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Non-destructive testing — Performance-based qualification

Essais non destructifs — Qualification sur une base de performances

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

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An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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.

ISO/TS 11774 was prepared by Technical Committee ISO/TC 135, *Non-destructive testing*, Subcommittee SC 7, *Personnel qualification*.

Introduction

Performance demonstration establishes the ability of a specific examination system (i.e. equipment, procedures and personnel) to achieve a desirable level of performance. The pre-established criteria for acceptable performance are based on an industry obtaining desired test results on qualification specimens with or without discontinuities including an established acceptable false call rate using qualified procedures and equipment.

NOTE Wherever gender specific words such as “his”, “her”, “he” or “she” appear in this Technical Specification the other gender is also applicable.

Non-destructive testing — Performance-based qualification

1 Scope

This Technical Specification provides a method for qualification of non-destructive testing (NDT) personnel, procedures, and equipment for specific non-destructive tests conducted in accordance with documented procedures established within a performance-based qualification programme.

Implementation of this Technical Specification requires cooperation between applicable industry sector committees (ISCs) and qualification bodies to ensure that specific performance expectations are addressed.

The qualification methodology described in this Technical Specification is based upon the ability of a candidate to demonstrate capability in detecting and sizing critical discontinuities equivalent to those to be detected and sized in the performance-based qualification programme as established by the ISC.

It is possible that second party (employer-based) qualification and approval (e.g. in accordance with ANSI/ASNT CP-189[3]) or qualification and third party certification (e.g. in accordance with ISO 9712[1] or EN 473[2]), followed by on-the-job training does not provide the required degree of confidence for safety critical inspections, and this Technical Specification provides criteria to assist in preparing an individual for performance-based qualification examinations.

Qualification to this Technical Specification is limited to the specific applications, using the specific documented procedure in the performance-based qualification programme.

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.

ISO/IEC 17024, *Conformity assessment — General requirements for bodies operating certification of persons*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
candidate
individual seeking qualification under a qualification procedure who has satisfied all prerequisites detailed in the qualification document

NOTE The qualification document is a description of the qualification system, including all applicable conditions, agreed between the parties to the qualification.

3.2
certification body
body that administers procedures for certification according to the requirements of this Technical Specification and which fulfils the requirements of ISO/IEC 17024

3.3
employer
legal entity for which the candidate for qualification or the qualified individual works on a regular basis

3.4
essential parameter
parameter of the NDT method, technique, the component, and defects that the test is intended to detect or characterize

3.5
false call
reporting a defect when none exists

3.6
grading unit
section of a qualification specimen

NOTE Grading units can be of unequal lengths and spacing, and either with or without discontinuities.

3.7
industry sector committee
ISC
body comprised of individuals representative of the interests in the inspection to be qualified

3.8
NDT qualification examiner
impartial individual who is certified to NDT level 3 within a scheme recognized by the qualification body, and who is qualified in the specific NDT application

3.9
NDT procedure
written description of all essential parameters and precautions to be applied when non-destructively testing products in accordance with standard(s), code(s) or specification(s)

3.10
performance-based qualification programme
methodology for establishing the ability of a specific qualification system (for equipment, procedures, and personnel) to achieve a required level of performance

3.11
qualification body
independent entity that administers qualification of NDT personnel, NDT equipment and NDT procedures

3.12
qualification certificate
document issued under the rules of a qualification system indicating that adequate confidence is provided that NDT procedures, equipment and personnel or any combination of these are capable, for a specific non-destructive test, of achieving the stated objectives

3.13
qualification procedure
orderly sequence of rules describing how a specific non-destructive test on a specific component is qualified

3.14
qualification specimen
example or a simulation of the component for which the non-destructive test is qualified which, as appropriate, replicates size, geometry, material properties and containing discontinuities to be encountered on site

4 Responsibilities

4.1 Qualification body

A qualification body shall develop and administer the qualification process, in accordance with the qualification procedure, and issue certificates of qualification upon compliance with this Technical Specification and ISC specific requirements.

4.2 Employer

An employer is responsible for authorizing employees to perform NDT for which they are qualified in compliance with this Technical Specification and ISC specific requirements.

4.3 Industry sector committee

An ISC establishes qualification requirements for specific industry applications, and advises the qualification body on all technical and procedural matters concerning the qualification.

5 Qualification of the NDT procedure

To ensure effective and consistent evaluation of personnel, the NDT procedure shall first be qualified in accordance with Annex A. The qualified procedure is valid only when the essential parameters are applied and controlled as defined within the procedure. The procedure qualification shall demonstrate the capability to resolve mandatory detectable discontinuities under representative conditions.

6 Prerequisites for performance-based qualification examinations

6.1 To be permitted to continue with the performance-based qualification examination, the candidate shall fulfil either 6.1.1 or 6.1.2.

6.1.1 The candidate shall provide evidence of current level 2 or 3 certification in the method(s) for which he is to be qualified under this Technical Specification. For NDT level 2 personnel, the certification may be from a nationally recognized employer-based programme or a certification body accepted by the ICS. For NDT level 3 personnel, the certification shall be from a certification body.

6.1.2 The candidate shall satisfy the training and experience established by the ISC in 6.2 and successfully complete written examinations administered by a certification body approved by the ISC. The certification body accepted by the ISC shall confirm conformance with the foregoing.

6.2. Candidates for qualification shall have sufficient training and specific practical experience to ensure they are capable of performing non-destructive tests using the qualified NDT procedure. The experience may be obtained with the use of virtual training systems, or by examining representative specimens, that may be located in a laboratory, with relevant and non-relevant discontinuities that may be located in a laboratory, or analysing recorded data from automatic, digital or analogue systems.

7 Performance-based qualification examination

7.1 Qualification specimens

The ISC shall:

— specify the mandatory detectable discontinuities size and type, in consultation with the regulator, original equipment manufacturer or design authority where appropriate, using applicable codes, standards and engineering principles; and

— confirm that qualification specimens are consistent with the specification.

7.2 Assembly of the specimens

7.2.1 The discontinuities in the specimens that the candidates shall report may be actual or simulated and shall range in size from the minimum detectable using a qualified procedure to not more than the maximum size specified by the ISC in 7.1. The tolerance for reporting discontinuity dimensions by candidates shall be determined by the ISC.

7.2.2 As a minimum, a set of specimens or grading units containing at least 10 discontinuities is required.

7.2.3 The specimen or grading unit sets containing discontinuities for each practical examination shall be assembled from the specimen bank using a random process, while taking reasonable steps to achieve a consistent level of difficulty.

Blank (containing no discontinuities) qualification specimens or grading units shall be included in the specimen set so that no more than one-third of the specimens or grading units in the set contain discontinuities required to be detected. Examples are provided in Table 1.

Table 1 — Numbers of grading units with and without discontinuities

Grading units containing discontinuities	Minimum grading units containing no discontinuities	Minimum total grading units
10 (minimum[a])	20	30
11	22	33
12	24	36
13	26	39
14	28	42
15	30	45

[a] The above grading units may be increased provided the ratio of grading units containing discontinuities to grading units without discontinuities is maintained at 1:2 or less.

7.2.4 The unique identification of specimens or grading units with or without discontinuities shall be masked such that neither can be identified.

7.3 Administration and grading of examinations

7.3.1 The minimum detection and false call rate shall be determined by the ISC.

7.3.2 The qualification body shall be responsible for the administration and grading of examinations and shall appoint the NDT qualification examiner. Provisions to ensure the confidentiality of qualification materials (e.g. qualification specimens and answer sheets) shall be included in the procedures of the qualification body. Access to such qualification materials shall be limited, and the qualification examinations shall be maintained in secure files.

7.3.3 Candidates failing initially are allowed to be re-examined. Candidates failing re-examination shall receive additional documented training and experience as determined by the ISC before further re-examination. For all re-examinations, the candidate shall be presented with at least 50 % new discontinuities.

8 Post-qualification requirements

8.1 Continuing practice

Once qualified, NDT personnel shall practice NDT applicable to the scope of the qualification held with sufficient frequency as determined by the employer. This may be achieved by examining real or virtual parts similar to those used in the performance-based qualification programme. Continuing practice shall be supervised and documented by an NDT level 3 as a prerequisite to periodic performance demonstration.

8.2 Periodic performance demonstration

8.2.1 The frequency and content of periodic performance demonstration shall be determined by the ISC. Periodic performance demonstrations shall be conducted under the direct control of the ISC on specimens provided by the qualification body.

8.2.2 The candidate shall test a minimum of two grading units containing discontinuities, plus one or more grading units without discontinuities, detecting and characterizing all mandatory detectable discontinuities in accordance with the qualification procedure. An NDT level 3 in the respective test method, appointed by the ISC, shall supervise and grade the performance demonstration. The NDT level 3 shall also verify the individual has maintained a vision examination as required in Clause 10, under the candidates current NDT level 2 or 3 certification. The NDT level 3 shall also verify the current certification.

8.2.3 If the candidate is unsuccessful, Clause 7 applies with the NDT level 3 selecting a similar number of discontinuities to be detected and accurately sized accordingly.

9 Validity

Qualification shall be invalid under the following conditions:

a) if the prerequisite certification becomes invalid;

b) where performance is determined to be deficient as indicated by the periodic performance demonstration;

c) when the performance demonstration interval exceeds 12 months (see Note);

d) as determined by the qualifying body after consultation with the ISC.

A full performance-based qualification examination conducted in accordance with Clause 7 is required if the original qualification becomes invalid, except as noted below.

NOTE If the performance demonstration interval exceeds 12 months but is less than 24 months, the qualification can be reinstated following a successful performance demonstration.

10 Records and documentation

The qualification body is responsible for maintaining the qualification record, which shall include at least the following information:

a) identification and contact information of candidate;

b) copy of the certificate of qualification;

c) unique reference number of all specimens tested;

d) graded NDT reports produced by the candidate;

e) dates of qualification and periodic performance demonstrations;

f) signature, printed name, and title of the qualification body's certifying representative;

g) evidence that, at initial qualification and annual performance demonstration, both the vision and NDT certification are valid;

h) a copy of the candidate's record of continuing practice;

i) the inspection procedure to which the inspector is qualified.

Annex A
(normative)

Non-destructive testing procedure qualification

A.1 Status of this annex

This annex is generic; it can be adapted to the application of any particular NDT method to virtually any product or industry sector.

A.2 Non-destructive testing procedure confirmation

Procedure qualification shall be used to confirm that the NDT procedure provides reliable and repeatable results so that it removes the procedure as a variable in evaluating personnel performance.

A.3 Qualification steps

Table A.1 indicates the steps which shall be taken to qualify NDT procedures. It does not necessarily indicate the order in which the steps are taken.

Table A.1 — Steps to qualification of NDT procedures

Prior to qualification	Reference	Responsibility
Make available all required input information concerning component, defects, inspection and qualification objectives	A.4	Design authority/plant owner/plant operator
During qualification	**Reference**	**Responsibility**
Qualify the NDT procedure using open trials for NDT procedures	A.5, A.6	Qualification body
Issue/refuse qualification certificate for procedure	A.7.3	Qualification body
Compile and finalize procedure qualification dossier	A.7.2	Qualification body
Following qualification	**Reference**	**Responsibility**
Maintain qualification dossier	A.7.2	Qualification body

A.4 Input information

Prior to the start of NDT qualification, all necessary input information for the qualification has to be made available. This information is typically:

— objectives of the qualification exercise;

— full description and condition of the component to be non-destructively tested;

— site conditions/environmental considerations, constraints and limitations;

— type and dimension, position and orientation, of discontinuities to be detected and/or sized, depending on the situation considered;

— the non-destructive test performance (detection, sizing and location) to be achieved;

— the NDT technique, equipment and personnel requirements.

A.5 Qualification methodology

A.5.1 The NDT procedure, NDT equipment and test specimens shall be qualified by open trials using qualification specimens as defined in 7.1.

A.5.2 Where an item of the equipment falls within the scope of a national or international standard (which specifies qualification requirements) or other written specification, the qualification shall include, where appropriate:

— a paper study to determine the relevance of the standard or specifications to the specific case;

— proof of compliance with the standard(s).

Where an item of the equipment does not fall within the scope of an appropriate standard or specification, or the ISC does not want to use existing standards or specifications, or the ISC has the option of setting aside the requirements of existing standards or specification, the qualification shall include open trials or other experimental tests designed to measure the essential parameters identified during the analysis of parameters that could influence the test. In this case, the NDT procedure shall identify the essential parameters and shall specify allowable values and tolerances.

A.6 Open trials

A.6.1 Personnel carrying out testing in open trials for procedure qualification, who are subsequently candidates for qualification, shall test different specimens in their qualification examination(s).

A.6.2 The NDT procedure shall consider all aspects such as the techniques, equipment, decision steps used and personnel. This typically includes:

— the description of the NDT equipment (including software used);

— NDT techniques;

— calibration requirements;

— the list of essential parameters;

— the range of variation acceptable for these parameters;

— non-destructive test personnel requirements;

— instrument settings;

— scanning method and sensitivity;

— reporting level and acceptance standard;

— decision process to interpret the indications;

— documentation requirements;

— limitations imposed by site conditions (normally defined in input information), e.g. access, environment, time constraints;

— material types, geometries, size ranges, etc.

A.6.3 NDT procedures in which the decision steps are not specified in full detail are not suitable for qualification, because the performance could depend excessively on the experience of the evaluating NDT personnel.

A.6.4 In the NDT procedure, all the decision steps related to combination and interpretation of the results of the different techniques allowing personnel to arrive at the final result shall be written down in a clear, logical and traceable manner. This minimizes the extent that the results depend on the experience of the evaluating NDT personnel.

A.6.5 The essential parameters in the NDT procedures developed to qualify NDT personnel shall be identical to those used in service.

A.6.6 The qualification specimens used, and the discontinuities contained within them, shall be from the specimen bank that is to be used to qualify personnel, and shall replicate the actual components that the qualified personnel are to test in service.

A.7 Responsibilities of the parties involved

A.7.1 Agreement

The responsibilities for NDT and NDT qualification, respectively, shall be the subject of an agreement between interested parties prior to qualification commencing. This includes identification of the qualification body.

When safety issues are involved the interested parties may include a regulatory body.

A.7.2 Qualification body

The responsibility of the qualification body in this text refers to the NDT procedure and to the personnel in the cases where they are involved in the qualification.

The qualification body has the following responsibilities:

— preparation of the qualification procedure;

— assessment of the NDT procedure;

— identification or design of any qualification test pieces and their fabrication;

— supervision of the qualification trials;

— assessment of the qualification results;

— assembling and storage of the final qualification dossier (or associated summary of technical evidence);

— issuing qualification certificates;

— maintaining and updating the qualification dossier.

A.7.3 Procedure qualification certificates

A.7.3.1 Where qualification has been successful, the qualification body issues a certificate (or other form of document) to those responsible for the NDT, which identifies the NDT procedure which was qualified and the criteria used for assessment. Where qualification was not successful, the qualification body shall issue a document recording reasons for failure and stating the conditions for a further attempt at qualification.

A.7.3.2 Qualification certificates for procedures are valid indefinitely unless changes are made to the procedures or to any code whose requirements have to be met. If, following changes to the procedure or input information, the ISC wishes to extend the qualification certificate, the qualification body shall seek technical information from the ISC to justify extension. Only if satisfied that the changes have not invalidated the certificate should the qualification body extend the certificate to the new circumstances. If not satisfied, the qualification body shall identify the further checks it believes to be necessary and make proposals to the ISC for these to be carried out as a condition of extending the certificate.

A.7.3.3 The qualification body shall be informed of any change to the procedure in order to allow updating of the qualification dossier.

A.7.3.4 When changes are needed to meet updated code requirements, the ISC shall specify any changes, and a timetable for implementation, to the qualification body.

Bibliography

[1] ISO 9712, *Non-destructive testing — Qualification and certification of NDT personnel — General principles*

[2] EN 473, *Non-destructive testing — Qualification and certification of NDT personnel — General principles*

[3] ANSI/ASNT CP-189, *American National Standard for Qualification and Certification of Non-destructive Testing Personnel*

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