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## Quality Assurance Documents

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### SCHEME MANUAL EN 4179:2017 -NANDTB Qualification & Certification of NDT Personnel engaged in Aerospace Industries

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## Singapore National Aerospace NDT Board, NDTSS-NANDTB-Scheme Document

### 1.0 INTRODUCTION

The NDTSS-NANDTB has adopted **EN 4179:2017/ NAS 410 Rev 4** as the Standard for the qualification and approval of NDT personnel in the aerospace industry. The Singapore national aerospace board supplement this manual to the operating procedure NDTSS-OM-003. Employers applying these standards sometimes may not be sure how certain clauses should be implemented. The following document is the interpretation of EN4179:2017 adopted by the NANDTB. Much of the standard is clear and easily understood, and so is not reproduced here, only those parts from the standard for which the Board offers guidance appear below, the clauses used in this document are the exact clauses of EN4179:2017 for ease of reference.

### 1.1 PURPOSE:

This document establishes the minimum requirements for the qualification and certification of personnel performing non-destructive testing (NDT), non-destructive inspection (NDI), or non-destructive evaluation (NDE) in the aerospace manufacturing, service, maintenance and overhaul industries. For the purposes of this document, the term NDT will be used and will be considered equivalent to NDI and NDE.

The term “approval” is used to denote a written statement by an employer that an individual has met specific requirements and has operating approval. Prior to issuance of approval Certification accredited in accordance with EN ISO 17024 is required by this document.

The term “certification” as defined in paragraph 3.1 is used throughout this document as a substitute for the term “approval”. Except when otherwise specified in the written practice, certification in accordance with this document includes operating approval.

The interpretation of the words certification and approval is a source of confusion. An individual may or may not hold third party certification in NDT such as EN ISO 9712 or ASNT issued by accredited certification body yet qualify for approval by an employer under this document. National certification schemes such as SGNDT, AINDT, PCN and COFREND offer a certification which is a portable testimony that an individual has achieved a document of knowledge and competence in NDT. The approval granted by an employer under its own written practice in accordance with NAS 410 or EN 4179 documents is not portable, but it should be taken into consideration by the new employer when determining the suitability of a person for NDT approval. Hopefully not adding confusion, however it is possible under an employer’s written practice, that the employer makes NDT certification to the national certification scheme a prerequisite to granting a company NDT approval (E.g. Industry Sector to Aerospace by ISO 9712:2012).

### 1.2 APPLICABILITY:

This document applies to personnel using NDT methods to test and/or accept materials, products, components, assemblies or sub-assemblies. This document also applies to personnel directly responsible for the technical adequacy of the NDT methods used, who write NDT procedures and/or work instructions, who audit NDT facilities, or who provide technical NDT support or training. This document does not apply to individuals who only have administrative or supervisory authority over NDT personnel or to research personnel developing NDT technology for subsequent implementation



and approval by a certified Level 3. Personnel performing specialized inspections using certain direct readout instruments as determined by a Level 3 certified in the method, do not require qualification or certification to this document.

The applicability statement is reasonably clear, however the “specialized inspections referred to with direct readout instruments could be electrical conductivity or ultrasonic thickness measurement or similar. The Level 3 takes the responsibility to ensure training, experience and assessment for these inspections is adequate for the employer’s requirements.

Also, these specialized inspections do not require personnel approval (certification by this document). However, an employer is free to approved these individuals in accordance with it written practice.

1.2.1 IMPLEMENTATION: This document addresses the use of a Singapore National Aerospace NDT Board (NANDTB) Scheme. Personnel certified to previous revisions of NAS 410 or EN 4179 need not recertify to the requirements of this document until their current certification expires.

1.3 COMMON METHODS: This document contains detailed requirements for the following common NDT methods:

Liquid penetrant (PT)

Magnetic particle (MT)

Eddy current (ET)

Ultrasonic (UT)

Radiography (RT)

Thermography (IRT)

Shearography (ST)

1.3.1 OTHER METHODS: When invoked by engineering, quality, cognizant engineering organization or prime contractor requirements, this document applies to other current and emerging NDT methods used to determine the acceptability or suitability for intended service of a material, part, component, sub-assembly or assembly. Such methods may include, but are not limited to, acoustic emission, neutron radiography, leak testing and holography. The requirements for personnel training, experience, and examination for these other methods shall be established in accordance with paragraph 6.4 and shall be documented by the employer.

The introduction of new NDT methods is when the resources of a NANDTB would be most useful to an employer.

## **2.2 ORDER OF PRECEDENCE:**

In the event of a conflict between the text of this document and the references cited herein, the requirements of this document take precedence. Nothing in this document supersedes applicable laws and regulations unless a specific exemption has been obtained. The clauses here in after follow the clauses of EN 4179:2017.



The specific exemption may be required from a regulator, prime contractor or customer, and should be in writing in clear and unambiguous terms.

### **3.0 DEFINITIONS AS APPLIED TO THIS DOCUMENT**

**3.1 CERTIFICATION:** A written statement by an employer that an individual has met the applicable requirements of this document. This document uses the word “certification” as equivalent to “approval”. The certificate shall be registered with NDTSS- NANDTB database.

**3.7 EMPLOYER:** A government, prime contractor, sub-contractor, supplier, or outside agency employing or contracting the services of one or more individuals who perform NDT.

Self-employed individuals are included in this definition.

In the case of self-employed, it should be noted that clause 7.2 states that an examination may not be administered to one’s self, or by a subordinate. In this case the written practice should describe the way examinations are administered.

**3.10 EXAMINER:** A Level 3 certified to this document and designated by the Responsible Level 3 or NANDTB to administer all or part of the qualification and certification process, excluding vision examinations, in the NDT method(s) in which the Examiner is certified. The examiner need not be the person who invigilates the examination, but rather the person who grades the examination.

**3.19 SINGAPORE NATIONAL AEROSPACE NDT BOARD (NANDTB):** An independent national aerospace organization representing a nation’s aerospace industry that is chartered by the participating prime contractors and recognized by the nation’s regulatory agencies to provide or support NDT qualification, examination, and/or certification services in accordance with this document. The NANDTB is the scheme committee of NDTSS

Unless the NANDTB complies with all the requirements of this definition, such as having a charter, demonstrable independence and industry representation, and recognition by the Civil Aviation Authority Singapore, it may not operate as the NANDTB in accordance with this document. The Singapore NANDTB complies with all the requirements of this clause.

**3.28 QUALIFICATION:** The skills, training, knowledge, examinations, experience and visual capability required for personnel to properly perform to a particular level.

The usual use of “qualification” may not include the experience or visual capability, however all the elements shown in this definition must be achieved by an NDT technician before he/she may be considered as qualified.

**3.29 RESPONSIBLE LEVEL 3:** A Level 3 designated by the employer with the responsibility and authority to ensure that the requirements of this document are met and to act on behalf of the employer.

An employer may have more than one Level 3, such as when NDT is conducted at several dispersed sites. However, this document requires that one qualified Level 3 is to be nominated as responsible for the overall NDT operational quality.

**3.30 SPECIFIC EXAMINATION:** A written examination to determine an individual’s understanding of operating procedures, codes, documents, product technology, test techniques, equipment and specifications for an NDT method as used by the employer.

Recent changes have made the specific examination open book style. Organizations which have past examinations based on closed book style should review these to ensure the questions are suitable for open book examination. That is, that they require the candidate to source, interpret and apply the information, rather than only know its location.

#### **4.0 GENERAL REQUIREMENTS APPLICABLE TO EN 4179:2017**

**4.1 WRITTEN PRACTICE:** The employer shall develop and maintain a written practice for the qualification and certification of their NDT personnel that meets the requirements of this document. The written practice shall address the procedural details necessary for the employer to implement an NDT qualification and certification program and shall include, either directly or by reference, the details of the NDT qualification and certification process, including:

- the levels of qualification and certification used by the employer
- personnel duties and responsibilities
- training and experience requirements
- certification and recertification requirements
- records and record keeping requirements
- requirements for expiration, suspension, revocation and reinstatement of certifications

The employer's written practice may reference this document in whole or in part to meet these requirements provided the written practice includes the requirements in paragraphs 4.1.1 through 4.1.6. The written practice shall be approved by the Responsible Level 3.

The written practice and applicable NANDTB procedures shall be available for review by the employer's customer(s) and regulatory agencies. The written practice need not be a large document. It may be stand alone or incorporated into the employer's quality, training or approval procedures.

**4.1.2 NDT TECHNIQUES:** The written practice shall include the specific technique(s) within each method and the actions to be taken concerning additional training and experience, as well as the written and practical testing, when additional techniques are introduced for a currently certified individual as defined by the employer or NANDTB.

From the definitions section a technique is a category within a method; for example, ultrasonic immersion testing or ultrasonic testing of composites. The document requires that they be differentiated.

**4.1.3 TRAINING OUTLINES:** The written practice shall reference or include the NDT training outlines used by the employer. The amount of time to be spent on each subject area shall be documented. If an outside agency or NANDTB is used to provide training, the Responsible Level 3 shall verify that the training meets the employer's requirements. It may be sufficient to specify an existing training outline such as from a national NDT training curriculum. However for specialised or limited scope NDT work the training outline may be only the relevant parts of these.

**4.1.4 EXAMINATION PRACTICES:** The written practice shall include the designation of the individual(s) or organization(s) responsible for administering examinations, the number of examination

questions to be administered, and the specific visual acuity examination method to be used. If required, the use of a general examination for recertification shall be documented in the written practice.

One way to show these details would be to refer directly to NDTSS NANDTB Scheme which approve examination centres and administer examinations.

#### **4.1.5 ADMINISTRATION:**

The written practice shall include the identification of the individual(s) or organization(s) responsible for administering and maintaining all or part of the employer's certification program.

The Responsible Level 3 would be identified here because he/she has a central role. Others within the company such as training or quality managers may also have responsibilities.

#### **4.4.1 RESPONSIBLE LEVEL 3:**

The employer shall identify in writing a "Responsible Level 3" to act on its behalf in matters regarding the NDT qualification and certification process.

The Responsible Level 3 shall be certified in accordance with this document as a Level 3 or EN4179:2017 from other Certification bodies accredited in accordance with ISO/IEC 17024 in one or more NDT methods and shall have a thorough knowledge of the written instructions, codes, specifications and documents used by the employer. He/she shall also have a thorough knowledge of the materials, components, product technologies, NDT methods and NDT techniques used by the employer.

Additional Level 3 Examiners as defined in this document may be identified and delegated in writing as necessary to provide coverage for all methods used by the employer. The Responsible Level 3 may be an outside agency but in this case he/she can only qualify personnel, as only the employer can certify personnel.

Notwithstanding a Level 3 attesting to the qualification(s) of an individual, the employer must implement a process of acceptance of that qualification and any other requirements such as relevant experience, before approving (ie certifying by this document) the person to operate.

#### **4.4.2 NANDTB Administration Process:**

When an Singapore NANDTB scheme (OM-003) is used, it shall oversee procedures for qualification and certification of NDT personnel in accordance with the requirements of this document. It is entitled, in conjunction with the employer, to recognize equivalencies of qualification and certification, and may be requested to provide general guidelines in accordance with this document regarding facilities for NDT training, course outlines, examination questions and examination procedures.

The NANDTB is a resource for employers and they are encouraged to seek its guidance when necessary.

The procedure clearly defines what role and tasks, as applicable, are to be performed by the Responsible Level 3. The employer shall designate a Responsible Level 3 in accordance with paragraph 4.4.1. The Responsible Level 3 is designated by the employer to ensure the requirements of this document are met and to act on behalf of the employer for those tasks designated here-in for the Responsible Level 3.

NANDTBs described in this document apply solely to boards meeting the definition of paragraph 3.19 of the procedure. Other agencies performing examination, qualification and/or training activities shall be considered outside agencies as defined in paragraph 3.24.



## 5.1 LEVELS OF QUALIFICATION AND CERTIFICATION:

The four basic levels of certification are Level 1-Limited, Level 1, Level 2 and Level 3. The employer may subdivide, add or limit levels as appropriate, but cannot eliminate or reduce the minimum requirements for each level. If the employer does not wish to use all of the following levels, those levels to be used shall be documented in the employer's written practice. Where other variations or subdivisions are implemented, the requirements and responsibilities shall also be detailed in the employer's written practice. NDT personnel shall not independently perform the functions listed in 5.1.2, 5.1.3, 5.1.4 and 5.1.5 if not certified to the appropriate level in the applicable technique/method.

It is important to note that the employer may subdivide or add to the approval level (certification by this document). This gives flexibility but does not remove the responsibility to ensure that the NDT levels used meet customer or regulatory requirements, and that the NDT personnel have the correct level of skill and knowledge to perform the work.

5.1.4 LEVEL 2: In the method in which certified, Level 2 individuals shall:

- have the skills and knowledge to set up and documented equipment, process parts, interpret and evaluate for acceptance or rejection, and document results.
- be thoroughly familiar with the scope and limitations of the technique/method.
- have the skills and knowledge to conduct system performance checks in accordance with the applicable process document.
- be capable of providing the necessary guidance and/or supervision to trainees and Level 1 personnel.
- be familiar with the codes, documents, and other contractual documents that control the method as used by the employer.
- when specified in the written practice, be capable of developing work instructions from approved general procedures. Such work instructions shall require final approval by a Level 3 certified in the method.
- have a basic knowledge of relevant product manufacturing and inspection technology.
- when specified in the written practice, have a basic knowledge of aircraft or

vehicle maintenance. It is becoming more common for inspection data to require Level 2 qualifications to perform tests. In circumstances where the scope of the Level 2 NDT work is limited to only a few parts or a particular technique, the employer is permitted to apply clause 5.1. The prescription of Level 2 qualification for some tests is an indication that the work is significantly complex that it exceeds Level 1 or Level 1 "Limited" training. The use of Level 2

"Limited" implies that the full theoretical training and assessment is undertaken, however due to the restricted scope of the work, the person would be unlikely to fully achieve the required experience in the first instance, or for ongoing competence in all the aspects of the NDT method.

Accordingly, following general qualification to Level 2, the Responsible Level 3 would be permitted to determine the amount of practical experience and assessment criteria for a Level 2 "Limited" approval to perform the work.



### 5.1.6 AUDITOR:

Personnel performing external supplier technical NDT audits, surveys or assessments shall have the education, training, skills and knowledge to understand the processes and procedures utilized in the application of NDT processes. The individual shall be familiar with the applicable codes, documents, and other contractual documents that control the applicable method(s). An understanding of audit principles and processors would also be required. All NANDTB auditors shall be approved and shall be maintained in the list of auditors

## 6.1 TRAINING

Training hours shall fulfil Table I or Table 1A as applicable.

### 6.1.1 TRAINING OUTLINES:

All training shall be conducted in accordance with a detailed course outline approved by the Responsible Level 3 and such outlines shall be reviewed during NANDTB audit for internal or outside agencies. The outline shall include a list of references from which the training material is derived. As a minimum the training shall include:

- Basic theory
- Test principles, including choice of NDT methods, relevance to different materials and part and test variables
- Product forms and materials; defect formation and characterization
- Equipment operation and documentation
- The importance of process controls
- The importance of appropriate processing steps and parameters
- Safety
- Applicable techniques and the advantages and disadvantages of each
- Limitations and capabilities of each method and technique
- Applicable specifications, codes, operating procedures and work instructions
- If applicable, evaluation, interpretation and documentation of inspection

results.

If an outside agency is used to provide training, the Responsible Level 3 shall verify that the training provided by them meets the employer's requirements.

There are a range of existing training outlines available, such as NDTSS and other national NDT organizations, documents, regulators, industry associations and training bodies. The NANDTB has a listing of acceptable training outlines. safety, and applicable codes, documents and specifications.



### **6.1.2 EQUIVALENT TRAINING:**

For personnel previously certified under NAS 410, EN 4179 or other recognized NDT qualification program, the adequacy and equivalency of their previous training to the requirements of Table I or IA shall be determined and documented by the Responsible Level 3.

The NANDTB develop a listing of acceptable equivalent training programs as a guideline.

### **6.2 TRAINING AND EXAMINATION PERSONNEL:**

The NANDTB shall maintain the list of responsible level 3, examiners, internal agencies and outside agencies. The NANDTB has procedures for assessment of training and examination providers (outside & internal agencies).

### **6.3 EXPERIENCE:**

Candidates for certification to Level 1-Limited, Level 1, Level 2 or Level 3 shall have sufficient practical experience to assure that they are capable of performing the duties of the level for which certification is sought. The minimum experience requirements for Levels 1 and 2 are provided in Table II and Table IIA as applicable.

The requirements for Level 3 are in Table III and paragraph 6.4.2, as applicable. Experience requirements for Level 1-Limited shall be determined and documented by the Responsible Level 3, but shall not be less than 10% of those required for Level 1 in the applicable method. As documented in the written practice, on-the job training for the purpose of gaining experience shall be conducted by personnel certified in accordance with this document.

#### **6.4.1 LEVELS 1 AND 2:**

When determining training or experience hours for new methods not listed in Tables I and II, the minimum hours shall be based on the requirements for a method of similar complexity listed in Table I and II. This only applies to “other” or emerging methods as defined in paragraph 1.3.1 and cannot be applied to penetrant, magnetic particle, ultrasonic, radiography, thermography, shearography or eddy current testing. There may be tests such as ACFM or other techniques which are derivations of a document NDT method. In such cases any previous NDT training may be relevant (or required) and would be factored into determining the training and experience requirements.

#### **TABLE V: VISION REQUIREMENTS**

##### **Examination Requirements**

Near Vision Options in accordance to Table V shall be used and confirmed for at least one eye, natural or corrected.

Colour Perception Personnel shall be capable of adequately distinguishing and differentiating colours used in the process involved. Equivalency to be determined by the Responsible Level 3. Caution should be taken when determining visual acuity equivalence. It would be recommended that a specialist in vision testing be consulted.

**7.1.2 GENERAL:**

The general examination for all levels shall be a closed book examination covering the cross-section of the applicable method at the appropriate level. A minimum of 10 questions shall be administered for the general examination for Level 1-Limited. A minimum of 40 questions shall be administered for the general examination at Levels 1, 2 or 3. For Level 3, the general examination questions shall address the general knowledge of other methods used by the employer as well as the method for which certification is sought. Passing a “basic” examination covering the other NDT methods used before passing any NDT method examination shall be considered satisfactory evidence the other NDT methods have been satisfactorily covered. Possession of a current SGNDT, ASNT, ISO 9712 NDT certificate at the appropriate level by the candidate may be satisfactory evidence that the general examination requirement is satisfied as defined in the employer’s written practice.

The General examination QB is managed & provided by NANDTB for Approved Outside Agencies. Inside Agencies or Employers shall send their initial candidate directly to NDTSS or Outside Agencies to take the general examinations.

**7.1.3 SPECIFIC:** The specific examination for all levels shall be an open book examination covering the requirements and use of the specifications, codes, equipment, operating procedures and test techniques the candidate may use in the performance of his/her duties with the employer. A minimum of 8 questions shall be administered for the specific examination for Level 1-Limited. A minimum of 30 questions shall be administered for the specific examination at Levels 1, 2, and 3. Reference material such as specifications, tables, formulas, etc. may be provided as determined by the Responsible Level 3 or Examiner. Questions utilizing such material shall require understanding of the information contained therein rather than merely finding its location. Questions banks would be approved during the IA audit process. Examination questions shall not be used for any training purposes. Examination shall be administered by independent person other than the trainer for the candidate.

**NOTE:** Where an NANDTB OA is used, the specific examination may cover a wider scope within the method used within the aerospace industry and may use examinations which cover more than the employer’s requirements. When a wider scope is used the employer is responsible for administering a supplemental examination representative of the employer’s process.

**7.2.1 ADMINISTRATION BY AN OUTSIDE AGENCY:**

When an outside agency is used to administer examinations, the employer shall ensure that all individuals involved in the administration of the examinations meet the requirements of this document. In all cases, the ultimate responsibility for compliance to this document shall remain with the employer. It is important that the employer has to ensure that an outside agency is approved, qualified and resourced to undertake the examination of its employees. It is not acceptable for the employer to accept an outside agency without applying due diligence.

**7.2.3 RE-EXAMINATION:**

Candidates failing any general, specific or practical examination shall receive additional training before attempting re-examination of the failed exam. The additional training shall be documented and shall address those areas found deficient in the candidate’s skills or knowledge. The re-examination shall not use the same written tests or test samples that were used in the initial examination. The re-examination test must contain a minimum of 25% new questions.



Additional training may be targeted self-study, OJT or face to face as determined by the Responsible Level 3. A current certification shall be suspended if an individual fails an examination for recertification.

## 8. CERTIFICATION

8.1 GENERAL: Personnel who have demonstrated that they possess the appropriate qualifications are eligible for certification by their employer in accordance with the employer's written practice. All certifications issued through SNANDT shall be registered within the scheme. Certification is not required for trainees, instructors, NDT auditors, or personnel performing specialized inspections using direct readout instruments. Employers are free to approve (certify by this document) any of the roles shown above in accordance with its written practice. Some regulators may require it, and employers need to be aware of such compliance requirements.

8.2 RECORDS. The employer shall maintain personnel certification records as long as the certification is in effect. The records maintained by the employer shall include, as a minimum:

- a. Name of the certified individual.
- b. Level, method, and technique(s) for which individual is certified.
- c. The latest written and practical examinations and the scores from the immediately previous exams.
- d. If Annex A is used, documentation of credit points used for Level 3 recertification.
- e. Date and expiration of current certification(s).
- f. NDT training history that identifies the source, type of training, dates of training and course hours, and, if applicable, the documentation required by paragraphs 6.1.2 and 6.1.3
- g. NDT experience history, including any previous certifications, both with current and previous employers sufficient to justify satisfaction of experience requirements for qualification, and, if applicable, the documentation required by paragraphs 6.3.1 and 6.3.2
- h. Results of the most-recent (i.e. current) visual acuity and color perception examinations.
- i. Extent and documentation of formal education when used to meet qualification requirements.
- j. The name and signature of the employer's representative authorizing the certification.
- k. For Level 1-Limited certifications, the case-by-case justification, the cognizant engineering organization's approval, the training and experience hours, the length of the certification (up to 1 year), the specific NDT test to be performed, the specific hardware to be tested, and, if applicable, the approval to accept reject hardware.

Regulators may have more stringent record requirements, and employers need to be aware of such compliance requirements.

8.3 LOSS OF CERTIFICATION: NDT certifications may expire, be suspended, or be revoked.

8.3.1 EXPIRATION: Certifications for all levels shall expire when the certification interval has

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lapsed with no recertification issued. Certification for all levels is considered to expire at the end of the corresponding month in which the certification began.

**8.3.2 SUSPENSION:** Certification shall be suspended when employment is terminated, the visual acuity examination is overdue, the individual does not perform in the method certified for at least 12 consecutive months, or when the individual's performance is found to be deficient in any manner.

**8.3.3 REVOCATION:** Certification shall be revoked when the individual does not perform in the certified method for the employer for at least 24 consecutive months or when the individual's conduct is found to be unethical or incompetent.

These issues are important to employees, and it would be helpful if the employer's written practice was clear about the conditions which result in a suspension of an employee's NDT approval (certification by this document).

**8.5 RECERTIFICATION:** Personnel are eligible for recertification as follows:

**8.5.1 LEVEL 1-LIMITED, LEVEL 1 AND LEVEL 2:** Level 1-Limited personnel shall be recertified for each certification held at intervals not to exceed one year. Level 1 and 2 personnel certified to this document shall be recertified at intervals not to exceed five years.

Recertification shall be accomplished by successful completion of practical and specific examinations equivalent to those required for initial certification.