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Non-destructive testing — NDT personnel training organizations

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 135, *Non-destructive testing*, Subcommittee SC 7, *Personnel qualification*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

This first edition cancels and replaces ISO/TR 25108:2006.

Introduction

Since the effectiveness of non-destructive testing (NDT) personnel is dependent on the technical knowledge acquired, a system to evaluate and document the appropriate theoretical and practical knowledge competencies of personnel is required.

To harmonize and maintain training and certification of NDT personnel, this document for NDT training organizations, together with NDT training syllabuses (ISO/TS 25107) have been developed with the intent to serve those involved in training to achieve a uniform level of training, training material and consequently competence of personnel.

Non-destructive testing — NDT personnel training organizations

1 Scope

This document gives requirements and recommendations for non-destructive testing (NDT) training organizations, 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.

NOTE ISO/TS 25107 gives requirements and recommendations for NDT training syllabuses intended for training.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO/TS 18173, *Non-destructive testing — General terms and definitions*

ISO 9712, *Non-destructive testing — Qualification and certification of NDT personnel*

ISO/TS 25107, *Non-destructive testing — NDT training syllabuses*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TS 18173 and ISO 9712 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
course note
educational material that is used in the classroom to support learning objectives

Note 1 to entry: Supplied and produced by the organization in either paper or electronic format (e.g. course manual or presentation, assignments, lab exercises, quizzes, etc.).

3.2
course outline
document agreed between the organization and students that includes a high-level overview of what will be taught

3.3
curriculum
detailed plan of study prepared by the training organization which describes the aims, academic and practical content, learning outcomes and practical competencies to be gained, teaching, training and learning methods, assessment processes for the lessons and academic content taught and practical competencies trained in a specific course

3.4
distance education
any mode of delivery which occurs when students are learning independently at a location away from the premises of the training organization and the instructor provides only consultation to the student(s)

3.5
e-learning
learning method facilitated by information and communication technology

3.6
instructor
person performing training

3.7
training staff
personnel performing work affecting the NDT training quality

Note 1 to entry: Pertains to personnel other than the *instructor* (3.6) such as secretariat staff, assistant instructors, lab assistants, proctors.

4 General

A planned and systematic training process can make an important contribution in helping a training organization to improve its capabilities and to meet its objectives.

For selecting and implementing training to address gaps between required and existing competence requirements, training organizations shall monitor the following stages:

a) defining training needs;

b) designing and planning training;

c) providing training;

d) evaluating the outcome of training.

Training curriculum shall be developed to establish a clear understanding of the training objectives and the learning outcomes that define what the student will be able to achieve as a result of the training and to ensure that the basic knowledge required by students in continuing to fulfil their training needs are met.

This can include initial training in areas such as math, materials and processes and safety.

Training objectives shall be based on the expected competence as developed for the training needs in order to ensure the effective delivery of training. They should consider the following:

a) training needs;

b) students;

c) training methods;

d) outline of content;

e) lesson plans;

f) duration;

g) resources required;

h) delivery mode.

Criteria for evaluating the training outcomes and monitoring the training process should be defined.

5 Training organization management

The training organization shall appoint a person to be responsible for the overall management of the training centre and courses.

A person should also be appointed to be responsible for establishing a quality management system covering all aspects of the training services provided.

6 Quality management system

The training organization shall have a suitable quality management system which is documented and ensures the effective delivery of the training requirements.

EXAMPLE A documented quality management system based on ISO 9001 is an example of method of satisfying this requirements.

The system shall be controlled and periodically reviewed according to the stipulations (for example, ISO 9712, ISO/TS 25107) in the quality management system.

Where the competence of an individual is based on appropriate education, training, skills and experience, the training organization shall:

— determine the necessary competence for training staff performing work affecting the NDT training quality;

— provide training or take other actions to satisfy these needs; and

— evaluate the effectiveness of the action taken.

7 Induction of students

The training organization shall provide all information and conditions necessary for attendance in the training.

For example, a system of induction should ensure that, upon receipt of an application for training, students are provided with unambiguous information/instructions on the following:

— prior knowledge requirements (i.e. math, materials and processes, radiation safety);

— training fees, including all that is covered by the fees, and methods of payment (there should be no hidden extras requiring further payments, and a schedule of course fees should be published);

— dates and times for course attendance, and clear instructions concerning the location of the training venue;

— transport (including information on parking), accommodation and catering arrangements;

— NDT equipment required to be provided by the student, and/or details of the NDT equipment provided by the training organization;

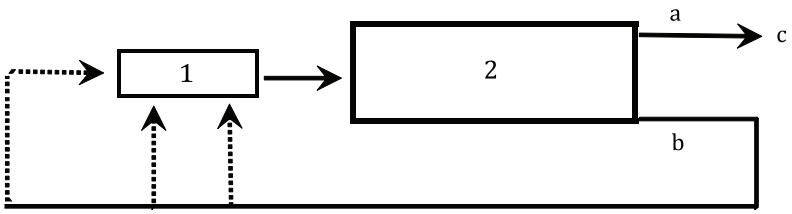
— personal protective equipment, if required, and details of the essential safety requirements pertaining to the training venue, especially where the training includes the use of ionizing radiation or substances hazardous to health;

— any textbooks that the student is required to provide;

— the name and contact information of a training organization representative from whom additional information can be obtained prior to or during the training.

8 Student assessment

A system of ongoing assessment of students shall be used to ensure that the learning progress of the individual student is monitored, and which results in counselling for those students who fail to achieve the required standard at any point during the course.



Key

1 training

2 on-going assessment

NOTE The dotted line indicates additional training with the options theoretical, practical or both.

a Good.

b Poor.

c Successful completion of training.

Figure 1 — Student assessment

The training organization shall have a system in place to ensure every effort is made for safeguarding the integrity of training examinations no matter what training format is used.

NOTE Training format can include in-class training or distance education including e-learning (Annex B provides guidance on e-learning).

A traceable statement of completion of training shall be issued, including the list of trainers, following final evaluation. This statement shall contain the result of the final evaluation.

Contracts between the training organization and the student, and/or representative, shall highlight the possible consequences of the student not meeting the requirements at any assessment point during training.

9 Training curriculum and course notes

The training organization should publish and make freely available upon request a training outline for each course offered. This outline should cover the relevant elements of the syllabus referenced in ISO 9712.

The training curriculum shall be designed to balance both theoretical and practical elements. For Levels 1 and 2 training organizations should dedicate (50 ± 10) % of the minimum training requirement to practical exercises.

The training organization shall maintain a master set of training notes bearing a revision date, to ensure consistency between courses in the event of instructor changes. The master set shall be reviewed

periodically and revised as necessary in light of changes to the referenced syllabus and applicable standards.

Each student shall be provided with a comprehensive set of appropriate course notes.

10 Facilities

Classrooms and practical facilities shall be well lit and ventilated, and there should be adequate provision of teaching aids.

Where applicable, personal protective equipment shall be provided if students are not advised to provide this for themselves. Equipment provided by students shall be verified as suitable by the responsible course instructor.

11 Training specimens

Training specimens, including radiographs and data sets, shall be available in sufficient quantity and complexity to cover the full range of NDT methods and techniques encompassed by the training syllabuses.

The specimens with discontinuities shall contain real or artificial discontinuities representative of those found in the field (not applicable to strain gauge testing or other techniques which are not focussed on the detection of discontinuities such as thickness measurements, conductivity measurements, etc.).

The position and characterization of all real or artificial discontinuities, relevant to the NDT method/technique within each specimen shall be recorded in a report.

12 NDT equipment — General

Appropriate NDT equipment; including NDT instruments, accessories, calibration blocks, shall be available in sufficient quantities that provide each student with the opportunity to complete all exercises individually with a maximum of two students working on the same exercise at the same time (see Annex A).

There shall be a documented system for maintenance and verification of NDT equipment, including records.

13 Technical library

The NDT and product standards relevant to the courses shall be available to the students.

Relevant technical publications covering the training syllabus should also be available.

Relevant certification scheme documents should be included in this library and made known to the students.

14 Instructors

There shall be sufficient instructors available to ensure that a minimum of one trained and appropriately qualified instructor is present and available to students at all times whilst the course is in progress.

Instructors shall be appropriately qualified for the NDT method, sector or subject matter that the course covers.

Instructors shall be familiar with the course outline and curriculum requirements, various training systems, and be able to transfer knowledge by effective means.

The training organization is responsible to ensure that the instructor's NDT and product knowledge is current and maintained up to date.

Class sizes should be limited to 10 students for each instructor during practical training.

15 Training records

There shall be a system for raising and maintaining training records, which shall be kept secure and confidential.

Students' records shall include:

1) names and contact details for all students;

2) duration and completion dates of training;

3) training history, including results of on-going assessments and the result of the final evaluation; and

4) training staff involved for each student.

Instructor's records should include:

1) background and experience;

2) qualifications;

3) certification;

4) formal training and updating; and

5) evaluation of the training provided by the instructor (i.e. periodic monitoring of delivery).

Annex A
(informative)

Guidelines for NDT training organization on holdings

NDT equipment should be available for the full range of NDT techniques, within the scope of the NDT method and techniques being taught (Clause 12).

a) Ultrasonic testing (UT):

Equipment (Instruments):

- Ultrasonic test instrument with adjustable repetition rate and pulse length – Freq. 1 to 10 MHz minimum;
- Cables as applicable to connect probe and instrument;

Probes (Sensors):

- Angle beam probe:
  - 2,25 MHz to 5 MHz, 45/60 or 65/70 degrees, 12 mm to 24 mm square or round;
  - 2,25 MHz to 5 MHz, 45/60 or 65/70 degrees, 6 mm to 12 mm square or round;
- Straight beam probe:
  - 2 MHz to 2,25 MHz, 10 mm to 24 mm square or round;
  - 4 MHz to 5 MHz, 10 mm to 24 mm square or round;
- Dual element straight beam probe:
  - 4 MHz to 5 MHz, 6 mm to 12 mm square or round;

Consumable materials:

- Couplant (machine oil, glycerin, water, etc.);

Calibration Blocks (Standard blocks):

- Step wedge calibration block:
  - 0,100 in to 0,500 in 0,1 increments;
  - 1 mm to 8 mm in 1 mm increments as specified in ISO 16946;
  - Equivalent calibration block according to regional standard 3 mm to 10 mm in 1 mm increments as specified in relevant standards;
- Calibration block:
  - IIW block (steel – type 1 or 2);
  - Calibration block No. 1 according to ISO 2400;

- Equivalent calibration block according to regional standard;

— Calibration block:

- DSC or Mini-angle beam block;
- Calibration block No. 2 according to ISO 7963;
- Equivalent calibration block according to regional standard;

Others (Optional):

— Lab scanner with turntable (any brand)/manipulator tube; 2 degrees of freedom/rollers for back shock;

— Focused immersion probe, 5 MHz to 20 MHz;

— Non-Focused immersion probe, 5 MHz to 20 MHz;

— Portable immersion tank with manipulator (manual or mechanized);

— Resolution block or in range of ASME: resolution block;

UT-TOFD:

— UT-TOFD data collection instrument;

— Computer with software to interact with the UT-TOFD instrument, read the data and evaluate the results;

— UT-TOFD scanner including probe and encoder;

— Transducers with matching wedges to produce centre beam refracted angles;

— Calibration blocks;

— Cables for all parts of the equipment;

UT-PAUT:

— Data collection instruments;

— Computer with software to interact with the UT-PAUT instrument, read the data and evaluate the results;

— Transducer sets for each UT-PAUT instrument with sufficient elements and frequencies;

— Appropriate wedges and adaptors;

— UT-PAUT scanner including probe and encoder;

— Calibration blocks;

— Cables for all parts of the equipment.

b) Radiographic testing (RT):

Equipment (Instruments):

— At least one X-ray tube with a kilovolt range appropriate to the materials to be tested;

— For gamma radiography (where appropriate), an Iridium 192 source, with suitable container and projection mechanism;

— Bunker or X-Ray cabin;

— An X-ray beam centering device;

— Separate darkrooms for film processing and film preparation;

— A manual or automatic processing unit incorporating thermostatically controlled developing tank, stop bath, rinsing, fixing and washing tanks;

— Thermostatically controlled drying cabinet;

— Darkened room with dimmed lights for film or monitor viewing;

Consumable materials:

— Radiographic film;

— Developing chemicals;

Calibration Blocks (Standard blocks):

— Several sets of image quality indicators (IQI) for full thickness range: wire IQIs, hole type IQIs, step/hole type IQIs and duplex wire IQI; wires and hole type IQIs at least for steel and optional for aluminium;

Accessory:

— Lead letters and numbers;

— Blocking-off compounds and/or liquids;

— Copper and lead filters;

— Densitometer;

— Film viewers, including at least one for densities $D > 4$;

— Radiation monitoring equipment as applicable;

— Caliper or other device for measuring material thickness;

— Viewing aids, such as magnifiers;

— Channel and clip type film hangers in the common sizes (manual processing);

— Lead screens in the common sizes;

— Flexible and rigid type cassettes;

— Darkroom timer (manual processing);

— Safelights (RT-F);

— Trimmer to accommodate largest size of films (if required);

— Materials (of lead or tungsten) for masking and collimation;

Others (Optional):

— Step wedge for making exposure curves;

RT-D (Digital Radiography):

— DR system:

  — CR System;

  - DDA System;
- X-ray image intensifier or DDA;
- Monitors for digital image viewing;
- Test image for monitor calibration;
- The monitors for image evaluation shall fulfil minimum requirements, as
  - Minimal brightness of 250 cd/m^2,
  - Display of at least 256 shades of grey,
  - Minimum displayable light intensity ratio of 1:250, and
  - Display of at least 1 million pixels of a pixel size <0,3 mm;
- Personal computers for student;
- Image processing software:
  - Tool to evaluate the digital data of radiographic detectors with linearized grey value (linearized pixel value) representation which is directly proportional to the radiation dose;
  - Tool for determination of SNR, SR_b and SNR_N of linearized grey value representations (or linearized pixel value representations);
  - Interactive adjustment of zoom, pan, contrast and brightness;
  - Histogram tool;
  - Selection of image presentation in positive or negative mode;
  - Look up table correction;
  - Digital filter functions, as high pass, low pass and median filters;
  - Profile plot in free selectable directions and profile line averaging;
  - Tool for measuring and annotation of dimensions and dimensional calibration;
  - Synchronously evaluation of taken digital radiographs and catalogue radiographs;
- Simulation software for virtual lab. training with following functions:
  - Input of different test objects (CAD files);
  - Selection and positioning of image quality indicators, radiation source (selectable parameters);
  - exposure geometry; detectors (DDA, CR, Film);
  - Selection of basic spatial resolution, pixel size, photon and detector noise, efficiency and build up factor; optionally noise calculation by Monte Carlo tool;
- CT tool, if CT belongs to the training;
- Different data formats for input of CAD files, output of digital radiographs as 16-bit image data in TIFF, DICONDE or RAW.

c) Eddy current testing (ET):

Equipment (Instruments):

— Dedicated analogue or digital instruments: at least one of the following for

  — Conductivity measurement,

  — Coatings thickness measurement, and/or

  — Ferrite content measurement;

— General purpose instruments (with impedance plane display):

  — Standard single (adjustable) frequency with either one analogue meter display instrument or a corresponding digital version;

  — Where training is offered for multifrequency heat exchanger tube inspection, one multifrequency, multichannel instrument, suitable for testing of the samples held;

Probes (Sensors):

— Selection of encircling, internal, surface standard probe types, absolute and differentially wound as deemed appropriate for the testing requirements;

— Shielded pencil and spade probes, suitable for testing ferritic and austenitic steels and aluminum alloys;

— Where training incorporates bolt hole testing, one dynamic rotating probe assembly and compatible instrument;

Calibration Blocks (Standard blocks):

— Calibration blocks, appropriate to all probe, instrument and material types as applicable;

Accessory:

— One saturation unit;

Systems:

— Where training is offered for automated/semi-automated testing of tubes (steel, austenitic alloys, copper alloys, titanium), appropriate test equipment (bench, driving mechanism, control unit, ET instrument) together with coils/probes and with reference test pieces containing relevant holes/notches.

d) Magnetic particle testing (MT):

Equipment (Instruments):

— A bench or freestanding transformer with AC or half wave output with a current flow adapter and coil, magnetic flux flow adapter;

— AC/DC ammeter (The effective value display or the peak value display);

— AC/DC electromagnetic yokes with articulated legs and pole pieces;

— Permanent magnets with pole piece adapters suitable for all applications;

— Inspection area or booth equipped with black out facilities for visible and UV(A) viewing of samples;

— Demagnetizing equipment;

— Powder dispensers;

— Portable and/or stationary UV(A) black light lamp having sufficient intensity and strength;

— Various rigid and flexible coils, threaded bars etc.

Consumable materials:

— Supplies of detection media (aerosol and bulk as applicable) including non-fluorescent, fluorescent, dry powder and contrast paint;

Calibration Blocks (Standard blocks):

— Artificially or naturally cracked blocks/specimens for performance checking;

Accessory:

— Independent or combined photometer and radiometer for measuring the intensity of visible and black light;

— Flux measuring and comparison gauges to standard recommendations;

— Centrifuge tube for measuring solid content of magnetic ink;

Others (Optional):

— Ultrasonic cleaner for cleaning specimens;

Magnetic Flux Leakage (MFL):

— Rotating head type flaw detector;

— Fixed head type flaw detector;

— Travelling mechanism with pinch roller, cradle, or others for the test material;

— Electronic device for flaw detector;

— AC/DC power supplier with AC/DC, or half wave output with a current flow adapter;

— Power amplifier for magnetic leakage flux;

— Scanning speed meter to show relative speed between the test material and detector;

— Marker provides paint mark to show detect location on the test material;

— Recorder makes record of analogue/digital output as a testing result;

— printer print-outs the testing result;

— Magnetic transducers (MFL transducers);

— Reference standard includes drill holes, notches and crevasses for the calibration of equipment;

— Flux measurement and comparison gauges to standard recommendation;

— Checking signal generator for operation checking.

e) Penetrant testing (PT):

Equipment (Instruments):

— An effective component cleaning/degreasing facility for thorough cleaning of specimens;

- A penetrant line comprising:
  - Water washable penetrant tank;
  - Post emulsifiable penetrant tank;
  - Emulsifier tank;
  - Water rinsing station with spray nozzle;
  - Drying station;
  - Dust storm cabinet;
- Inspection area or booth equipped with black out facilities for visible and UV(A) viewing of samples;
- Portable and/or stationary UV(A) black light lamp having sufficient intensity and strength;

Consumable materials:

- Aerosol liquid penetrant inspection kits comprising:
  - Penetrant remover/degreaser;
  - Fluorescent penetrant;
- Colour contrast dye penetrant;
- Developer;

Calibration Blocks (Standard blocks):

- Reference test blocks (TAM panel) or other means of process control of penetrant line;

Accessory:

- Independent or combined photometer and radiometer for measuring the intensity of visible and black light.

f) Visual testing (VT):

Equipment (Instruments):

- Surface table (of suitable size for largest measurement);
- V blocks;
- Block mounted pointers/sensors;
- Squares, rules, protractors;
- Micrometers;
- Verniers;
- External callipers;
- Dial reading bore gauge;
- Hand magnifiers (×2, ×5 and ×10);
- Loupes with metric scales no greater than ×7;
- Mirrors of various sizes up to 50 mm diameter with fixed and articulating heads;

— Light sources – penlights, flashlights, customized sources for power endoscope and fiberscope;

— Indirect viewer, borescope, fiberscope and endoscope. Including various direction of viewing (as a minimum);

— forward viewing, 90° viewing, assortment of field of view/depth of field (articulating end, etc.), system with;

— surface and depth measurement capabilities;

— Photometer;

— Weld gauges, weld profiles, surface comparator;

— Optical comparators with variety of reticles;

Others (Optional):

— Examples of Report Software which address the Visual Report criteria identified in applicable national codes and standards. Recording and archiving devices;

— Additional examples of imaging capturing equipment used for remote examinations (telephoto, underwater, low light, high speed, Pan and Tilt camera systems, etc.);

— Remote crawlers with image capturing and retrieval tools.

g) Leak testing (LT):

Equipment (Instruments):

— Compressor;

— Vacuum pump;

— Pressure gauge;

— Vacuum box;

— Illuminometer;

— Ultraviolet lamp;

Calibration Blocks (Standard blocks):

— Calibrated leak calibration block;

— Capillary leak;

Systems:

— Differential pressure decay leak tester;

— Helium leak detector;

— Ultrasonic leak detector.

h) Acoustic emission testing (AT):

Equipment (Instruments):

— Sweep function/variable pulse generator;

— Arbitrary function generator;

— 5 pre-amplifiers, if the sensor have no built-in amplifier;

— AE Multi-channel test equipment (signal conditioning and processing), at minimum 4 channels, with external parameter input;

Probes (Sensors):

— 5 identical sensors with or without pre-amplifier, within a frequency band of 100 kHz to 300 kHz (4 for acquisition and one as transmitter);

Calibration Blocks (Standard blocks):

— Test body for sensor check;

Accessory:

— Test plate;

— Sensor installation (e.g. magnetic-holders);

— Hsu-Nielsen source(s);

— Coupling media;

— Cables.

i) Infrared thermographic testing (TT):

Equipment (Instruments):

— Infrared camera(s) with suitable detector size (minimum 320 pixel × 240 pixel array) and NETD (100 mK or better), adjustability for emissivity, transmissivity and background radiation settings, with suitable wavelengths, adjustable focus lenses for wide angle and telephoto;

Calibration Blocks (Standard blocks):

— Blackbody calibration source;

Accessory:

— Suitable computer for processing thermographic data;

— Air temperature and Humidity meter;

— Digital visual camera;

Others (Optional):

— Heat lamps and active thermographic sources;

— Spot radiometer;

— Various contact type thermometers including a reference thermocouple with digital readout;

— Clamp meter to measure electrical load;

— Hygrometers/moisture detectors;

— Proper personal protective equipment as needed for work with live electrical equipment;

— Blower door mechanisms to pressurize rooms and buildings.

j) Strain gauge testing (ST):

Equipment (Instruments):

— Resistance meter;

— Insulation resistance tester;

— Static strain meter (data logger) with printer;

— Dynamic strain meter;

— Bridge box;

— Digital recorder or other device for recording and printing of dynamic strain;

Probes (Sensors):

— Unaxial strain gauge with two wire system;

— Triaxial strain gauge (Rosette strain gauge) with three wire system;

— Load cell with fixing apparatus;

Calibration Blocks (Standard blocks):

— Test pieces (steel strip, aluminium square tube);

Accessory:

— Adhesive (cyanoacrylate liquid);

— Sandpaper;

— Weights;

— Protractor or other device for measuring angle of strain gauge.

k) Other equipment:

In addition, the following should be provided in adequate quantities (dependent on the number of students):

— Squares, rules, protractors;

— Micrometers;

— Verniers;

— Light sources – penlights, flashlights.

Annex B
(informative)

E-Learning

B.1 ISO 9712 and the use of e-learning

ISO 9712 explicitly allows the use of e-assessment systems for the general and specific examination.

Therefore, e-learning technologies can be utilized if requirements for training as defined in ISO 9712 are fulfilled:

— training fulfils a syllabus (ISO/TS 25107) approved by the certification body;

— the student provides documentary evidence, acceptable to the certification body, that he has satisfactorily completed a course of training;

— training is related to the method and level for which the certification is sought;

— training includes both practical and theoretical elements.

The full replacement of practical training by e-learning is not possible.

B.2 Basic requirements on an e-learning system in NDT

The learning content should be defined in accordance with the training syllabus including monitoring for updates.

The content should be divided into chapters. The average time needed to complete a chapter should be in accordance with the recommendations of ISO/TS 25107. The content has to be adjusted to the learning environment of the platform/webpage.

The e-learning system and its content requires the approval of the certification body.

The system has to support the placement of course materials online and associate students with courses.

The identity, activity and performance of the participant needs to be tracked and stored. Regular checkpoints and the performance based activation of content are tools to support these requirements.

Participants need to have access to communicate with an instructor to gain help, solve problems and answer questions.

Participants who successfully complete the course have to be provided with a personalized document stating their participation.

B.3 Quality assurance for e-learning systems

There are different dimensions of quality in e-learning systems. One dimension is the pedagogical approach of delivering the content in a way that the transfer to the learner is optimized and useable.

The second dimension is the quality of the system. It should be well documented, auditable and updateable. The access to content should be well structured, a rights administration should exist.

The design of the system should follow a common standard of reference model like SCORM (Sharable Content Object Reference Model).

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[1] ISO 9001, *Quality management systems — Requirements*

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