

EWF Special Course

Personnel with the responsibility for Macroscopic and Microscopic Metallographic Examination of Structural Materials and their Joints Prepared/Produced by Welding and Allied Techniques



Minimum Requirements for the Education, Examination and Qualification



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MINIMUM REQUIREMENTS FOR THE EDUCATION,
TRAINING, EXAMINATION AND QUALIFICATION

**SPECIAL COURSE FOR TRAINING AND QUALIFICATION
FOR “PERSONNEL WITH THE RESPONSIBILITY FOR
MACROSCOPIC AND MICROSCOPIC METALLOGRAPHIC
EXAMINATION OF STRUCTURAL MATERIALS AND THEIR JOINTS
PREPARED/PRODUCED BY WELDING AND ALLIED TECHNIQUES”**

This is a reduced version; It is not the full Guideline

**For more information regarding the EWF Qualification System,
the EWF-IAB/IIW Combined Secretariat or
the National ANB should be contacted
(see on the EWF site – www.ewf.be the ANB contacts)**

Published by: **EFW-IAB/IIW Secretariat**
Av. Prof. Dr. Cavaco Silva, 33
Taguspark – Apartado 012
P-2741-901 Porto Salvo
Portugal

Tel: +351 21 4211351
Fax: +351 21 4228122
E-Mail: ewf@isq.pt
www.ewf.be

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Section I: Minimum Requirements for the Education

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

1. Introduction

Mechanical, physical and chemical properties of metals and alloys are determined essentially by their structure. Therefore the metallographic examination is widely used for determination of both macro- and microstructure of metals and their alloys. Metallographic examination enables to assess the influence of various kinds of processes and technological treatment, for instance metallurgical processes, plastic working, welding and allied processes, heat treatment etc. on changes occurring in the structure of metals and their alloys.

Metallographic examination belongs to the group of destructive tests because the preparation of suitable specimen is connected inherently with the injury to the whole of the test element.

In the present-day welding technology, in relation to welded joints and those made by allied techniques, metallographic examination is employed on a very large scale, namely:

- a) in testing of weldability of materials appropriated for welding,
- b) in verification of welding personnel qualifications (welders, welding operators),
- c) in development of welding consumables (filler metals, fluxes etc.),
- d) in development of new methods of welding, surfacing, brazing, soldering and thermal cutting,
- e) in determination of optimum conditions of welding, weld surfacing, brazing, soldering and thermal cutting,
- f) in current control of welding processes (in testing of joints or test elements),
- g) in final control of welded, brazed or the like products,
- h) in testing of conditions of arising of welding defects and imperfections,
- i) in determination of reasons of failures of structures and products made by welding and allied methods.

The course „MACROSCOPIC AND MICROSCOPIC METALLOGRAPHIC EXAMINATION OF STRUCTURAL MATERIALS AND THEIR JOINTS PREPARED/PRODUCED BY WELDING AND ALLIED TECHNIQUES” is a three-level course:

COMPREHENSIVE LEVEL: “Advanced techniques in metallographic examination of structural materials and their joints prepared/produced by welding and allied techniques”.

STANDARD LEVEL: “Macro- and microscopic examination of structural materials and their joints prepared/produced by welding and allied techniques”

BASIC LEVEL: „Specimens preparation for macro- and microscopic examination of structural materials and their joints prepared/produced by welding and allied techniques”.

The course is oriented to the application of metallographic examination of joints of the following structural materials :

- carbon and alloy structural steels,
- plain and alloy cast irons,
- aluminum and copper alloys,
- titanium alloys,
- nickel alloys,
- thermoplastics.

Type or types of structural materials will be chosen upon the request of students for the course.

The guideline covers the minimum requirements for education and training, agreed upon by all national welding societies within the EWF in terms of objectives, keywords and recommended times devoted to them. It will be revised periodically by the Committee to take into account any changes which may affect the “state of the art”. Students having successfully completed this course of education will be expected to be capable of applying preparation and assessment of specimens for metallographic investigations as covered by this guideline. A subsequent document covers the examination and qualification.

2. Education program

A teaching hour will contain at least 50 minutes of direct teaching time. It is not obligatory to follow the order of the topics given in this guideline and choice in the arrangements of the syllabus is permitted. The depth to which each topic is dealt with is indicated by the recommended number of hours allocated to it in the Guideline. This will be reflected in the scope and depth of the examination.

COMPREHENSIVE LEVEL: “Advanced techniques in metallographic examination of structural materials and their joints prepared/produced by welding and allied techniques”.

Course profile:

The main purpose of this course of the COMPREHENSIVE LEVEL is to present to the students advanced testing techniques and interpretation of the macroscopic and microscopic examination results of structural materials and their joints.

The programme of the COMPREHENSIVE LEVEL course is a survey of necessary theoretical and practical issues, which the students should learn in order to get the knowledge regarding advanced techniques used in metallographic examination.

The contents are given in the following structure:

Ser. no.	Subject	Number of theoretical teaching hours	Number of practical teaching hours
1	The types of metallographic examination; work safety conditions during preparation of specimens for metallographic examinations	1,0	-
2	Methods of specimen preparation for macro- and microscopic examination	3,0	-
3	Macroscopic examination and its application in welding technology	0,5	-
4	Microscopic examination and its application in welding technology	0,5	-
5	Demonstration of specimen preparation manners for metallographic examination	-	6,0
6	Electrolytic polishing, chemical polishing, coloured etching – purpose and application	5,0	-
7	Demonstration of electrolytic polishing and coloured etching	-	3,0
8	Demonstration of different kinds of microscopic structures	-	2,0
9	Image analysis as a tool in metallographic examination	6,0	-
10	Demonstration of capabilities of the program for image analysis	-	4,0
11	Introduction to scanning microscopy	5,0	-
12	Demonstration of scanning microscope capabilities	-	4,0
13	Practical examination	-	3,0
14	Written (test) examination	2,0	-
		23,0	22,0

STANDARD LEVEL: “Macro- and microscopic examination of structural materials and their joints prepared/produced by welding and allied techniques”

Course profile:

The main purpose of the STANDARD LEVEL course is to present characteristics of defects in joints prepared by welding or allied processes according to the standards and to present the interpretation of the results of macro and microscopic examination .

The programme of the STANDARD LEVEL course is a survey of necessary theoretical and practical issues which students should learn in order to have the knowledge and skill for the assessment of joints quality using macro- and microscopical examination. To this end, pieces of both homogeneous material and their joints of chosen structural materials will be performed.

The contents are given in the following structure:

Ser. no.	Subject	Number of theoretical teaching hours	Number of practical teaching hours
1	The types of metallographic examination; work safety conditions during preparation of specimens for metallographic examinations	1,0	-
2	Methods of preparation of specimens for macro- and microscopic examination	3,0	-
3	Macroscopic examination and its application in welding technology	0,5	-
4	Microscopic examination and its application in welding technology	0,5	-
5	Presentation of the EN 1321 standard	1,0	-
6	Demonstration of specimen preparation manners for metallographic examination	-	2,0
7	Practical training in specimen preparation	-	4,0
8	Presentation of standards relating to the quality assessment of joints made by welding and allied techniques	16,0	-
9	Demonstration of assessment of macroscopic specimens of joints	-	3,0
10	Demonstration of different kinds of microscopic structures	-	1,0
11	Practical training in unaided identification of welding imperfections on macroscopic specimens	-	6,0
12	Practical training in unaided identification of structures in microscopic specimens	-	2,0
13	Practical examination	-	3,0
14	Written (test) examination	2,0	-
		24,0	21,0

BASIC LEVEL: „Specimens preparation for macro- and microscopic examination of structural materials and their joints prepared/produced by welding and allied techniques”

Course profile:

The essential question for carrying out metallographic examination properly is suitable and correct preparation of specimens for examination of this type.

Therefore the main purpose of this course is to instruct students how to prepare specimens for macro- and microscopic examination as well as to introduce the interpretation of the examination results.

The programme of the BASIC LEVEL course is a survey of necessary theoretical and practical issues which the students should learn in order to get the basic knowledge about preparation of specimens for macro- and microscopic examination. Because this course is of practical nature, its essential part is the instruction of the students in the manners of specimen preparation for metallographic examination.

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To this end, specimens of both homogeneous materials and their joints prepared by welding or allied processes of structural materials will be prepared according to the individual demand of the course attendees.

The contents are given in the following structure:

Ser. no.	Subject	Number of theoretical teaching hours	Number of practical teaching hours
1	The types of metallographic examination; work safety conditions during preparation of specimens for metallographic examinations	1,0	-
2	Methods of specimens preparation for macro- and microscopic examination	3,0	-
3	Macroscopic examination and its application in welding technology	0,5	-
4	Microscopic examination and its application in welding technology	0,5	-
5	Presentation of the EN 1321 standard	1,0	-
6	Practical training in preparation of specimens for metallographic examination	-	24
7	Practical examination	-	3,0
8	Written (test) examination	2,0	-
		8,0	27,0

3. Access to the Education

Candidates for students of the STANDARD LEVEL and COMPREHENSIVE LEVEL course shall possess, at least, secondary technical education in mechanical branch. The candidates with another secondary education than mechanical one or with professional technical education in mechanical branch but with at least 3-year professional practice corresponding the course subject-matter are also admitted.

The candidates for the COMPREHENSIVE LEVEL course, who have completed the STANDARD LEVEL course, can be relieved from the duty to attend the part relating to the STANDARD LEVEL course and, in this case, they shall attend 32 lessons under the COMPREHENSIVE LEVEL.

The candidates for the COMPREHENSIVE LEVEL course, who have completed the BASIC LEVEL course, can be relieved from the duty to attend the instruction part relating to the BASIC LEVEL course and, in this case, they shall attend 31 lessons under the COMPREHENSIVE LEVEL.

The candidates for the STANDARD LEVEL course, who have completed the BASIC LEVEL course, can be relieved from the duty to attend the instruction part relating to the BASIC LEVEL course and, in this case, they shall attend 33 lessons under the STANDARD LEVEL.

Candidates for students of the BASIC LEVEL course shall possess, at least, professional technical education in mechanical branch. The people with another professional education than the mechanical one but with at least 2-year professional practice corresponding the course subject-matter are also admitted.

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The BASIC LEVEL, STANDARD and COPMPREHENSIVE LEVEL courses are independent of each other and can be conducted jointly or separately, according to the needs.

3.1 Requirements for candidates

All candidates shall provide evidence of a satisfactory visual test in accordance with the requirements of the standard EN 970.