and test No 1. For test objects see part II of this Guideline.						



E 3	Practical training					Material group 1, 2, 3, 8, 10, 11 (ISO/TR 15608)
No.	Process 111					
	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks	
1	Introduction					
2	Grinding, flame gouging and arc gouging	Optional				
3	Butt weld	$t > 8$	PA		bs with grinding or gouging	
4	Butt weld	$t > 3$	PA		bs without grinding or gouging	
5	Butt weld	$t > 3$	PA		ss nb	
6	Butt weld	$t > 3$	PC		ss nb	

Welding and evaluation of test pieces according to the appropriate part of ISO 9606; only visual testing required.

No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks
1	Butt weld	$t > 3$	PA		ss nb
2	Butt weld	$t > 3$	PC		ss nb



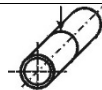
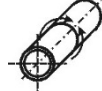
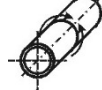
E 4	Practical training					Material group 1, 2, 3, 8, 10, 11 (ISO/TR 15608)
No.	Process 111					
	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks	
1	Introduction					
2	Fillet weld, corner joint	$t > 8$	PF			
3	T-butt weld	$t > 8$	PF			
4	Butt weld	$t > 3$	PE		ss nb	
5	Butt weld	$t > 8$	PF		bs with grinding or gouging	
6	Butt weld	$t > 3$	PF		ss nb	
7	Double bevel T-butt weld	$t > 8$	PB			

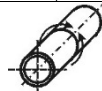
Qualification tests according to the appropriate part of ISO 9606 examined by an independent authorized examiner.

No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks
1	Butt weld	$t > 3$	PE		ss nb
2	Butt weld	$t > 3$	PF		ss nb

For test object examination use the test object for plate weld and test No 1. For test objects see part II of this Guideline.



E 5	Practical training					Material group 1, 2, 3, 8, 10, 11 (ISO/TR 15608)
No.	Process 111					
	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks	
1	Introduction					
2	Butt weld	$t > 3$ $D \geq 100$	PA		ss nb	
3	Butt weld	$t > 3$ $D \geq 100$	PC		ss nb	
4	Butt weld	$t > 3$ $40 \leq D \leq 80$	PC		ss nb	
5	Butt weld	$t > 3$ $D \geq 100$	PH*		ss nb	
6	Butt weld	$t > 3$ $40 \leq D \leq 80$	PH*		ss nb	
7	Butt weld	$t > 3$ $40 \leq D \leq 80$	PH*		full penetration	
*According to ISO 6947:2011 welding position PF for tubes has been changed to test position PH covering PE, PF and PA.						

Welding and evaluation of test pieces according to the appropriate part of ISO 9606; only visual testing required.						
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks	
1	Butt weld	$t > 3$ $D \geq 40$	PC		ss nb	
2	Butt weld	$t > 3$ $D \geq 40$	PH*		ss nb	



E 6		Practical training				Material group 1, 2, 3, 8, 10, 11 (ISO/TR 15608)	
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Process 111		Remarks
1	Introduction						.
2	Tube to plate	$t > 3$ $40 \leq D \leq 80$	PH*				Free choice of joint preparation; full penetration
3	Branch connection butt weld (set on)	$t > 3$ $D \geq 40$	H-L045				D = outside pipe diameter d = branch = 0,5 · D
4	Butt weld	$t \geq 5$ $D \geq 100$	H-L045				ss nb
5	Butt weld	$t > 3$ $40 \leq D \leq 80$	H-L045				ss nb
6	Tube to tube flange	$t > 3$ $40 \leq D \leq 80$	H-L045				
*According to ISO 6947:2011 welding position PF for tubes has been changed to test position PH covering PE, PF and PA.							

Qualification tests according to the appropriate part of ISO 9606 examined by an independent authorized examiner.							
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks		
1	Butt weld	$t > 3$ $40 \leq D \leq 80$	H-L045				ss nb
2	Butt weld	$t > 3$ $D \geq 100$	H-L045				ss nb
For test object examination use the test object for tube weld and test No 1. For test objects see part II of this Guideline.							



10 Process 135, 136 and 138 (MAG-welding) for ferritic and stainless steel.

Module M covers normally the welding processes 135, 136 and 138. In certain cases the training, examination and issuing of diplomas may be limited to either welding process 135 or 136 and 138.

10.1 Module M 1

Objective:

To obtain basic experience in the MAG welding process (135, 136 and 138) and to be able to produce fillet welds in plate in PA, PB, PD, PF and PG positions.

Scope:

See table M 1.

The average recommended time for the exercises is about 90 h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound fillet welds in different types of joints as specified in table M 1 in single and multi run technique.
4. Perform flame cutting in the range of 3 – 15 mm (not tested).
5. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control

10.2 Module M 2

Objective:

To obtain experience in the MAG welding process (135, 136 and 138) and produce fillet welds in tube-to-plate joints in PB, PH and PD positions.

Scope:

See table M 2.

The average recommended time for the exercises is about 90 h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound fillet welds in different tube to plate connections as specified in table M 2 in single and multi-run technique.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control

10.3 Module M 3

Objective:

To obtain experience in the MAG welding process (135 and 136) and to be able to produce butt welds in plate in PA, PC and PG positions with and without gouging.

Scope:

See table M 3.

The average recommended time for the exercises is about 75 h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound butt welds in different types of joints as specified in table M 3 in single and multi run technique.
4. Perform grinding and/or gouging (not tested).
5. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control.



10.4 Module M 4

Objective:

To obtain experience in the MAG welding process (135 and 136) and to be able to produce single sided butt welds in plate in PB, PD, PE and PF positions.

Scope:

See table M 4.

The average recommended time for the exercises is about 75 h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound butt welds in different types of joints as specified in table M 4 in single and multi run technique.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control

10.5 Module M 5

Objective:

To obtain experience in the MAG welding process (135,136 and 138) and to be able to make single sided butt welds in pipe in PA, PC and PH positions.

Scope:

See table M 5.

The average recommended time for the exercises is about 75 h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound butt welds in different types of joints as specified in table M 5 in single and multi run techniques.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control

10.6 Module M 6

Objective:

To obtain experience in the MAG welding process (135,136 and 138) and to be able to produce single sided butt welds in pipe in H-L045 position.

Scope:

See table M 6.

The average recommended time for the exercises is about 50 h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound butt welds in different types of joints as specified in table M 6 in single and multi run technique.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control

10.7 Training and test pieces for MAG welding of steel.

M 1	Practical training					Material group 1, 2, 3, 8, 10, 11 (ISO/TR 15608)
No.	Process 135, 136 and 138					
	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks	
1	Introduction				Wherever possible (136), both rutile and basic wires shall be used in both single and multi run welding.	
2	Bead on plate	Unlimited	PA / PF / PG		process 135	
3	Fillet weld, T-joint	t > 1	PA		single layer, 135-D	
4	Fillet weld, T-joint	t > 1	PB		single layer, 135-D welding around the corner	
5	Fillet weld, T-joint	t > 1	PG		single layer, 135-D	
6	Fillet weld, corner joint	t > 1	PG		single layer, 135-D Full penetration not required	
7	Fillet weld, T-joint	t > 8	PB		process 135, 136 and 138 welding around the corner	
8	Fillet weld, T-joint	t > 8	PF		process 135. 136 and 138	
9	Fillet weld, T-joint	t > 8	PD		process 135, 136 and 138 welding around the corner	

Welding and evaluation of test pieces according to the appropriate part of ISO 9606; only visual testing required.

No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks
1	Fillet weld, T-joint	$t > 1$	PB		single layer, 135-D
2	Fillet weld, T-joint	$t > 8$	PB		process 136 multi run
3	Fillet weld, T-joint	$t > 1$	PF		single layer, 135-D
4	Fillet weld, T-joint	$t > 8$	PF		process 136 multi run



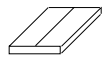
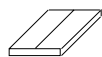
M 2	Practical training					Material group 1, 2, 3, 8, 10, 11 (ISO/TR 15608)
						Process 135, 136 and 138
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks	
1	Introduction				Wherever possible (136), both rutile and basic flux cored wires shall be used in both single and multi run welding.	
2	Fillet weld, Tube to plate	$t > 3$ $D \geq 40$	PB		process 135	
3	Fillet weld, Tube to plate	$t > 3$ $D \geq 40$	PH*		process 135, 136 and 138	
4	Fillet weld, Tube to plate	$t > 3$ $D \geq 40$	PD		process 135, 136 and 138	
5	Fillet weld, Tube to plate	$t > 3$ $D \geq 40$	PD		plate horizontal, pipe approx. 60° position.	
*According to ISO 6947:2011 welding position PF for tubes has been changed to test position PH covering PE, PF and PA.						

Qualification tests according to the appropriate part of ISO 9606 examined by an independent authorized examiner.					
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks
1	Fillet weld, Tube to plate	$t > 3$ $D \geq 40$	PD		process 135
2	Fillet weld, Tube to plate	$t > 3$ $D \geq 40$	PD		process 136
3	Fillet weld, Tube to plate	$t > 3$ $D \geq 40$	PH*		process 135
4	Fillet weld, Tube to plate	$t > 3$ $D \geq 40$	PH*		process 136
For test object examination use the test object for fillet weld and tests No 1 and 2. For test objects see part II of this Guideline.					



M 3	Practical training					Material group 1, 2, 3, 8, 10, 11 (ISO/TR 15608)
						Process 135 and 136
No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks	
1	Introduction					
2	Butt weld	t > 1	PA		process 135 ss nb 135-D for root run	
3	Butt weld	t > 1	PG		process 135 ss nb 135-D for root run	
4	Butt weld	t > 8	PA		process 135 ss nb and 136 bs with grinding or gouging or process 136 ¹ ss nb and 136 bs with grinding or gouging	
5	Butt weld	t > 5	PC		process 135 and 136 ¹ ss nb	

Welding and evaluation of test pieces according to the appropriate part of ISO 9606; only visual testing required.

No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks
1	Butt weld	$t > 1$	PA		process 135 ss nb 135-D for root run
2	Butt weld	$t > 8$	PA		process 136 ¹ ss nb
3	Butt weld	$t > 1$	PC		process 135 ss nb 135-D for root run
4	Butt weld	$t > 8$	PC		process 136 ¹ ss nb

Remark: for group 8 and 10, bs with grinding or gouging is allowed.

¹ For flux cored wires, ss mb is allowed or the root run may be done with metal cored wire (138).



M 4	Practical training					Material group 1, 2, 3, 8, 10, 11 (ISO/TR 15608)
						Process 135 and 136
No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks	
1	Introduction					
2	Butt weld	$t > 1$	PE		process 135 ss nb 135-D for root run	
3	Butt weld	$t > 5$	PE		process 136 ¹ ss nb	
4	Butt weld	$t > 8$	PF		process 135 ss nb and 136 bs with grinding or gouging or process 136 ¹ ss nb and 136 bs with grinding or gouging	
5	Single bevel butt weld, T-joint	$t > 5$	PB		process 135 and 136 bs with grinding or gouging	
6	Single bevel butt weld, T-joint	$t > 5$	PD		process 135 and 136 ¹ ss nb	
7	Single bevel butt weld, T-joint	$t > 5$	PF		process 135 and 136 ¹ ss nb	

Qualification tests according to the appropriate part of ISO 9606 examined by an independent authorized examiner.

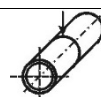
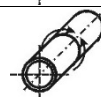
No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks	
1	Butt weld	$t > 1$	PF		process 135 ss nb 135-D for root run	
2	Butt weld	$t > 8$	PF		process 136 ¹ ss nb	
3	Butt weld	$t > 1$	PE		process 135 ss nb 135-D for root run	
4	Butt weld	$t > 8$	PE		process 136 ¹ ss nb	

For test object examination use the test object for plate weld and tests No 1 and 4. For test objects see part II of this Guideline.

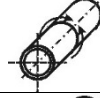
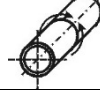
Remark: for group 8 and 10, bs with grinding or gouging is allowed.

¹ Root run may be done with metal cored wire (138)



M 5	Practical training					Material group 1, 2, 3, 8, 10, 11 ISO/TR 15608)	
						Process 135, 136 and 138	
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks		
1	Introduction						
2	Butt weld	$t > 3$ $D \geq 100$	PA		process 135, 136 ¹ and 138 ss nb		
3	Butt weld	$t > 3$ $D \geq 100$	PH*		process 135, 136 ¹ and 138 ss nb		
4	Butt weld	$t > 3$ $D \geq 100$	PC		process 135, 136 ¹ and 138 ss nb		
*According to ISO 6947:2011 welding position PF for tubes has been changed to test position PH covering PE, PF and PA.							

Welding and evaluation of test pieces according to the appropriate part of ISO 9606; only visual testing required.

No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks
1	Butt weld	$t > 3$ $D \geq 100$	PC		process 135 ss nb
2	Butt weld	$t > 3$ $D \geq 100$	PC		process 136 ¹ ss nb
3	Butt weld	$t > 3$ $D \geq 100$	PH*		process 135 ss nb
4	Butt weld	$t > 3$ $D \geq 100$	PH*		process 136 ¹ ss nb

¹ Root run may be done with metal cored wire (138)



M 6	Practical training		Material group 1, 2, 3, 8, 10, 11 (ISO/TR 15608)		
	Process 135, 136 and 138				
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks
1	Introduction				
2	Butt weld	$t > 3$ $D \geq 100$	H-L045		135, 136 ¹ and 138
3	Branch connection butt weld (set on)	$D \geq 40$ $t > 3$	H-L045		process135,136 ¹ and 138 D = pipe d = branch = 0.5 · D

Qualification tests according to the appropriate part of ISO 9606 examined by an independent authorized examiner.					
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks
1	Butt weld	$t > 3$ $D \geq 100$	H-L045		process 138 ss nb
2	Butt weld	$t > 3$ $D \geq 100$	H-L045		process 136 ¹ ss nb
For test object examination use the test object for tube weld and tests No 1 and 2. For test objects see part II of this Guideline.					

¹ Root run may be done with metal cored wire (138).



11 Process 131 (MIG-welding) for aluminium material groups.

11.1 Module MAI.1

Objective:

To obtain basic experience in the MIG welding process (131) and to be able to produce fillet welds in plate in PA, PB, PF and PG positions.

Scope:

See table MAI.1.

The average recommended time for the exercises is about 75 h (reduced time, experience assumed).

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound fillet welds in different types of joints in plates as specified in table MAI.1 in single and multi run technique.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control

11.2 Module MAI.2

Objective:

To obtain experience in the MIG welding process (131) and produce fillet welds in plate in PD position and in tube-to-plate joints in PB, PH and PD positions.

Scope:

See table MAI.2.

The average recommended time for the exercises is about 75 h (reduced time, experience assumed).

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound fillet welds in different types of joints as specified in table MAI.2 in single and multi run technique.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control

11.3 Module MAI.3

Objective:

To obtain experience in the MIG welding process (131) and to be able to produce single sided butt welds with backing and double sided butt welds with root opening in plate in PA and PF positions.

Scope:

See table MAI.3.

The average recommended time for the exercises is about 60 h (reduced time, experience assumed).

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound butt welds in different types of joints in plates as specified in table MAI.3 in single and multi run technique.
4. Perform grinding and/or gouging (not tested).
5. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control



11.4 Module MAI.4

Objective:

To obtain experience in the MIG welding process (131) and to be able to produce single sided butt welds with backing in plate in PC and PE positions and double sided butt welds with root opening in plate in PB, PC, PD, PE and PF positions.

Scope:

See table MAI.4.

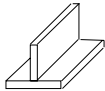
The average recommended time for the exercises is about 60 h (reduced time, experience assumed).

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound butt welds in different types of joints in plates as specified in table MAI.4 in single and multi run technique
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control

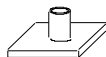
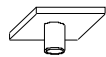
11.5 Training and test pieces for MIG welding of aluminium material groups.

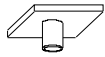
MAI.1	Practical training					Material group 21, 22, 23 (ISO/TR 15608)
No.	Process 131					
	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks	
1	Introduction					
2	Bead on plate	Unlimited	PA / PF / PG		single run	
3	Fillet weld, T-joint	$t > 3$	PA		single run	
4	Fillet weld, T-joint	$t > 3$	PB		single run	
5	Fillet weld, T-joint	$t > 3$	PG		single run	
6	Fillet weld, corner joint	$t > 3$	PG		Full penetration not required, single run	
7	Fillet weld, T-joint	$t > 8$	PB		multi run welding around the corner	
8	Fillet weld, T-joint	$t > 8$	PG		single run	
9	Fillet weld, T-joint	$t > 8$	PF		multi run, welding around the corner	

Welding and evaluation of test pieces according to the appropriate part of ISO 9606; only visual testing required.

No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks
1	Fillet weld, T-joint	$t > 8$	PB		multi run
2	Fillet weld, T-joint	$t > 3$	PF		single run



MAI.2	Practical training		Material group 21, 22, 23 (ISO/TR 15608)		
	Process 131				
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks
1	Introduction				
2	Fillet weld, T-joint	$t > 8$	PD		multi run welding around the corner
3	Fillet weld, tube to plate	$t > 3$ $D \geq 60$	PB		
4	Fillet weld, tube to plate	$t > 3$ $D \geq 60$	PH*		
5	Fillet weld, tube to plate	$t > 3$ $D \geq 60$	PD		
*According to ISO 6947:2011 welding position PF for tubes has been changed to test position PH covering PE, PF and PA.					

Qualification tests according to the appropriate part of ISO 9606 examined by an independent authorized examiner.					
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks
1	Fillet weld, tube to plate	$t > 3$ $D \geq 60$	PD		
2	Fillet weld, tube to plate	$t > 3$ $D \geq 60$	PH*		



MAI.3	Practical training					Material group 21, 22, 23 (ISO/TR 15608)	
						Process 131	
No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks		
1	Introduction						
2	Butt weld	t > 6	PA		ss mb		
3	Butt weld	t > 6	PF		ss mb		
4	Butt weld	t > 6	PA		bs with or without grinding		
5	Butt weld	t > 6	PF		bs with or without grinding		

Welding and evaluation of test pieces according to the appropriate part of ISO 9606; only visual testing required.

No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks
1	Butt weld	$t > 6$	PA		ss mb
2	Butt weld	$t > 6$	PF		bs with or without grinding

Remark: During test welding the use of pulsed current is prohibited.



MAI.4	Practical training					Material group 21, 22, 23 (ISO/TR 15608)
						Process 131
No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks	
1	Introduction				When welding bs, it is not necessary to weld the back side in the defined position	
2	Butt weld	$t \leq 3$	PE		ss mb	
3	Butt weld	$t \leq 3$	PC		ss mb	
4	Butt weld	$t > 6$	PE		bs with or without grinding	
5	Butt weld	$t > 6$	PC		bs with or without grinding	
6	Single bevel butt weld, T-joint	$t > 6$	PB		bs with or without grinding	
7	Single bevel butt weld, T-joint	$t > 6$	PD		bs with or without grinding	
8	Single bevel butt weld, T-joint	$t > 6$	PF		bs with or without grinding	

Qualification tests according to the appropriate part of ISO 9606 examined by an independent authorized examiner.

No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks
1	Butt weld	$t \leq 3$	PC		ss mb
2	Butt weld	$t > 6$	PE		bs with or without grinding



12 Process 141 (TIG-welding) for ferritic and stainless steel.

12.1 Module T 1

Objective:

To obtain basic experience in process 141 (TIG welding) and to be able to make fillet welds in plate in PA, PB and PF positions.

Scope:

See table T 1.

The average recommended time for the exercises is about 50 h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound fillet welds in different type of joints as specified in table T 1.
4. Perform gas or plasma cutting in the range of 3 – 15 mm (not tested).
5. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control.

12.2 Module T 2

Objective:

To obtain experience in process 141 (TIG-welding) and produce fillet welds in plate in PD position and in tube-to-plate joints in PB, PD and PH positions.

Scope:

See table T 2.

The average recommended time for the exercises is about 50 h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound fillet welds in different type of joints as specified in table T 2.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control.

12.3 Module T 3

Objective:

To obtain experience in process 141 (TIG-welding) and to be able to produce single sided butt welds in plate in PA and PC positions.

Scope:

See table T 3.

The average recommended time for the exercises is about 50 h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound butt welds according to table T 3.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control.



12.4 Module T 4

Objective:

To obtain experience in process 141 (TIG-welding) and to be able to produce single sided butt welds in plate in PE and PF position.

Scope:

See table T 4.

The average recommended time for the exercises is about 50 h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound butt welds according to table T 4.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control.

12.5 Module T 5

Objective:

To obtain experience in process 141 (TIG-welding) and to be able to produce single sided butt welds in pipe in PA, PC, PH and H-L045 positions using relatively thin materials.

Welding with consumable inserts is recommended in at least one exercise (not mandatory)

Scope:

See table T 5.

The average recommended time for the exercises is about 50 h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound butt welds in pipe as specified in table T 5.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control.

12.6 Module T 6

Objective:

To obtain experience in process 141 (TIG-welding) and to be able to produce single sided butt welds in PA, PC, PH and H-L045 position using relatively thick materials.

Scope:

See table T 6.

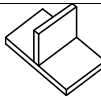
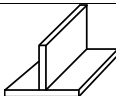
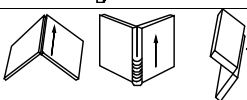
The average recommended time for the exercises is about 50 h.

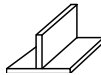
Learning Outcomes:

The student is capable to (in addition to 8.3):

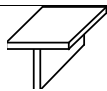
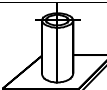
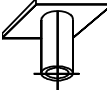
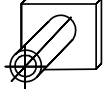
1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound butt welds in pipe in different types of joints as specified in table T 6.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control.

12.7 Training and test pieces for TIG welding of steel.

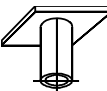
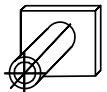
T 1	Practical training					Material group 1, 2, 3, 8, 10, 11 (ISO/TR 15608)
No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks	Process 141
1	Introduction				Remelting (dressing) the top layer is not permitted.	
2	Bead on plate	Unlimited	PA, PF, PC			
3	Fillet weld, T-joint	$t > 1$	PA			
4	Fillet weld, T-joint	$t > 1$	PB			
5	Fillet weld, T-joint	$t > 1$	PF			
6	Outside fillet weld, corner joint	$t > 1$	PA, PF, PC		Full penetration weld	

Welding and evaluation of test pieces according to the appropriate part of ISO 9606; only visual testing required.					
No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks
1	Fillet weld, T-joint	$t > 1$	PB		
2	Fillet weld, T-joint	$t > 1$	PF		

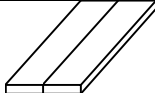
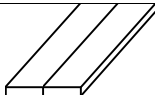
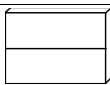
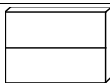


T 2	Practical training					Material group 1, 2, 3, 8, 10, 11 (ISO/TR 15608)	
No.						Process 141	
	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks		
1	Introduction						
2	Fillet weld, T-joint	$t > 1$	PD				
3	Fillet weld, tube to plate	$t > 1$ $40 \leq D \leq 80$	PB				
4	Fillet weld, tube to plate	$t > 1$ $40 \leq D \leq 80$	PD				
5	Fillet weld, tube to plate	$t > 1$ $40 \leq D \leq 80$	PH*				
*According to ISO 6947:2011 welding position PF for tubes has been changed to test position PH covering PE, PF and PA.							

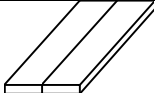
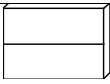
Qualification tests according to the appropriate part of ISO 9606 examined by an independent authorized examiner.

No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks
1	Fillet weld, tube to plate	$t > 1$ $40 \leq D \leq 80$	PD		
2	Fillet weld, tube to plate	$t > 1$ $40 \leq D \leq 80$	PH*		
For test object examination use the test object for fillet weld and test No 1. For test objects see part II of this Guideline.					

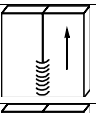
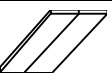
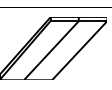


T 3	Practical training					Material group 1, 2, 3, 8, 10, 11 (ISO/TR 15608)	
No.						Process 141	
	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks		
1	Introduction						
2	Butt weld	t > 1	PA		ss nb		
3	Butt weld	t > 5	PA		ss nb		
4	Butt weld	t > 1	PC		ss nb		
5	Butt weld	t > 5	PC		ss nb		

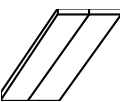
Welding and evaluation of test pieces according to the appropriate part of ISO 9606; only visual testing required.

No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks		
1	Butt weld	$t > 1$	PA		ss nb		
2	Butt weld	$t > 1$	PC		ss nb		



T 4	Practical training					Material group 1, 2, 3, 8, 10, 11 (ISO/TR 15608)
No.	Process 141					
	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks	
1	Introduction					
2	Butt weld	$t > 1$	PF		ss nb	
3	Butt weld	$t > 5$	PF		ss nb	
4	Butt weld	$t > 1$	PE		ss nb	
5	Butt weld	$t > 5$	PE		ss nb	

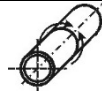
Qualification tests according to the appropriate part of ISO 9606 examined by an independent authorized examiner.

No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks
1	Butt weld	$t > 1$	PF		ss nb
2	Butt weld	$t > 1$	PE		ss nb

For test object examination use the test object for plate weld and test No 2. For test objects see part II of this Guideline.



T 5	Practical training					Material group 1, 2, 3, 8, 10, 11 (ISO/TR 15608)	
No.						Process 141	
	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks		
1	Introduction						
2	Butt weld	$t > 1$ $40 \leq D \leq 80$	PA		ss nb		
3	Butt weld	$t > 1$ $40 \leq D \leq 80$	PC		ss nb		
4	Butt weld	$t > 1$ $40 \leq D \leq 80$	PH*		ss nb		
5	Butt weld	$t > 1$ $40 \leq D \leq 80$	H-L045		ss nb		
*According to ISO 6947:2011 welding position PF for tubes has been changed to test position PH covering PE, PF and PA.							

Welding and evaluation of test pieces according to the appropriate part of ISO 9606; only visual testing required.					
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks
1	Butt weld	$t > 1$ D free choice	PC		ss nb
2	Butt weld	$t > 1$ D free choice	PH*		ss nb



T 6	Practical training		Material group 1, 2, 3, 8, 10, 11 (ISO/TR 15608)		
No.	Process 141, solid wire				
	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks
1	Introduction				
2	Butt weld	$t > 5$ $40 \leq D \leq 80$	PA		ss nb
3	Butt weld	$t > 5$ $40 \leq D \leq 80$	PC		ss nb
4	Butt weld	$t > 5$ $40 \leq D \leq 80$	PH*		ss nb
5	Butt weld	$t > 5$ $40 \leq D \leq 80$	H-L045		ss nb
6	Branch connection butt weld (set on)	$t > 3$ $40 \leq D \leq 80$	H-L045		D = pipe d = branch = $0,5 \cdot D$

*According to ISO 6947:2011 welding position PF for tubes has been changed to test position PH covering PE, PF and PA.

Qualification tests according to the appropriate part of ISO 9606 examined by an independent authorized examiner.					
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks
1	Butt weld	$t > 1$ D free choice	H-L045		ss nb
For test object examination use the test object for tube weld and test No 1. For test objects see part II of this Guideline.					



13 Process 141 (TIG-welding) for aluminium material groups.

13.1 Module TAI.1

Objective:

To obtain basic experience in process 141 (TIG welding) and to be able to make fillet welds in plate in PA, PB and PF positions.

Scope:

See table TAI.1.

The average recommended time for the exercises is about 50h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound fillet welds in different types of joints as specified in table TAI.1.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control

13.2 Module TAI.2

Objective:

To obtain experience in process 141 (TIG-welding) and produce fillet welds in plate in PD and in tube-to-plate joints in PB, PD and PH positions.

Scope:

See table TAI.2.

The average recommended time for the exercises is about 50h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound fillet welds in different types of joints as specified in table TAI.2.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control

13.3 Module TAI.3

Objective:

To obtain experience in process 141 (TIG-welding) and to be able to produce double sided butt welds in plate in PA, PC, and PF positions.

Scope:

See table TAI.3.

The average recommended time for the exercises is about 50h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound double sided butt welds in plate connections according to table TAI.3.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control



13.4 Module TAI.4

Objective:

To obtain experience in process 141 (TIG-welding) and to be able to produce single sided butt welds in plate in PA, PC, PF and PE position.

Scope:

See table TAI.4.

The average recommended time for the exercises is about 50h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound single sided butt welds in plate according to table TAI.4.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control

13.5 Module TAI.5

Objective:

To obtain experience in process 141 (TIG-welding) and to be able to produce single sided butt welds in pipe in PA, PC, PH and H-L045 positions using relatively thick materials.

Scope:

See table TAI.5.

The average recommended time for the exercises is about 50h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound single sided butt welds in pipe as specified in table TAI.5.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control

13.6 Module TAI.6

Objective:

To obtain experience in process 141 (TIG-welding) and to be able to produce single sided butt welds in pipe in PC, PH and H-L045 positions using relatively thin materials.

Scope:

See table TAI.6.

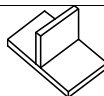
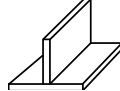
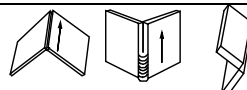
The average recommended time for the exercises is about 50h.

Learning Outcomes:

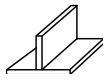
The student is capable to (in addition to 8.3):

1. Adjust the welding power source to fit the purpose.
2. Control the welding power source efficiently.
3. Make sound single sided butt weld in different types of joints in pipe as specified in table TAI.6.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control

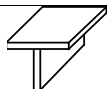
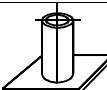
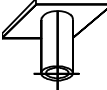
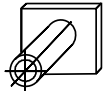
13.7 Training and test pieces for TIG welding of aluminium material groups.

TAI 1	Practical training					Material group 21, 22, 23 (ISO/TR 15608)
No.	Process 141					
	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks	
1	Introduction				Re-melting (dressing) the top layer is not permitted.	
2	Bead on plate	Unlimited	PA, PF, PC			
3	Fillet weld, T-joint	$t > 1$	PA			
4	Fillet weld, T-joint	$t > 1$	PB			
5	Fillet weld, T-joint	$t > 1$	PF			
6	Outside fillet weld, corner joint	$t > 1$	PA, PF, PC		Full penetration weld	

Welding and evaluation of test pieces according to the appropriate part of ISO 9606; only visual testing required.

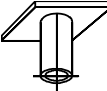
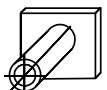
No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks
1	Fillet weld, T-joint	$t > 1$	PB		
2	Fillet weld, T-joint	$t > 1$	PF		



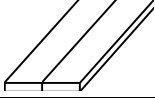
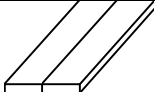
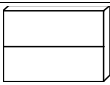
TAI 2	Practical training		Material group 21, 22, 23 (ISO/TR 15608)		
No.	Process 141				
	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks
1	Introduction				Re-melting (dressing) the top layer is not permitted.
2	Fillet weld, T-joint	$t > 1$	PD		
3	Fillet weld, tube to plate	$t > 1$ $40 \leq D \leq 80$	PB		
4	Fillet weld, tube to plate	$t > 1$ $40 \leq D \leq 80$	PD		
5	Fillet weld, tube to plate	$t > 1$ $40 \leq D \leq 80$	PH*		

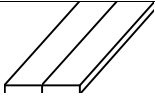
*According to ISO 6947:2011 welding position PF for tubes has been changed to test position PH covering PE, PF and PA.

Qualification tests according to the appropriate part of ISO 9606 examined by an independent authorized examiner.

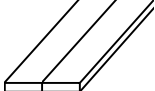
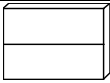
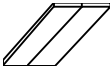
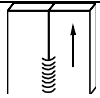
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks
1	Fillet weld, tube to plate	$t > 1$ $40 \leq D \leq 80$	PD		
2	Fillet weld, tube to plate	$t > 1$ $40 \leq D \leq 80$	PH*		

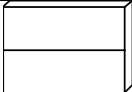
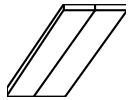


TAI 3	Practical training					Material group 21, 22, 23 (ISO/TR 15608)
No.	Process 141					
	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks	
1	Introduction					
2	Butt weld	$t \leq 3$	PA		bs without grinding or gouging	
3	Butt weld	$t > 6$	PA		bs without grinding or gouging	
4	Butt weld	$t \leq 3$	PC		bs without grinding or gouging	
5	Butt weld	$t > 6$	PF		bs without grinding or gouging	

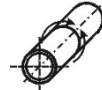
Welding and evaluation of test pieces according to the appropriate part of ISO 9606; only visual testing required.					
No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks
1	Butt weld	$t \leq 3$	PA		bs without grinding or gouging
2	Butt weld	$t > 6$	PF		bs without grinding or gouging

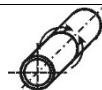


TAI 4	Practical training					Material group 21, 22, 23 (ISO/TR 15608)
No.	Process 141					
	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks	
1	Introduction					
2	Butt weld	$t \leq 3$	PA		ss nb	
3	Butt weld	$t > 6$	PC		ss nb	
4	Butt weld	$t > 1$	PE		ss nb	
5	Butt weld	$t \leq 3$	PF		ss nb	

Qualification tests according to the appropriate part of ISO 9606 examined by an independent authorized examiner.					
No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks
1	Butt weld	$t > 6$	PC		ss nb
2	Butt weld	$t \leq 3$	PE		ss nb



TAI 5	Practical training		Material group 21, 22, 23 (ISO/TR 15608)		
No.	Process 141				
	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks
1	Introduction				
2	Butt weld	t > 6 D = free choice	PA		ss nb
3	Butt weld	t > 6 D = free choice	PC		ss nb
4	Butt weld	t > 6 D = free choice	PH*		ss nb
5	Butt weld	t > 6 D = free choice	H-L045		ss nb
*According to ISO 6947:2011 welding position PF for tubes has been changed to test position PH covering PE, PF and PA.					

Welding and evaluation of test pieces according to the appropriate part of ISO 9606; only visual testing required.					
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks
1	Butt weld	$t > 6$ D = free choice	PH*		ss nb
2	Butt weld	$t > 6$ D = free choice	H-L045		ss nb



TAI 6		Practical training		Material group 21, 22, 23 (ISO/TR 15608)	
		Process 141			
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks
1	Introduction				
2	Butt weld	$t \leq 3$ D = free choice	PH*		ss nb
3	Butt weld	$t \leq 3$ D = free choice	PC		ss nb
4	Butt weld	$t \leq 3$ D = free choice	H-L045		ss nb
5	Branch connection butt weld (set on)	$t \leq 3$ D = free choice	H-L045		D = pipe d = branch = 0,5 · D

*According to ISO 6947:2011 welding position PF for tubes has been changed to test position PH covering PE, PF and PA.

Qualification tests according to the appropriate part of ISO 9606 examined by an independent authorized examiner.					
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks
1	Butt weld	$t \leq 3$ D = free choice	PC		ss nb
2	Butt weld	$t \leq 3$ D = free choice	PH*		ss nb



14 Process 311 (Gas-welding) for ferritic steel.

14.1 Module G 3

Objective:

To obtain basic experience in process 311 (Gas welding) to produce butt welds in plate in PA, PC, PF and PE positions by leftward welding.

Scope:

See table G 3.

The average recommended time for the exercises is about 50 h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Select the proper burner, the desired burning gas and the required pressures / flows.
2. Adjust the welding equipment to fit the purpose.
3. Make sound butt welds in plates as specified in table G 3.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control.

14.2 Module G 4

Objective:

To obtain experience in process 311 (gas welding) and to be able to produce butt welds in plate in PE by leftward welding and in PA, PC and PF positions by rightward welding.

Scope:

See table G 4.

The average recommended time for the exercises is about 50 h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Select the proper burner, the desired burning gas and the required pressures / flows.
2. Adjust the welding equipment to fit the purpose.
3. Make sound butt welds in plates as specified in table G 4.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control.

14.3 Module G 5

Objective:

To obtain experience in process 311 (gas welding) and to be able to produce single sided butt welds in pipe in PH, PC and H-L045 positions by leftward welding.

Scope:

See table G 5.

The average recommended time for the exercises is about 50 h.

Learning Outcomes:

The student is capable to (in addition to 8.3):

1. Select the proper burner, the desired burning gas and the required pressures / flows.
2. Adjust the welding equipment to fit the purpose.
3. Make sound butt welds in pipes as specified in table G 5.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control.



14.4 Module G 6

Objective:

To obtain experience in process 311 (gas welding) and to be able to produce single sided butt welds in H-L045 position by leftward welding and in PH, PC and H-L045 by rightward welding.

Scope:

See table G 6.

The average recommended time for the exercises is about 50 h.

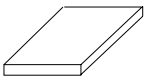
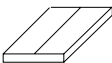
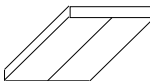
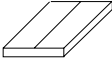
Learning Outcomes:

The student is capable to (in addition to 8.3):

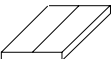
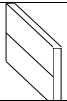
1. Select the proper burner, the desired burning gas and the required pressures / flows.
2. Adjust the welding equipment to fit the purpose.
3. Make sound butt welds in different types of pipes as specified in table G 6.
4. Visually inspect his/her own work and take appropriate action resulting from that inspection and deal with problems within his/her control.



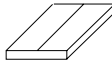
14.5 Training and test pieces for Gas welding of steel.

G 3	Practical training					Material group 1 and 11 (ISO/TR 15608)	
No.	Process 311						
	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks		
1	Introduction						
2	Bead on plate	Unlimited	PA				
3	Butt weld	t > 1	PA		Leftward welding		
4	Butt weld	t > 1	PF		Leftward welding		
5	Butt weld	t > 1	PC		Leftward welding		
6	Butt weld	t > 1	PE		Leftward welding		
7	Flame cutting	t > 5					

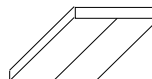
Welding and evaluation of test pieces according to the appropriate part of ISO 9606; only visual testing required.

No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks
1	Butt weld	$t > 1$	PA		Leftward welding
2	Butt weld	$t > 1$	PC		Leftward welding



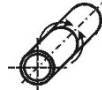
G 4	Practical					Material group 1 and 11 (ISO/TR 15608)
No.	Process 311					
	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks	
1	Introduction					
2	Single V-butt weld	$t > 3$	PA		Rightward welding	
3	Single V-butt weld	$t > 3$	PF		Rightward welding	
4	Single V-butt weld	$t > 3$	PC		Rightward welding	

Qualification tests according to the appropriate part of ISO 9606 examined by an independent authorized examiner.

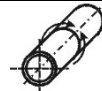
No.	Type of weld	Recommended material thickness [mm]	Welding position	Sketch	Remarks	
1	Butt weld	$t > 1$	PE		Leftward welding	
2	Single V-butt weld	$t > 3$	PF		Rightward welding	



G 5		Practical training				Material group 1 and 11 (ISO/TR 15608)	
		Process 311					
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks		
1	Introduction						
2	Butt Weld	t > 1 D > 25	PH*		Leftward welding ss nb		
3	Butt Weld	t > 1 D > 25	PC		Leftward welding ss nb		
4	Butt weld	t > 1 D > 25	H-L045		Leftward welding ss nb		
*According to ISO 6947:2011 welding position PF for tubes has been changed to test position PH covering PE, PF and PA.							

Welding and evaluation of test pieces according to the appropriate part of ISO 9606; only visual testing required.						
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks	
1	Butt Weld	$t > 1$ $D > 25$	PH*		Leftward welding ss nb	
2	Butt Weld	$t > 1$ $D > 25$	PC		Leftward welding ss nb	



G 6		Practical training				Material group 1 and 11 (ISO/TR 15608)	
		Process 311					
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks		
1	Introduction						
2	Butt weld	$t > 3$ $D > 25$	PH*		Rightward welding ss nb		
3	Butt weld	$t > 3$ $D > 25$	PC		Rightward welding ss nb		
4	Butt weld	$t > 3$ $D > 25$	H-L045		Rightward welding ss nb		
5	Branch connection butt weld (set on)	$t > 1$ $D \geq 40$	H-L045		$D = \text{pipe}$ $d = \text{branch} = 0,5 \cdot D$		

*According to ISO 6947:2011 welding position PF for tubes has been changed to test position PH covering PE, PF and PA.

Qualification tests according to the appropriate part of ISO 9606 examined by an independent authorized examiner.						
No.	Type of weld	Recommended material thickness / diameter [mm]	Welding position	Sketch	Remarks	
1	Butt weld	$t > 1$ $D > 25$	H-L045		Leftward welding ss nb	
2	Butt weld	$t > 3$ $D > 25$	H-L045		Rightward welding ss nb	



15 International welder specific requirements

15.1 Introduction

The national welding organisations, being members of IIW, mutually acknowledge the Diploma of International Welder awarded in any Member State following education and training, conducted in accordance with this Guideline for this purpose, and given at a training body (ATB) approved by the ANB for this purpose, and examination conducted at an ANB approved examination / test centre.

In case when an ATB is not authorized for the entire Guideline (e.g. regarding welding processes) the relevant scope shall be specified, as appropriate.

In addition to the rules given in Document IAB-001 (last edition), the following is required.

15.2 International Welder Training Requirements

Further to the general rules as given in IAB-001 (last edition) the following are applicable to the IIW Welders courses:

- o The welder training workshop must include the number of training booths required to cover the maximum number of students. The booths must be fully equipped, have correct ventilation and proper screening to protect other workers.
- o The range of welding and auxiliary equipment must reflect the scope of approval and must be in sufficient quantity to cover the maximum number of students. It must be in good working order and fit for its purpose.
- o Protective clothing and eye protection for trainees must be provided. Such items must be clean and in safe, good condition.
- o Instruments for checking welding parameters must be available and calibrated, validated or verified as appropriate (see e.g. ISO 17662).
- o Reference standards according to appendix 1 of this Guideline shall be available for the students during theoretical education and examination.

15.3 International Welder Teachers/Instructors

Teachers for theoretical education shall at least have an International Welding Specialist diploma or equivalent qualification that shall be assessed and approved by the ANB.

Note: ANBs shall put pressure on the ATBs to reach at least IWS-qualification for their teachers.

Instructors teaching practical skills shall have either:

- i. A valid ISO 9606 certificate, or skill qualifications based on equivalent technical conditions, appropriate to the scope of training provided or
- ii. An International Welding Practitioner diploma (covering the welding processes subject to teaching) and active in the field of welding in the last 3 years or
- iii. An IW-diploma, covering the appropriate level (IFW, IPW or ITW), the welding processes and parent material subject to teaching, and active in the field of welding in the last 3 years or
- iv. Instructor who at least the last 5 years has worked as instructor in practical welding will be evaluated by the ANB. If approved, he/she can work as International Welder Instructor for practical training. (Alternative iv. is valid 5 years for new ANBs from start of their implementation of the IW Guideline)

Note: It is recommended that instructors shall have technical knowledge at least at level of IWS.



Teachers and instructors shall demonstrate competence in instructional techniques (transfer of practical skills and theoretical knowledge). The above matters and monitoring of course performance shall be covered by appropriate documentation for review by the ANB.

15.4 ANB Authorised Examiner

The Board of Examiners shall implement the International Welder Guideline through the appointment of competent persons, to be known as ANB Authorised Examiners. All practical examinations that can lead to the award of an IW diploma (i.e. examinations after modules 2, 4 and 6) shall be conducted under the general supervision of the ANB Authorised Examiner.

ANB Authorised Examiners shall be qualified to at least the level of International Welding Specialist.

The Authorised Examiner can be part of the ATB providing that he/she is independent of the training of the person being examined. However, this independence has to be demonstrated through a Quality Manual and the ANB must be satisfied with both the Quality Manual and with its implementation. There is no obligation on the ANB to accept a proposed Authorised Examiner from within the ATB if the ANB is not convinced about his/her impartiality and independence as well as his/her competence.

15.5 International Welder Examinations

Theoretical examination

After the theoretical modules there are theoretical examinations of the multi-choice type for the relevant level of diploma.

The sets of International harmonised examination papers approved by IAB Group A shall be used for theoretical examination. The exam papers will be chosen from those sets of examination papers under the authority of the Board of Examiners of the ANB. At the discretion of the ANB the International examination papers can be completed with a national exam.

The examination procedure shall comply with the requirements as set forth in IAB-001(last edition) and OP17.

Although the modules A, B and C represent three modules of theory, at the discretion of the ANB, they may be added together and taught and examined as one total, provided they are finalised at the moment of finalising the first level of practical training.

In addition to the examination of the modules A, B and C, the examination of the specific welding process (S) module and – if applicable – the appropriate material (P) module is required.

The hours to be allocated to the International harmonised examination should be totally 3 h 15 minutes (for all modules). Any additional National exams will be defined by the ANB and their duration shall be added to the duration defined in Table 1.



Table 1 Maximum duration of each module harmonised written exam

Welding process Module (Duration)	Process 111	Process 141	Process 13X	Process 311
General Theoretical Training				
Module A (20 hours)	55 minutes (40 questions)			
Module B (18hours)	40 minutes (36 questions)			
Module C (7 hours)	15 minutes (14 questions)			
Welding Process Theoretical Training				
Module SA (5 hours)	10 min (10 questions)			
Module ST (5 hours)		10 min (10 questions)		
Module SM (7 hours)			15 min (14 questions)	
Module SG (5 hours)				10 min (10 questions)
Materials Specific Theoretical Training				
Module PSS (8 hours)	20 minutes (16 questions)			
Module PAL (8 hours)	20 minutes (16 questions)			
Total Duration of the all above modules	3 hours 15 minutes (195 minutes)			

The theoretical examinations pass mark is 60% for each module (A, B, C, PSS, PAL, SA, SM, ST and SG). Failure in theoretical parts of the examinations requires re-examination in the part failed. A third failure requires re-entry into the module leading to the examination.

The teacher of the group that is under training is allowed to perform the invigilation of the theoretical examination and also the supervision of the practical examination of the intermediate modules.

Practical examination

It is the responsibility of the ANB Authorised Examiner to verify compliance with ISO 9606 or equivalent, in particular with respect to:

1. Before starting test

- Checking of the welder's identity (e.g. driving licence)
- Checking of the WPS and handling it over to the welder
- Checking of the test piece
 - Parent material (identification)
 - Dimensions (thickness, length and diameter)
 - Joint preparation (acc. to WPS)
 - Welding position
 - Stamping (welder's and examiner's stamps)
- Checking the tack welds in the test piece
- Identification of the welding consumables (acc. to WPS)

2. During the test

- Welding parameters (acc. to WPS) e.g.
 - Current
 - Polarity
 - Voltage
 - Wire feed speed
 - stand-off distance
 - Gas flow rate
- Interruption of root- and capping run
- Possible permission for repair (Note! Weld imperfections on capping runs must not be removed)
- Weld time (reasonable)
- Interruption of the test (if welder's capability to carry out the test is insufficient)



3. After welding

- a) Make sure that the required test for the particular approval test are carried out (test reports)
 - Visual inspection, ISO 17637
 - Radiography, ISO 17636
 - Fracture tests, ISO 9017
 - Macro examination, ISO 17639
 - Bend tests, ISO 5173
 - Magnetic particle testing, ISO 17638
 - Penetrant testing, ISO 3452-1
 - Transverse tensile test, ISO 4136
- b) That the acceptance levels are fulfilled, ISO 5817, ISO 10042
- c) Signing of the welder's certificate. The certificate shall be typed and at least in English.

Note: The signing of the welder's certificate may be allocated to a certification body, as appropriate.

Items 1) to 3) will be undertaken by an Examiner/Examining Body who/which may be either the ANB Authorised Examiner or a third party approved by the ANB, according to the needs of the student, the relevant industry or any contracting parties.

ISO 9606 certificates or equivalent issued under the authority of one ANB authorised by EWF/IIW to implement the International Welder Guideline shall be recognised by all other ANBs.

15.6 Destructive and Non-destructive Examinations

Destructive and non-destructive tests for qualification testing of welders shall be carried out by inspection personnel competent in accordance with appropriate standards.

Test specimens shall be prepared according to the requirements of ISO 9606.

15.7 Validity of theoretical examinations

The theoretical knowledge obtained in this training program may be transferred to another welding process or material group, as long as the examination date is no longer than 5 (five) years ago. The specific modules for materials and processes need to be studied and examined.

15.8 Diploma

After successful theoretical and practical examination, the Authorized National Body awards a diploma to the candidate. This diploma shall include the actual scope granted. See specific requirements when printing the IW-diplomas in document IAB-001 (last edition).

If test object examination has been used, the words “with Test Object Endorsement” shall be written on the diploma below the diploma designation for welder.



Appendix 1

Reference standards

EN 169	filter glasses
EN 1089-3	marking of gas cylinders
ISO 9606-1	qualification of welders
ISO 636	consumables for TIG for non alloy and fine grain steels
ISO 2553	welding symbols
ISO 2560	covered electrodes for non alloy and fine grain steels
ISO 5817	quality levels
ISO 6848	TIG electrodes
ISO 14175	shielding gases
ISO 14341	solid wires for MAG for non alloy and fine grain steels
ISO/TR 15608	material grouping
ISO 17632	tubular cored electrodes for non alloy and fine grain steels
ISO 17637	visual testing of fusion-welded joints