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European Destructive Testing Technician Profile Curricula

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1. CONTENTS

2. Introduction

Destructive tests (DTs) of metallic materials and welded joints, particularly mechanical and metallographic tests, constitute an important element of quality and validation tests often required by related regulations. For this reason, the qualifications and competence of personnel performing DTs of metallic materials and welded joints are of great significance.

The effectiveness, quality, and repeatability when performing the DTs of structures and elements, including those containing welded joints, depend primarily on the competence of personnel performing or supervising such tests or evaluating their results.

These Guidelines aim to provide the possibility of harmonised training of personnel whose duties and responsibilities require appropriate theoretical and practical knowledge of DTs.

The necessity of the qualification of personnel performing the DTs of metallic materials and their welded joints results from various industrial applications and the necessity of a joint and unified approach to the use of such tests in industry.

3. Subject of the Guidelines

The subject of the Guidelines includes training schemes involving the necessary scope of theoretical knowledge and practical skills to be mastered by applicants and assessed during related examinations in order to ensure that DT personnel are appropriately qualified in the following areas:

- Mechanical Destructive Tests (MechDTs) of metals and welded joints including:
  - tensile tests of metals and welded joints,
  - bending tests of metals and welded joints,
  - Charpy impact strength tests of metals and welded joints,
  - Vickers hardness tests of metals and welded joints,
  - fracture test of welded joint.

Training performed and provided in accordance with these Guidelines can constitute the basis enabling the confirmation of competence of personnel performing tests in accredited laboratories operating on the basis of EN ISO/IEC 17025.

4. Reference Documents

The application of these Guidelines requires the documents and reference standards listed below. In cases of dated references, only cited issues apply. In cases of undated references, the latest issue of a cited document (as amended) applies.

EN ISO/IEC 17024	Conformity Assessment. General Requirements for Bodies Operating Certification of Persons
EN ISO/IEC 17025	General Requirements for the Competence of Testing And Calibration Laboratories
EN ISO 6892-1	Metallic Materials. Tensile Testing. Part 1: Method of Test at Room Temperature
EN ISO 4136	Destructive Tests on Welds in Metallic Materials. Transverse Tensile Test
EN ISO 9017	Destructive tests on welds in metallic materials — Fracture test
EN ISO 9018	Destructive Tests on Welds in Metallic Materials. Tensile Test on Cruciform and Lapped Joints
EN ISO 5178	Destructive Tests on Welds in Metallic Materials. Longitudinal Tensile Test on Weld Metal in Fusion Welded Joints
EN ISO 7438	Metallic Materials. Bend Test
EN ISO 5173	Destructive Tests on Welds in Metallic Materials. Bend Tests
EN ISO 148-1	Metallic Materials. Charpy Pendulum Impact Test. Part 1: Test Method
EN ISO 9016	Destructive Tests on Welds in Metallic Materials. Impact Tests. Test Specimen Location, Notch Orientation and Examination
EN ISO 6507-1	Metallic Materials. Vickers Hardness Test. Part 1: Test Method
EN ISO 9015-1	Destructive Tests on Welds in Metallic Materials. Hardness Testing. Part 1: Hardness Test on Arc Welded Joints
EN ISO 9015-2	Destructive Tests on Welds in Metallic Materials. Hardness Testing. Part 2: Microhardness Testing of Welded Joints
EN ISO 9712	Non-destructive testing. Qualification and certification of NDT personnel.

5. Terms and Definitions

For the purposes of these Guidelines, the below-presented terms and definitions shall apply.

4.1 Applicant

A person applying for participation in training and qualification.

4.2 Qualification (Final) Examination

A two-stage written, and practical examination administered by a certification body or an authorised qualification body aiming to assess the applicant's knowledge and skills in DTs covered by related training.

4.3 Multiple-Choice Examination Questions

The formulation of a question containing four possible answers of which only one is correct while the remaining ones are wrong or incomplete.

4.4 Examination Committee

Persons authorised by a certification body to perform, supervise, and assess a qualification examination in MechDTs. An examination committee should be composed of a certification body representative, a training course lecturer who has not participated in a given DT training, and a MechDT specialist.

4.5 On-the-Job Training

Training of a person seeking certification provided by his or her employer (or by the employer's representative) in DT-related aspects characteristic of the employer's products, equipment, DT procedures, related codes, standards, and specifications leading to the granting of a licence to perform related tests.

4.6 Examiner

A specialist in a given MechDT possessing a minimum of five years' documented work experience who has not participated in training provided to applicants. An examiner is appointed and approved by a certification body.

6. Objective and Intended Application of Destructive Testing of Metallic Materials and Their Welded Joints

DTs are among the most commonly performed tests of structural materials and their welded joints.

MechDTs, commonly used in industry, aim to determine the operational characteristics of elements subjected to loads. In terms of welding engineering, MechDTs are performed during:

a) qualification of welding technologies,
b) quality tests of joints,
c) verification of conformity concerning required features of base materials with the requirements of related standards and technical acceptance conditions,
d) tests of filler metals,
e) verification of qualification levels of personnel holding welding licences,
f) diagnostics concerning reasons for the formation of welding imperfections,
g) identification of reasons for failures of welded structures.

7. Types and Organisation of Training Courses

7.1. Mechanical Destructive Tests (MechDTs)

Training in MechDTs includes single module:

- Independent Level designed for technicians performing Destructive Testing including tensile tests, bend tests, impact strength tests, fracture tests and hardness measurements.

The training objective concerning MechDTs includes the theoretical and practical preparation of candidates for the single-handed performance of tests and the interpretation of test results in relation to tensile tests, bend tests, impact strength tests, fracture tests and hardness measurements involving metallic materials and their welded joints.

7.2. Organisation of Training Courses

MechDT-related training can be organised at training centres possessing appropriate technical facilities (laboratory/laboratories) enabling the performance of the practical part of MechDT-related training. The laboratory/laboratories should be provided with efficient and approved equipment that satisfies metrological requirements.

It is recommended that the training be conducted by lecturers possessing a minimum of five years' practical experience of performing DTs of metallic materials and their welded joints.

8. Entry Requirements/Access Conditions

The minimum requirements to apply and successfully complete the EDTT Qualification are:

a) have completed at least secondary technical education majoring in mechanics;

or

b) have completed secondary education other than mechanical education and a minimum of one year of practical training in mechanical tests confirmed by the head of the laboratory/testing department where a given applicant works;

or

c) any applicant that fulfils with the EWF National access conditions for the qualification level of EWS complies with the access conditions;

and

d) be in possession of a certificate confirmed by a specialist physician stating that the applicant satisfies the requirements specified in 7.4 in EN ISO 9712 (latest version) in relation to:

- near vision acuity – making it possible to read characters of at least no. 1 on the Jaeger scale or N 4.5 of the Times Roman scale or equivalent letters (1.6-mm in height) from a distance not shorter than 30 cm, using one or both eyes.

- chromatic vision - making it possible to recognise colours and distinguish chromatic contrast or greyscale used in a given DT specified by the employer.

9. Scheme of Training

Contact hours are distributed between theoretical (A), assigned projects/exercises (B), practical workshop training(C), as showed in the following example:

Qualification: Example 1	
CONTACT HOURS	**X = (SUM A:C)**
Subject Contents	A + B + C

Competence Units

The European Destructive Testing Technician qualification standard is structured as follows (overview):

COMPETENCE UNITS	**MINIMUM CONTACT HOURS[1]**	**EXPECTED WORKLOAD[2]**
CU: Introduction to Destructive Testing	3	6
CU: Mechanical Tests (Tensile Tests, Bend Test, Charpy Impact Strength Test, Fracture test, Hardness Test)	24	48
CU: Measurement Uncertainty	7	14
CU: Introduction to Metallic Materials (optional)	5	10
Total with Mandatory Subject	**34**	**68**
Total with Optional Subject	**39**	**78**

9.1. Training Content in Mechanical Tests (MechDTs)

I. CU: Introduction to Destructive Testing

CU: Introduction to Destructive Testing	**MINIMUM CONTACT HOURS**
SUBJECT TITLE	
Introduction to Destructive Testing and Safety Rules in Destructive Testing	1
Design of Destructive Testing Machinery and Equipment	2
TOTAL	3
WORKLOAD	**6**

LEARNING OUTCOMES	
COMPETENCE UNIT	**Introduction to Destructive Testing**
KNOWLEDGE	**Factual and theoretical knowledge of the principles and applicability of:** – Destructive Testing, – types of DT, – safety rules, – testing machinery and equipment.

[1] **Contact Hours** are the minimum recommended teaching hours for the Standard Routes. A contact hour shall contain at least 50 minutes of direct teaching time

[2] **Workload** is calculated in hours, corresponds to an estimation of the time students typically need to complete all learning activities required to achieve the defined learning outcomes in formal learning environments plus the necessary time for individual study

LEARNING OUTCOMES	
COMPETENCE UNIT	**Introduction to Destructive Testing**
SKILLS	– List the main DT used during tests of metallic materials and their welded joints, including their purpose and fields of applications. – Match laboratory equipment with type of DT. – Identify applicable DT according to the metallic material´s properties and the welding process used. – Apply the appropriate safety rules to the performing task. – Correctly use personal protective equipment when performing the test. – Identify hazards to personnel during DT

II. CU: Mechanical Tests (Tensile Tests, Bend Test, Charpy Impact Strength Test, Fracture test, Hardness Test)

CU: Mechanical Tests (Tensile Tests, Bend Test, Charpy Impact Strength Test, Fracture test, Vickers Test)	**MINIMUM CONTACT HOURS**
SUBJECT TITLE	
Tensile Tests of Metals at room Temperature	5
Tensile Tests of Welded Joints with Butt Welds, Cruciform Joints, Overlap Joints and Joints with Fillet Welds	5
Bend Tests of Metals and Welded Joints	3
Charpy Impact Strength Test of Metals and Welded Joints	5
Fracture Tests of Welded Joints	1
Hardness Tests of Metals and Welded Joints	5
TOTAL	24
WORKLOAD	**48**

JOB FUNCTION	**JOB REQUIRED ACTIVITIES**	**MINIMUM CONTACT HOURS**	**WORKLOAD**
Conducting mechanical tests	Using measurement instruments to verify the size, the dimensions and the geometry of specimens to be tested.	24	48
	Using the specimen's data to determine and calculate the results required by each standard test method.		
	Selecting the proper testing machine and standard to perform a test.		
	Match laboratory equipment with appropriate test and standards.		
	Setting up a testing machine in compliance with the standard test method of the required test.		
	Interacting with high-ranking personnel to review the current progress of the tests execution thus to update the testing schedule on the basis of the actual performed work.		
	Writing a test report by inserting the results obtained from the tests		

LEARNING OUTCOMES	
COMPETENCE UNIT	**Mechanical Tests (Tensile Tests, Bend Test, Charpy Impact Strength Test, Fracture test, Vickers Test)**
KNOWLEDGE	**Factual and theoretical knowledge of the principles and applicability of:** – standards for different Destructive Testing methods, – tensile test of metallic materials and different types of welded joints at room temperature, – tensile test specimen types and variations, – tensile test diagrams, – bend test of metallic materials and welded joints, – impact strength test of metallic materials and welded joints, – types of impact strength test methods, – hardness and microhardness measurements of metallic materials and welded joints, – hardness and microhardness measurements methods.
SKILLS	– Inspect the equipment to ensure that it is safe and suitable to use. – Identify the specimen to ensure traceability. – Use measuring equipment to determine all specimen essential dimensions. – Perform tensile tests to determine required properties according to standards – Perform visual examination of specimen after test to analyse post test results. – Perform bend test of metals and welded joints to confirm material plastic properties. – Perform impact test of metals and welded joint at room and lower temperatures to evaluate impact strength and percent shear fracture. – Perform fracture test and preserve fractured surface. – Perform measurements in metals and welded joints to evaluate hardness. – Report/document test results according to applicable standard.

III. CU: Measurement uncertainty

CU: Measurement Uncertainty **SUBJECT TITLE**	**MINIMUM CONTACT HOURS**
General methods of calculating uncertainties	3
Measurement uncertainty for tensile test, impact test and hardness test	4
TOTAL	7
WORKLOAD	**14**

LEARNING OUTCOMES	
COMPETENCE UNIT	**MEASUREMENT UNCERTAINTY**
KNOWLEDGE	**Factual and theoretical knowledge of the principles and applicability of:** – Uncertainty evaluation in case of Vickers hardness Test – Uncertainty evaluation in case of Tensile Test – Uncertainty evaluation in case of Charpy Impact Strength Test – Uncertainty evaluation in case of Bending Test
SKILLS	– Conduct a type A and B uncertainty assessment/calculation for Vickers hardness test, tensile test, Charpy impact test and bending test.

IV. CU: INTRODUCTION TO METALLIC MATERIALS (optional)

CU: Introduction to metallic materials SUBJECT TITLE	MINIMUM CONTACT HOURS
Structure and properties of metals	2
Manufacture and classification of steels	2
Behaviour of structural steels in fusion welding	2
TOTAL	6
WORKLOAD	**12**

LEARNING OUTCOMES	
COMPETENCE UNIT/ULO	**INTRODUCTION TO METALLIC MATERIALS**
KNOWLEDGE	**Factual and theoretical knowledge of the principles and applicability of:** – Structure and properties of metals; – Classification of steels; – Behaviour of structural steels.
SKILLS	– Identify and list the basic mechanical properties of metals. – Outline, describe the effect of loading conditions and temperature on the mechanical properties of metallic materials. – Outline a typical weld solidification structure and the most common principles of strengthening mechanisms. – Outline alloys and binary phase diagrams identifying alloy microstructures from given phase diagrams. – Describe steel making and processing of steel products (rolling and casting). – Identify the most common properties of a steel and types of steel. – Outline the influence of the weld thermal cycle, the peak temperature and the cooling rate when welding steels on the mechanical properties of a weld joint. – Identify on the weld joint the major regions, the HAZ sub regions, the reasons for grain size and microstructure changes and their effects on properties for a single pass weld versus a multi-pass weld including the microstructure formed during welding. – Recognize the weldability of steels, based on the factors (e.g. heat input, carbon equivalent, metal structure, cooling rate, weld pool solidification, single run, multi run) that will influence the weldability.

9. Didactic Instructions

During training, applicants should be provided with training materials that are the compendium of knowledge discussed during lectures related to MechDTs and constituting the basis enabling the preparation for the qualification (final) examination.

9.1. Didactic Instructions for Theoretical Classes

Theoretical classes (lectures) aim to prepare applicants for the informed and safe performance of DTs of metallic materials and their welded joints, to acquaint applicants with the interpretation of test

results, to instil in applicants the primary principles of the preparation and handling of test specimens, and to acquaint applicants with the criteria and methods of assessment of test results based on related standards, regulations, guidelines, and so on.

When discussing the methodology of DTs and their application in welding engineering, it is necessary to refer to appropriate standards and to use appropriate welding terminology.

Lectures should involve multimedia presentations, didactic films, and exhibits (specimens prepared for tests, specimens after tests, fractures, etc.).

Lectures should involve discussion with applicants in a manner that stimulates their logical thinking.

Lecturers should, from time to time, verify knowledge assimilated by applicants, for example by asking questions during lectures.

When discussing HSE-related issues during DTs, applicants' attention should be directed to specific hazards arising from various aspects of DTs, for example moving (rotating) machinery elements, electrocution, cooling medium vapours, and caustic chemicals such as acids and other hazardous substances. It is also necessary to remind applicants of basic first-aid principles.

9.2. Didactic Instructions for Practical Classes

Practical classes (demonstrations, presentations, and exercises) aim to prepare applicants for the single-handed performance and documentation of DT results.

Practical classes in laboratories should be preceded by on-the-job training related to individual machines to be used during exercises, that is, testing machines, bending machines, impact testing machines, hardness testing machines and so on.

During laboratory exercises, each applicant should personally conduct scheduled exercises supervised by a lecturer.

Applicants receiving training in mechanical tests (tensile tests, bend tests, and impact strength tests) should be able to dimension specimens applied in strength tests using measurement equipment (caliper, ruler, etc.) and identify working environment conditions accompanying tests using a thermometer and a hygrometer. During practical classes, applicants should be able to conduct a test, interpret a measurement result, and prepare a complete DT report.

A lecturer should present specimens to applicants after tests other than those specimens prepared during training. In doing so, the lecturer should direct applicants' attention to welding imperfections present in welded joints.

10. Qualification (Final) Examination

10.1. Final Examination

The final examination, including a theoretical and practical part, is conducted by an examiner.

The theoretical part of the final examination aims to verify the applicant's knowledge in relation to the entire scope of training and has the form of a multiple-choice test. Questions are provided with four answers, of which only one is correct. The test should contain a minimum of 40 questions covers equal way of the subjects of the training from module I to module VII. The time designated for an answer to one question amounts to 1.5 minutes.

The theoretical examination is passed if an applicant has properly answered a minimum of 60% of examination questions.

The practical part of the final examination aims to verify the applicant's practical skills in the performance of a test or a measurement involving each area covered by practical training in a laboratory (tensile tests, bend tests, impact strength tests, and hardness measurements) as well as the preparation of a test report using a given form.

The practical examination is passed if, during the examination, the applicant has demonstrated practical skills related to activities preceding a test, is capable of performing a test, and can assess and document the test result. The final examination is passed if the applicant has passed both the theoretical and practical parts of the examination.

10.2. Appeal Procedure

An applicant who believes he or she has been unjustly evaluated during an examination is entitled to appeal to a certification body and/or an Authorised Nominated Body (ANB).

10.3. Alternative Route

The Alternative Route is available for those who have previously gained the knowledge and expertise indicated in the instruction programme in EDTT Guideline, through informal and non-formal learning, and are able to demonstrate their capability in all respects, to proceed to examination without compulsory attendance at an ANB approved Training Course, as mentioned in the entry requirements. For further information on the Alternative Route please see IO5 Harmonised RPL Scheme for the EDTT.

10.4. Documents Issued after Examinations

Applicants who have passed the final examination receive a Diploma of completion of training.

ANNEX A. Previous curriculum revision

Table A1 shows the previous revision of the destructive testing technician course curriculum. The information contained in the table was used to develop the new programme within the TRUST project

Table A1. Previous revision of course curriculum.

Subject area no.	Name of subject area	Training programme	Number of hours	
			Lectures	Exercises
I	INTRODUCTION	I.1 Introduction to Destructive Testing	0,5	–
		I.2 Safety Rules in Destructive Testing	0,5	–
		I.3 Design of Destructive Testing Machinery and Equipment	1	1
		I.4 Destructive Testing Standards and Regulations	1	–
		I.5 Specimens - characteristics (dimensions, surface, etc.) and sampling	1	1
II	TENSILE TESTS OF METALS AND WELDED JOINTS	II.1 Tensile Tests of Metals at Ambient Temperature	1	4
		II.2 Tensile Tests of Welded Joints with Butt Welds, Cruciform Joints, Overlap Joints and Joints with Fillet Welds	1	4
III	BEND TESTS	III.1 Bend Tests of Metals and Welded Joints	1	3
IV	CHARPY IMPACT STRENGTH TEST OF METALS AND WELDED JOINTS	IV.1 Charpy Impact Strength Test of Base Materials and Welded Joints at Ambient and Lower Temperatures	1	2
V	FRACTURE TEST	V.1 Fracture Test of Welded Joints	1	2
VI	VICKERS HARDNESS TESTS OF METALS AND WELDED JOINTS	VI.1 Vickers Hardness and Microhardness Tests of Base Materials and Welded Joints	1	4
VII	TEST COMPLETION	VII.1 Interpretation of Test Results and Test Report	1	2
Total (lectures + exercises)			**34**	
Examination (theoretical + practical)			**6**	
Total			**40**	

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