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English Version

Non-destructive testing - Guidelines for NDT training syllabuses (ISO/TR 25107:2006)

Essais non destructifs - Lignes directrices pour les programmes de formation en END (ISO/TR 25107:2006)

Zerstörungsfreie Prüfung - Leitfaden für Ausbildungslehrinhalte (Syllabus) der zerstörungsfreien Prüfung (ISO/TR 25107:2006)

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Foreword

This document (CEN ISO/TR 25107:2006) has been prepared by Technical Committee CEN/TC 138 "Non-destructive testing", the secretariat of which is held by AFNOR, in collaboration with Technical Committee ISO/TC 135 "Non-destructive testing".

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this CEN Technical Specification: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

With this Technical Report, ISO/TC135 and CEN/TC138 present to the worldwide non-destructive testing (NDT) community their recommendations for the minimum technical knowledge to be required of NDT personnel. These recommendations provide means for evaluating and documenting the competence of personnel whose duties demand the appropriate theoretical and practical knowledge.

As part of the efforts to streamline and harmonize the training and certification of NDT personnel, ISO/TC 135 and CEN/TC 138 have been actively involved in developing guidelines for training syllabuses (this Technical Report) and for NDT training organizations (ISO/TR 27108). These documents are intended to serve those involved in training and to be useful in achieving a uniform level of training material and — consequently — in the competence of personnel.

This document, together with ISO/TR 27108, represents two years of effort for working groups of the two technical committees in the promotion of harmonization and mutual recognition of minimum requirements taken from the different existing certification schemes.

The content of this first edition has been based on the experience of the experts as well as on comments from the end-user industries, as well as the most recent edition of the International Committee for Non-destructive testing (ICNDT) recommended guidelines.

The time allotment for the different topics takes into account the latest developments in each method and, as a consequence, the total duration can be sometimes greater than the minimum duration required by ISO 9712 and EN 473.

This Technical Report is to be revised in the coming years in order to maintain a workable document in line with the development of NDT methods and techniques.

ISO/TC 135 and CEN/TC 138 wish to express their appreciation to all those who contributed to the production of this publication.

Non-destructive testing — Guidelines for NDT training syllabuses

1 Scope

This Technical Report gives guidelines for non-destructive testing (NDT) training syllabuses, with the intention of harmonizing and maintaining the general standard of training of NDT personnel for industrial needs.

It also establishes the minimum requirements for effective structured training of NDT personnel to ensure eligibility for qualification examinations leading to third-party certification according to recognized standards. In addition to non-destructive testing in general, its guidelines for syllabuses cover acoustic emission, eddy current, leak, magnetic particle, penetrant, radiographic, ultrasonic and visual testing.

NOTE ISO/TR 27108 gives associated guidelines for NDT training organizations intended for the general part of training courses.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1330 (all parts), *Non-destructive testing — Terminology*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1330 apply.

4 Introduction to NDT

4.1 Role

Non-destructive testing makes an important contribution to the safety, and economic and ecological welfare, of our society.

NDT is the only choice for the testing of an object which may not be destroyed, modified or degraded by the testing process. This is generally required for objects which are to be used after testing, for example, safety parts, pipelines, power plants, and also constructions under in-service inspection, but even for unique parts in archaeology and culture.

NDT is based on physical effects at the surface or the inner structure of the object under test. Often, the outcome of the test needs to be interpreted to give a useful result; sometimes different NDT methods must be combined, or verified by other test methods.

4.2 Task of NDT personnel

NDT personnel have a great responsibility, not only with respect to their employers or contractors but also under the rules of good workmanship. The NDT personnel must be independent and free from economic influences with regard to his test results, otherwise the results are compromised. The NDT personnel should be aware of the importance of his signature and the consequences of incorrect test results for safety, health and environment. Under legal aspects, the falsification of certificates is an offence and judged according to the national legal regulations. A tester may find himself in a conflicting situation about his findings with his employer, the responsible authorities or legal requirements.

Finally, the NDT personnel is responsible for all interpretations of test results carrying his signature. NDT personnel should never sign test reports beyond their certification.

4.3 History of NDT

The principle of NDT started to be put into practice with visual checks in prehistoric times. In medieval later centuries, test methods such as simple leakage tests and hardness checks were introduced. The breakthrough for NDT came with industrialization in the 19th and 20th centuries: X-ray and ultrasonic testing for inner defects, penetrant and magnetic particle testing for surface cracks. During the last few decades, sophisticated, mostly electronically linked methods, such as eddy current testing, RADAR, computer tomography and thermography have been developed. NDT methods have found application in a wide range of industries — from civil engineering and industrial plants to space and defence technology.

The history of NDT is linked to many famous researchers and inventors, including Röntgen, Becquerel, Curie, Oerstedt, Faraday and even Leonardo da Vinci. They discovered the physical principles and demonstrated early applications. Altogether approximately 5 000 scientists worldwide made contributions to the present state of NDT.

NDT is a global technology. Since NDT tasks and related technical problems are similar in all developed countries, improved solutions and new equipment are spread around the world within a few months. Many international conferences and standards committees contribute to a steady and consensual development of NDT for the benefit of safety, economy and the environment.

4.4 Terminology of NDT

Correct and standardized terminology is a necessity for a particular technology applied worldwide. It is needed for communication between contracting parties, NDT personnel and certifying bodies. Terms like “indication”, “imperfection”, “flaw” and “defect” require a precise and unequivocal definition if confusion and misinterpretation of results is to be avoided. See Clause 3.

4.5 General environmental and safety considerations

4.5.1 Non-destructive testing is often applied in conditions where the safety of the operator could be in danger owing to local conditions, or where the application of the particular NDT method or techniques could in itself compromise the safety of the operator and others in the vicinity.

An essential element of any course training for NDT personnel must therefore be safety. The duration of the training for this subject should be adequate and be provided in addition to the technical training associated with a particular NDT method.

4.5.2 General safety considerations include, but are not necessarily limited to, the following:

— environmental conditions (heat, cold, humidity);

— toxicity (NDT materials, tested products, atmosphere);

— radiation safety (NDT materials, products, local regulations);

— electrical safety (NDT equipment, lethal voltages, EMC);

— potential for injury to personnel (working at height or in other dangerous environments);

— personal protection equipment (clothing, radiation dosimeters).

5 Radiographic testing — Levels 1, 2 and 3

The letters **E** and **P** followed by a **value** indicate the *educational training time* and *practical training time* respectively, in hours.

NOTE As specified in EN 473, direct access to the level 3 examination requires the total hours shown for level 1 and level 2.

Content	Level 1	Duration h	Level 2	Duration h	Level 3	Duration h
5.1 **Introduction to, terminology and history of, NDT**	**History** Purpose **Terminology:** electromagnetic radiation energy dose dose rate	**E 0,5**	**History** Purpose **Terminology:** wave-length dose dose rate intensity dose rate constant	**E 1,0**	**History** Purpose **Terminology** **Relevant standards:** EN 1330-3	**E 1,0**
5.2 **Physical principles of the method and associated knowledge**	**Properties of X- and gamma radiation** **Relevant standards:** EN 444: General principles Straight line propagation Effects of radiation Capability of penetration	**E 0,5** **P 0,5**	**Properties of X- and gamma radiation** Photon Process of ionization: photochemical effects; biological effects; fluorescent effects. Energy	**E 1,0**	**Properties of radiation** X-radiography Gamma radiography Neutron radiography Electron radiography Process of ionization: photochemical effects; biological effects; fluorescent effects.	**E 1,0**
	Generation of X-radiation Function of X-ray tubes Tube current I High voltage U: effects on dose rate and energy of radiation.	**E 1,0** **P 0,5**	**Generation of X-radiation** Function of X-ray tubes Spectrum: intensity; max. energy; effective energy; change of spectrum by tube current and tube voltage. Inherent filtering	**E 1,5**	**Generation of X-radiation** Function of X-ray tubes Spectrum: intensity; max. energy; effective energy; change of spectrum by tube current and tube voltage. Characteristic radiation Inherent filtering hardening effect	**E 2,0**

Content	Level 1	Duration h	Level 2	Duration h	Level 3	Duration h
	Origin of γ-radiation Radio isotope Ir 192, Co 60, Se 75 Activity: half life; characteristics of γ-sources; life time; energy; activity; source size.	**E 1,0** **P 0,5**	**Origin of γ-radiation** Radio nuclide Isotope Ir 192, Co 60, Se 75, Yb 169 Activity A Characteristics of γ-sources: half life; decay curves maximum activity; source size. Characteristic of Gamma ray Dose rate constant Spectrum and effective energy	**E 1,5**	**Origin of γ-radiation** Natural and artificial decay decay series Radio nuclides for NDT Isotope Ir 192, Co 60, Se 75, Yb 169 Activity A Characteristics of γ-sources: half life; decay curves maximum activity; source size. Characteristic of Gamma ray Dose rate constant Spectrum and effective energy	**E 2,0**
	Interaction of radiation with matter Attenuation: absorption; primary radiation; scattered radiation; influence of penetrated thickness. Type of material Energy Half value layer Tenth value layer	**E 1,0**	**Interaction of radiation with matter** Attenuation: photo effect; coherent scattering; Compton scattering; pair production. Attenuation coefficient Scatter radiation Specific contrast Radiation contrast Effects of filtering Beam hardening	**E 3,0** **P 0,5**	**Interaction of radiation with matter** Attenuation vs. energy: photo effect; coherent scattering; Compton scattering; pair production. Attenuation coefficient Scatter radiation Specific contrast Radiation contrast Effects of filtering Beam hardening Klein-Nishina law	**E 6,0**