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QUALIFICATION AND CERTIFICATION OF NDT PERSONNEL

CODE: RO-NANDTB 02

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RECORD CHANGES			
No.	Edition / Revision	Name, Signature Changed by:	Date

1. DOMAIN

This procedure applies to the qualification in authorized CIE (Training and Examination Centre) of non-destructive examination personnel performing in the aeronautical industry by proficiency levels (Level 1, 2 or 3).

2. SCOPE

2.1 According to this procedure, RO-NANDTB as an organization representing the national aeronautics industry in the field of NDT:

-organizes and conducts examination sessions in authorized for NDT Level 3 personnel;
-authorize Outside and/or Inside Organisations for NDT personnel Training and Examination;
-may participate as an observer at the training and examination sessions for NDT Level 1 and 2 personnel organised by authorized CIE;
-recognizes the qualifications / authorizations of NDT Level 1, 2 and 3 personnel, conducted in training and examination centers accreditated by the NANDTB's recognized by the Aerospace NDT Forum.

2.2 NDT personnel performing non-destructive examinations in the aeronautical industry and who, at the date of entry into force of this procedure, is holding a valid authorization certificate issued by AACR under the RACR-NDT, maintain that authorization until its expiry date.

2.3 This procedure applies to personnel using NDT methods to test and / or accept materials, products, components, assemblies or subassemblies for both production and maintenance. The procedure applies to the personnel directly responsible for the technical adequacy of the NDT methods used, staff approving instructions and / or work procedures, auditing facilities, or providing NDT technical support or training.

2.4 The procedure does not apply to persons who have only administrative authority, NDT staff surveillance authority or NDT staff working on the development of NDT technologies for further implementation and to be approved by authorised Level 3 personnel.

3. REFERENCE DOCUMENTS

EN-4179	Aerospaces series. Qualification and approval of personnel for non-destructive testing
NAS-410	NAS certification and qualification of non-destructive test personnel, standard practice
ANDTBF-08	Organisation, Duties and Responsibilities of NANDTB's as members of ANDTBF
ANDTBF-10	General Knowledge of other methods as required by EN-4179
RO-NANDTB 01	Controlul documentelor
RO-NANDTB 03	Arhivare documente
RO-NANDTB 04	Autorizarea centrelor de instruire şi examinare personal NDT
RO-NANDTB 05	Auditarea CIE

4. DEFINITIONS AND ABBREVIATIONS

4.1. DEFINITIONS

Basic Examination: a written examination for authorization on Level 3, demonstrating the candidate's knowledge of material science, material development and processing technology, types of material discontinuities, and basic principles of NDT methods.

Candidate: a person requesting authorization under this procedure and working in the field of non-destructive examinations under the supervision of a certified NDT personnel, in order to gain the necessary experience to support the authorization exam.

Certification: Written declaration given by the employer that a person has met the requirements of EN-4179 / NAS-410.

Closed book examination: An examination administered without access to any reference materials.

Direct observation: Direct observation is when the observer is able to come to the immediate aid of the trainee and remains within a distance that permits uninterrupted, unaided visual and verbal contact with the trainee.

Employer: An organization employing or contracting the services of one or more individuals who perform NDT. Self-employed individuals are included in this definition.

Evaluation: A review following interpretation of the indications noted during an NDT inspection to determine whether the indications meet specified acceptance criteria or to determine the significance of the indication.

Examination: Formal, controlled, documented testing conducted in accordance with a documented written practice to verify a candidate's visual capability, skill or knowledge of an NDT method.

Examiner: A Level 3 certified to EN-4179 standard and designated by the Responsible Level 3 to administer all or part of the qualification process in the NDT method(s) in which the Examiner is certified.

Experience: Actual performance of an NDT method conducted in the work environment resulting in the acquisition of knowledge and skill. This does not include formal classroom training, but may include laboratory and on-the-job training as defined by the employer's written practice.

Formal training: An organized and documented program of learning activities designed to impart the knowledge and skills necessary to be qualified to EN-4179 / NAS-410 standard. Formal training may be a mix of classroom, practical and programmed self-instruction as approved by the Responsible Level 3 or Examiner.

General examination: A written examination addressing the basic principles and theory of an NDT method.

NDT method: one of the disciplines of non-destructive examinations (eg ultrasound examination, radiography, etc.) in which there can be several techniques

NDT Technique: A category within a method; for example, ultrasonic immersion testing or ultrasonic contact testing.

Open book examination: An examination administered with access to specific reference material that is provided with or referenced in the examination.

Operator / Personnel NDT: personnel performing nondestructive examinations in the field of aeronautics.

On the job training: Training in the work environment to gain experience in learning instrument set-up, equipment operation, applying the process, and recognition, interpretation and evaluation of indications under appropriate technical guidance.

Practical examination: An examination to demonstrate an individuals ability to conduct an NDT method as used by the employer. Questions and answers need not to be written, but a checklist must be used and observation and results must be documented.

Procedure: A written general "how to" instruction for conducting a given process. Procedures are then used to develop work instructions.

Qualification: the skills, training, knowledge, examinations, experience and visual capability required for personnel to properly perform to a particular level.

RO-NANDTB: An independent aerospace organization representing a nation's aerospace industry that is chartered by the participating of main organisations performing NDT and recognized by the AACR and/or AAMN regulatory agencies to provide or support NDT qualification and/or examination services in accordance with 4.4.2 of this standard.

Specific examination: a written examination to determine an individual's understanding of operating procedures, codes, standards, product technology, test techniques, equipment and specifications for an NDT method, as used by the employer,

Test sample: A part or image containing one or more known and documented natural or artificial discontinuities, flaws or conditions used in the practical examination to demonstrate the candidate's proficiency in an NDT method. Test samples can refer to actual hardware, fabricated test parts, or, when applicable, images of actual hardware such as radiographs.

Training and Examination Center for NDT personnel (CIE): an internal or external organization that is capable of training and examining NDT personnel in aeronautics in accordance with the requirements of this procedure. CIE must be approved by RO-NANDTB.

Work instruction: A document detailing the NDT technique and testing parameters to be used for the inspection of a specific component, group of parts (e.g. ″aluminium extrusions″ or ″steel brackets″), or assembly. These are sometimes referred to in the industry as ″technique sheets″ or ″data cards″.

Written practice: a document that describes an employers requirements and methodology for controlling and administering the NDT personnel qualification and certification process.

4.2. ABBREVIATIONS

AACR	Romanian Civil Aeronautical Authority
AAMN	Romanian Military Aeronautical Authority
CA	Certificate of Autorization
CIE	Training and Examination organization for NDT Personnel
RO-NANDTB	Romanian National Aerospace NDT Board
NDT	Nondestructive Examinations
RL 3	Responsible Level 3

5. APPLICATION FOR QUALIFICATION

The application for qualification for initial certification, extension of qualification or retraining for NDT Level 1, 2 or 3 personnel will be submitted to the CIE authorized by the code form: FORM 1 (Annex 1) together with the following supporting documents, required for qualification:

- proof of experience gained in accordance with Table 1;
- the vision examination;
- the written procedure of the organization to which the candidate belongs / or standard applicable to EN4179 / NAS 410;
- addressing to meet the requirements of point 12.1.4.3 in the case of retraining with a Level 3 credit scheme (Annex 2A);
- procedure specific to the method for which qualification is requested.

If no written procedure or method specific procedures are provided,
the examination may be carried out in accordance with applicable international standards.

6. GENERAL REQUIREMENTS

6.1. WRITTEN PRACTICE

The employer shall develop and maintain a written practice for the qualification and certification of NDT personnel that meets the requirements of EN 4179/ NAS 410 standard.
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;
- NDT personnel duties and responsibilities within the organisation, for each level of qualification;
- training and experience requirements;
- certification and recertification requirements;
- records and record keeping requirements;
- requirements for expiration, suspension, revocation and reinstatement of certifications;
- process for annual maintenance.

6.1.1 The written practice shall be approved by the organisation Responsible Level 3.

6.1.2 The written practice and applicable RO-NANDTB procedures shall be available for review by the employer's, customer's and regulatory agencies.

6.2. NDT METHODS

This standard contains detailed requirements for the following common NDT methods:

- Liquid penetrant (PT)
- Magnetic particle (MT)
- Thermography (IRT)
- Eddy current (ET)
- Ultrasonic (UT)
- Radiography (RT)

For common methods, the minimum training, experience and examination requirements are detailed

in Chapters 5 and 6 of this Procedure and serve as guidance for current methods or developing methods.

6.2.1 **Other methods**
If there are requirements for qualifying NDT personnel for other NDT methods that are used to determine acceptance or suitability for a particular use of materials, parts, components, subassemblies or assemblies, RO-NANDTB may approve CIE's with appropriate facilities (see RO-NANDTB 04).

6.2.2 Requirements for personnel experience, training and examinations for these other methods must be documented by the employer in the written procedure.

7. LEVELS OF QUALIFICATION AND COMPETENCIES

7.1.1 NDT personnel from aeronautical industry must be qualified in accordance with this procedure, according to their studies, training, physical skills and practical experience.
Independently of the qualification obtained in the authorized CIE, the NDT personnel from the aeronautical industry must be certified by the employer.
Depending on their qualification, NDT personnel will be classified on one of the following levels:

7.1. TRAINEE

An individual who is documented as participating in a training program for an NDT method and is in the process of becoming qualified for certification to Level 1, Level 2 or directly to Level 2, shall be considered a trainee. In the technique/method in which they are preparing for certification, trainees shall:

- be documented as a trainee and be actively participating in a training program for a stated NDT method for a limited and specified period of time;
- obtain experience under the direct observation of a Level 2 or Level 3 in the same method;
- not make accept or reject decisions;
- not independently conduct tests;
- not independently perform any other NDT function.

7.2. LEVEL 1

7.2.1 In the method in which is certified, Level 1 individuals shall:

- be able to follow work instructions.
- have the skills and knowledge to process parts, document results and perform equipment standardization in accordance with approved work instructions.
- have the skills and knowledge to carry out any necessary preparation of parts before or after inspection in accordance with approved work instructions.
- have the skills and knowledge to conduct system performance checks in accordance with the applicable process standard.
- receive guidance or supervision from a certified Level 2 or Level 3 in that method when necessary.

- when specified in the written practice and approved by the Responsible Level 3, may perform interpretations and evaluations of specific product(s) or product form(s) for acceptance or rejection in accordance with approved work instructions.

7.3. LEVEL 2

7.3.1 In the method in which is certified, Level 2 individuals shall:

- have the skills and knowledge to set up and standardize 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 standard.
- be capable of providing the necessary guidance and/or supervision to trainees and Level 1 personnel.
- be familiar with the codes, standards, 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.

7.4. LEVEL 3

7.4.1 In the method in which is certified, Level 3 individuals shall:

- have the skills and knowledge to interpret codes, standards, and other contractual documents that control the NDT method(s);
- be able of assuming technical responsibility for the NDT facility and personnel;
- be capable of selecting the method and technique for a specific inspection;
- be able of preparing and verifying the adequacy of procedures and work instructions;
- approve NDT procedures and work instructions for technical adequacy.
- have a general knowledge of other NDT methods and product manufacturing and inspection technologies used by the employer.
- when specified in the written practice, have a basic knowledge of aircraft or vehicle maintenance.
- be capable of providing or directing training, examination, and certification of personnel.
- conduct NDT for the acceptance of parts and document the results if a demonstration of proficiency in this ability was included in the practical examination.
- when required by the written practice, be capable of auditing outside agencies (CIE) to ensure the requirements of the written practice are met.

7.5. RESPONSIBLE LEVEL 3

Designated person in writing by the employer, acting on behalf of the employer in matters relating to the process of qualification and certification of NDT personnel.
RL3 must be authorised on Level 3 in accordance with this procedure for one or more NDT methods and must have in-depth knowledge of the written instructions, codes, specifications and standards used by the employer.
RL3 must have sound knowledge about materials, components, product technologies, NDT methods and NDT techniques used by the employer.
RL3 is responsible for implementing this procedure and for managing the qualification and certification program in its entirety.

7.6. AUDITOR

Personnel performing technical NDT audits, surveys or assessments shall have the 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, standards, and other contractual documents that control the applicable method(s).

8. TRAINING

Candidates for certification to all levels shall complete sufficient formal training to become proficient with the principles and practices of the applicable test method and technique(s) and be capable of carrying out the duties specified in para. 7.1.1. Formal training shall be conducted prior to, or in conjunction with, on-the-job training.

8.1. MINIMUM TRAINING HOURS

The minimum training hours for Level 1 and Level 2 are provided in Table I and Table 1A for the specified NDT methods. All completed NDT training shall be documented.
For NDT methods not covered by Table1, the minimum training requirements are set by RL3.

TABLE 1 – The minimum training hours for Level 1 and Level 2

Method	Level 1	Level 2 with previous Level 1 certification	Level 2 without previous Level 1 certification
PT	16	16	32
MT	16	16	32
IRT	20	40	60
ET	40	40	80
UT	40	40	80
RT film or non-film	40	40	80
RT film and non-film	60	60	120

TABLE 1A – RT formal training hours for transition to film and non-film

Ore suplimentare de instruire forrmală		
Current level 1	Current level 2	Current level 1 to Level 2 Film & NonFilm
20	40	80

Note: Additional training hours must be done in the appropriate manner.

8.1.1 Training Outlines

All training shall be conducted in accordance with a detailed course outline approved by the Responsible Level 3. 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 standardization;
- 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 (CIE) is used to provide training, the Responsible Level 3 shall verify that the training meets the employer's requirements.
A guidance for minimum training requirements in Annex 5.

8.2. PREVIOUS TRAINING

For personnel credited with previous training, or personnel not certified within 12 months of their training, refresher training must be provided. Previous training must be documented to be accepted by the employer. As a minimum, refresher training shall cover products, equipment set-up, operation and standardization, specific operating procedures, applicable techniques, interpretation and evaluation of NDT results, safety, and applicable codes, standards and specifications. For documentation of previous training, records other than original records may be accepted if adequacy and equivalency have been determined to be acceptable by the Responsible Level 3 or Examiner.

8.3. EQUIVALENT TRAINING

For personnel previously certified under NAS410, EN 4179 or other recognized NDT qualification program, the adequacy and equivalency of their previous training to the requirements of Table I and Table IA shall be determined and documented by the Responsible Level 3 or Examiner. All or a portion of previous hours may be accepted as applicable.

8.4. HEALTH AND SAFETY TRAINING.

8.4.1 All regulations relating to hazardous substances, accident prevention and safe working practices shall be strictly adhered to. Safety-related training requirements shall be determined in accordance with Romanian codes and regulations.

8.4.2 Prior to certification, all candidates seeking radiography qualification shall have received instruction on the hazards and safety requirements associated with ionizing radiation and be knowledgeable of, and comply with, the applicable regulations and laws.

9. EXPERIENCE

9.1. ACCUMULATED EXPERIENCE

9.1.1 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 candidate must provide RO-NANDTB with evidence of the experience gained by this procedure before submitting to the exam. These requirements must be established and documented by RL3 within the organization or Examiner.

9.1.2 Minimum experience requirements for a candidate for Level 1, Level 2 certification without prior certification on Level 1 and Level 2, are listed in Table 2 and Table 2A. The requirements for Level 3 are shown in Table 3.

9.1.3 On-the-job training for the accumulation of experience must be supervised by Level 2 personnel in accordance with EN 4179 / NAS410. For candidates who have experience, the documentation must be available to be checked for the person, date, task, and personnel who made the direct observation.

9.1.4 Direct access to level 2 is only possible if the duration of the candidate's experience is the sum of the duration required for Level 1 and Level 2.

TABLE 2 – Minimum experience requirements for Level 1 & Level 2

	Experience time in hours		
Method	Level 1 (Trainee experience)	Level 2 with previous Level 1 certification	Level 2 without previous Level 1 certification
PT	130	270	400
MT	130	400	530
IRT	200	600	800
ET	200	600	800
UT	200	600	800
RT film or NonFilm	200	600	800
RT film and NonFilm	220	780	1000

TABLE 2A – Experience requirements for transition to film and NonFilm

Additional Minimum Experience Time in Hours		
Current Level 1	Current Level 2	Current Level 1 to Level 2 Film & NonFilm
20	200	800

Note: The previous hours of experience must be in the applicable technique.

TABLE 3 – Minimum experience requirements for Level 3 in Common Methods

College or University	Level 2 Experience
None	4 years
Two years of engineering or science study at a technical school, college or university	2 years
3-4 years science or engineering undergraduate degree	1 year

Notes:

1. Additional experience required for Level 3 RT, moving from film to non-film or vice versa, is 240 hours with guidance or supervision from an Examiner, Instructor, or C.I.E.
2. The experience required for Level 3 authorization relates to the activity as a Level 2 Authorized NDT Operator.

9.2. PREVIOUS EXPERIENCE

9.2.1 A candidate's experience with a previous employer may be accepted by the current employer only if such experience is documented and approved by the organisation Responsible Level 3. All or a portion of previous hours may be accepted as applicable. For documentation of previous experience, records other than original records may be accepted if adequacy and equivalency have been determined to be acceptable by the Responsible Level 3.

9.3. EQUIVALENT EXPERIENCE

9.3.1 For personnel previously certified under NAS 410, EN 4179 or other recognized NDT qualification program, the adequacy and equivalency of their previous experience to the requirements of Table 2, Table 2A, or Table 3 shall be determined and documented by the organisation Responsible Level 3.

10. EXAMINATION

10.1. REQUIREMENTS

10.1.1 Examination to qualify NDT personnel should include a vision examination, a general examination, a specific examination, and a practical examination for each method in which NDT personnel is to be authorized.

10.1.2 Questionnaires and test samples must be available to NDT personnel only during the examinations, in Romanian / English. An oral translation of written examinations is not allowed during the examination.

10.1.3 The examination material consists of paper-based materials as well as test parts for examination.

10.1.4 The examination package includes:

- general questions about the method requested;
- specific questions about the method requested;
- reference materials if applicable (tables, specifications, standards, etc.);
- checklists for practical examinations.

10.1.5 Questions for theoretical examination valid at the time of the exam are randomly chosen by the examiner from the CIE collection of questions.

10.2. VISION EXAMINATOIN

10.2.1 Vision examination for NDT personnel shall assure that the applicants near vision and color perception meet the requirements of Table 3.

TABLE 3 – Requirements about vision examination

Examinatoin Requirements	
Near Vision Options:	• Tumbling E according to SR EN ISO 18490 • 20/25 (Snellen) at 40.64 cm ± 21.54 cm* • Jaeger No. 1 at no less than 30.48 cm*
Color Perception	Personnel shall be capable of adequately distinguishing and differentiating colors used in the process involved

** In at least one eye, natural or corrected.*

10.2.2 Requirements for near vision should be administered annually, and those on color perception should be administered at a maximum of 5 years.

10.2.3 The form used for the vision examination is determined by the organization to which the candidate belongs and must contain the requirements of Table 3.

10.2.4 Vision examination should be administered by trained personnel, designated by RL3 of the organization or qualified medical personnel.

10.2.5 If a correction is required to pass the visual acuity exam, then this correction must be applied during all tests / inspections.

10.2.6 Any limitations on color perception must be evaluated by the organization's RL3 before certification and must be approved in writing, if applicable.

10.3. GENERAL EXAMINATION

10.3.1 The general examination for all levels shall be a ″closed book examination″.

10.3.2 A minimum of 40 questions shall be administered for the general examination at Levels 1 and 2.

10.3.3 The general examination of a candidate for Level 3 initial qualification includes a basic examination and a NDT method examination for which qualification is required. For Level 3, the general examination questions shall address the general knowledge of other methods as defined within this standard 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.
The Level 3 basic exam is given by at least four methods corresponding to level 2, chosen by the candidate from the methods provided in paragraph 6.2, of which at least one method must be volumetric (UT or RT). For each of these methods, a minimum of 15 closed book questions are asked, ie a minimum of 60 questions in total. The minimum mark is 80%. This note does not count towards the final average.
The NDT method exam for which authorization is requested must have a minimum of 40 questions.

10.4. SPECIFIC EXAMINATION

10.4.1 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.

10.4.2 A minimum of 30 questions shall be administered for the specific examination.

10.4.3 Reference material, as determined by the Responsible Level 3 or Examiner, such as specifications, tables, formulas, etc. shall be provided. Questions utilizing such material shall require understanding of the information contained therein rather than merely finding its location.

10.4.4 The reference materials provided during the examination will be clearly indicated on the specific examination questionnaire.

10.5. PRACTICAL EXAMINATION

10.5.1 The practical examination shall consist of a demonstration of proficiency in performing tasks that are typical of those to be accomplished in the performance of the candidate's duties.

10.5.2 If the candidate is required to demonstrate proficiency in the application of the process as well as interpretation of results, hardware test samples shall be used. The candidate shall not be familiar with the test sample and the location of the defects located therein.

10.5.3 If the candidate is only required to interpret the results and not perform the process of generating the image, the test samples may be images, such as radiographs or other resultant test data.

10.5.4 A written checklist covering the topics detailed in the following sub-paragraphs shall be developed and completed by the Responsible Level 3 or Examiner to assure adequate coverage and to assist in the administration and grading of the examination. In addition to using the checklist, the Responsible Level 3 or Examiner shall determine and document how the examination results obtained by the candidate are to be documented (e.g. part maps, drawings, sketches, written descriptions, etc.). All such documentation shall become part of the examination and filed accordingly.

Notă : A guideline for drawing up the checklist for the practical examination of Level 1, 2 and 3 staff is presented in Annex 3A and 3B.

10.5.5 Level 1

10.5.5.1 The candidate shall demonstrate proficiency by using a work instruction to process at least 2 test samples of differing configurations for each method, with at least one test sample for each technique for which certification is sought. When only one configuration of hardware is to be inspected upon certification, both test samples may be of the same configuration.

10.5.5.2 The test samples shall be representative of the products to be encountered by the candidate in the performance of his/her duties with the employer.

10.5.5.3 The checklist shall include proficiency in the use and standardization of equipment and materials, adherence to procedural details, according to Annex A.

10.5.6 Level 2

10.5.6.1 The candidate shall demonstrate proficiency by inspecting at least 2 test samples of differing configurations for each method, with at least one test sample for each technique for which certification is sought. When only one configuration is to be inspected upon certification, both test samples may be of the same configuration.

10.5.6.2 The test samples shall be representative of the products to be encountered by the candidate in the performance of his/her duties with the employer. In addition to the two minimum known and documented test samples with discontinuities, specimens without discontinuities may be included.

10.5.6.3 The candidate shall document the NDT results in accordance with the applicable acceptance criteria.

10.5.6.4 The checklist shall include proficiency in the use and standardization of equipment and materials, adherence to procedural details, the accuracy and completeness of interpretation and evaluation of indications, according to Annex 3A.

10.5.7 Level 3

10.5.7.1 The candidate shall demonstrate proficiency by preparing an NDT procedure or work instruction appropriate to the employer's current requirements for the method.

10.5.7.2 The results of the practical examination shall be documented and a checklist shall be used to address the technical accuracy, technical content, and clarity of the procedures or written instructions prepared by the candidate, according to Annex 3B.

10.5.7.3 When the candidate's duties will include processing and/or acceptance or rejection of products, proficiency in performing such tasks shall be demonstrated by a hands- on practical examination equivalent to Level 2.

11. ADMINISTRATION OF EXAMINATIONS AT CIE

11.1.1 Examinations for qualification at all levels (Level 1, 2 and 3) are organized according to the requirements of the present procedure. The logical flows of these activities are presented in paragraph 11.1.3.

11.1.2 When presenting the exam, each candidate must have a valid proof of his identity. It must be shown, on request, to the examiner or to the examination committee. Any candidate who, during the examination, does not comply with the rules or commits a fraudulent act or is an accomplice to such an act, is excluded from continuing the examination. The candidate must wait for at least one year before being able to submit a reexamination.

11.1.3 For the administration of the examinations, RO-NANDTB will use an external or internal CIE. It must be authorized by RO-NANDTB in accordance with the RO-NANDTB 04 procedure.

A. <u>Examination administrated by authorised CIE</u>

1. The Employer shall send a Qualifying Application Form to the authorized CIE (Annex 1) and the supporting qualification file, which is proof that the Applicant has been examined for vision in accordance with paragraph 10.2 and has accumulated experience relevant to each Qualification Level, in accordance with paragraph 9.
2. If it considers it necessary, the CIE may require clarification or additions to the file.
3. When the file is complete, the authorized CIE draws up the Training Program and informs Ro-NANDTB of the training period and the date of the examination. Ro-

NANDTB registers and archives information. If deemed necessary, RO-NANDTB may send observers.

4. The CIE administers training and general theory, specific and practical theories with all the specific customer requirements. Examiners shall be Level 3 personnel.
5. For candidates who pass the exams, CIE issue the document qualification (diploma) with the RO-NANDTB logo.
6. All training and examination documents are archived by the authorized CIE for a period of 10 years.
7. Following the examination, the authorized CIE sends to RO-NANDTB the minutes of the completion of the qualification process containing the names of the operators, the method, the level, the exam results, the names and qualifications of the examiners and the names of the observers, if any.
8. RO-NANDTB registers and archives the minutes.

B. <u>Administration of examinations for level 3 personnel</u>

1. For Level 2 personnel applying for Level 3 initial admission, the employer sends RO-NANDTB a letter of application for authorization (Appendix 1) and the supporting qualification file which consists of proof that the applicant has previous Level Certification 2 and meets the experience conditions shown in Table 3.
For Level 3 personnel for which the employer requests the prolongation of the certification, the employer submits to RO-NANDTB the application letter for examination that must contain a reference to the third-level certificate.
The employer shall transmit the specific working documents in the non-destructive testing methods for which the examination is requested. It is clearly specified if the employer wants practical examination "on the job". The specific requirements of the employer are indicated.
2. If deemed necessary, RO-NANDTB may request clarification or additions to the file.
3. When the file is complete, RO-NANDTB approves the examination and announces the AACR
4. If there is only one application for the examination of Level 3 staff, the examination will be administered at the Employer's CIE Internal. If there are requests from several employers for the same period, RO-NANDTB will analyze the CIE's practical examination capabilities of the employing applicants and choose as the venue for the examination, that CIE which has the most active non-destructive examination. Those methods will prevail where stationary examination equipment (eg. MPI, FPI, RX lines or immersion ultrasound devices) will be available.
5. RO-NANDTB may request for the practical examination of each of the applicant employers, the collection of known defects representative for its field of activity. The pieces must reach that CIE where the examination will be performed.
6. RO-NANDTB designates an Examiner for each of the non-destructive testing methods for which the exam is administered.

7. The examiner receives the specific documentation and draws on it the set of specific questions that will be handled by each candidate. Choose from the collection of parts with known defects the parts for the practical examination and draw up the check-lists for the evaluation of the processing applicable to the on-the-job examination or for assessing the completeness of the specifications / procedures drawn.
8. The RO-NANDTB examiner administers the examination of general theory, specific theory and practical examination with all specific customer requirements.
9. Minutes containing exam results are sent to RO-NANDTB.
10. Examination Minutes shall be archived at RO-NANDTB, according to RO-NANDTB-03.

11.1.4 It is in no way admissible that a candidate should examine himself or by his subordinates.

11.1.5 Examiners
Examiners must be Level 3 qualified under this procedure for the method in which examination is requested. An examiner can prepare, administer and record, write NDT or practice examinations, and manage the qualification process in the qualifying method.
Examiners will be nominated in writing by RL3 or RO-NANDTB

11.1.6 Scoring

Candidates must obtain a minimum mark of 70% on each exam. In addition, in the practical examination, if applicable, it must detect all discontinuities or conditions specified in the practical examination and obtain a minimum score of 70%.

11.1.7 The average score for the exams (general, specific and practical) must be at least 80%.

11.1.8 When determining the final score, the marks obtained in each of the general, specific and practical examples will have equal weight.

11.1.9 Re-examination.

Candidates who do not pass any of the General, Specific or Practical NDT exams must be further trained before attempting again to pass the exam they have not promoted. Training after the failed exam must address those areas that are deficient in the candidate's skills or knowledge. After the examination failed, the re-examination must:

- do not use the same written tests or test samples that were used in the initial examination;
- the re-examination tests shall contain at least 25% new questions.

12. CERTIFICATION

12.1.1 Granting certification

For Candidates admitted to the Qualification Exam, the authorized CIE issues a Qualification Diploma specifying qualification level and Qualified Methods.

Based on the Qualification Diploma and the organization's qualification and certification procedure, the employer certifies the staff.

The validity of the Qualification Diploma and the certification is of maximum 5 years. Evidence of

qualification diplomas and certification documents is made by the employer according to the organization's qualification and certification procedure.

12.1.2 Loss of Certification

Certifications may expire, be suspended, or be revoked.

12.1.2.1 Expiration.

Certifications shall expire when the certification interval has lapsed with no recertification issued.

12.1.2.2 Suspension.

Certification shall be suspended when:

- vision examination is expired;
- individual does not perform in the method certified for at least 12 consecutive months;
- individual fails recertification examination;
- individual's performance is found to be deficient in any manner;
- annual maintenance is expired.

The vision examination and the annual assessment shall be deemed expired at the end of the month in which they were performed.

12.1.2.3 Revocation

The employer shall revoke a certification when:

- the individual does not perform in the certified method for the employer for at least 24 consecutive months;
- when employment has been terminated;
- when the individual's conduct is found to be unethical or incompetent.

When an individual is re-hired by the same employer within 24 months, certification may be considered as suspended.

12.1.3 Reinstatement of certification

In order to reinstate a certificate that has been suspended, the employer must ensure that the reasons for the suspension have been corrected. Certificates that have expired or have been revoked may be reinstated only by a specific and practical examination equivalent to that of the initial qualification.

12.1.4 Recertification

12.1.4.1 The Level 1 and Level 2 certified personnel must be recertified at intervals that do not exceed 5 years. Recertification is done by successfully passing exams (specific and practical) equivalent to those given in the initial qualification.

If a recertification is also given a general examination, the result will be entered with an equal weight in the final score calculation.

12.1.4.2 Level 3 personnel certified to EN 4179 / NAS 410 standard, shall be recertified at intervals not to exceed five years. Recertification may be accomplished:

- by activity criteria points in accordance with Annex A or
- by successful completion of specific and practical examinations equivalent to initial certification.

If equipment operation or accepting hardware is required as a part of the Level 3's duties, an additional hands-on practical examination equivalent to Level 2 is required.

12.1.4.3 Credit System for Recertification of Level 3 NDT Personnel

To be applied only to NDT Level 3 personnel that holds a valid certification and does not have acceptance / rejection tasks for parts.

Upon recertification of Level 3 with assignment acceptance / rejection tasks, using the credit system the candidate must undergo a practical examination according to para. 10.5. The "hands-on" exam score will be used as a final score.

(a) The candidate shall have been employed in a Level 3 function for a minimum of 36 months (at least 12 of which are in the last 24 months) within the previous five years in the method(s) for which recertification is sought. The number of months is cumulative and does not need to be consecutive months for validation purposes.

(b) Continuity in the method shall be demonstrated. The candidate shall provide a list of 8 verifiable Level 3 tasks in each NDT method for which recertification is sought covering the 5 year period.

(c) Candidates shall provide objective evidence that they have kept up to date with current NDT technology in the method(s) for which they are seeking recertification by obtaining a minimum of 24 points during the five year period of certification, irrespective of the number of certifications (methods) obtained, by engaging in a combination of activities listed in Annex 2A.

(d) Level 3 staff activity will be reported as outlined in Annex 2A, with objective evidence of the activities being carried out.

(e) Approval of the activities carried out in accordance with Annex 2A must be detailed and documented in accordance with the written procedure of the organization to which the candidate belongs.

12.1. EQUIVALENCY

Equivalence of previously acquired qualifications to other employers will be in the following situations:

- the candidate was qualified by another accredited NANDTB recognized by ANDTBF, according to the requirements of EN 4179 or NAS 410, in which case the equivalence is automatic.
- the candidate was qualified by an aeronautical organization according to EN 4179 or NAS 410, in which case the qualifications (training, experience) are recognized and an exam must be passed, for certification in accordance with the organization's procedure.
- the candidate was qualified according to SNT-TC-1A or ISO 9712, in which case the qualifications are recognized and the candidate will pass an examination for certification in accordance with the organization's procedure, conditional on demonstrating the accumulation of aeronautical experience.

If the experience does not comply with the requirements of EN 4179 / NAS 410, the candidate will be admitted to the examination only after completing an internship of the organization decided by RL3

12.2. ANNUAL MAINTENANCE

Annual maintenance is done by the employer in accordance with the organization's qualification and certification process for all levels by promoting a practical exam for processing and / or inspecting the organization-specific products.

The results of these practical exams must be documented and maintained by the employer.

13. RECORDS

RO-NANDTB must maintain records for NDT personnel examinations in accordance with RO-NANDTB 03.

13.1.1 The recordings that RO-NANDTB shall keep are:

- the information that the CIE has transmitted on the training period, the instructors, the operators, the methods, the levels and the date of the examination;
- the minutes of the completion of the training with the results of the examination.

13.1.2 Availability of records. All records must be maintained and archived in accordance with RO-NANDTB 03, and may be submitted on request to regulatory agencies and customer organizations.

ANNEX 1

APPLICATION FOR NDT PERSONNEL QUALIFICATION

[ ] INITIAL QUALIFICATION
[ ] DOMAIN EXTENSION
[ ] PROLONGATION
[ ] RE-QUALIFICATION

1. Requesting Organisation:_____

2. Legal Representative:_____

3. Phone: _____ **Fax:**_____**E-mail:** _____

4. Organisation Address :_____

5. Name of NDT Operator :_____

6. Qualification Certification Held:_____

7. Domains for which authorization is requested:

☐ **PT** ☐ **UT** ☐ **RT**

☐ **MT** ☐ **ET** ☐ **IRT**

☐ **Other methods**

8. Legal Representative Signature and Organisation Stamp:

10. Completion Date:

11. Supporting Documents for Qualification:
- Vision examination certificate
- Proof of experience accumulation
- Organization qualification and certification procedure
- Procedures / specifications required for the specific examination (if possible)

ANNEX 2A

LEVEL 3 AWARDED CREDIT ACTIVITY
Credit points cumulated for 5 years between year……. and year……..

Activity	Criteria	Pts.	Max 5 year	Y 1	Y 2	Y 3	Y 4	Y 5	Total	Max. total
Auhtoring or coauthoring technical NDT papers, presentations oe white papers	Sole Author	8	8							
	Co-author>30%)	4								
	Co-author <30%)	2								
Auhtor, co-autor or custodian for company or industry NDT specifications or standards	Each standard/ specification	2	8							
Attending NDT technical sessions, committee or panel meetings organized by:	1 day or 1 meeting	1	8							
a. National NDT technical societies or institutes	2 days	2								
b. Inter-company NDT teams comprised of members from several locations	3 or more days	4								
NDT instructor teaching academic courses, or courses designated to prepare students for NDT qualification.	For each 8 hours of instruction	4	8							
Participating in technical courses or seminars	For every 8 hours of documented instruction	2	8							
Participating in technical courses or seminars for which academic credit is given	For academic credit earned	Actual credit awarded	8							
Obtaining an initial* Level 3 certificate from a recognized industry source (applicable only to initial professional certification. *This does not apply to professional recertification)	For each method obtained	4	4							
NDT Examiner	For each qualification examination	1	6							
NDT related technical and/or scientific publications published either internally or externally	For each published paper	4	8							
Documented NDT contributions to company, technical society, or industry committee projects	For each documented contribution	4	8							
Documented participation in NDT related studies, developments or investigations	For each documented contribution	4	8							
Documented continuous satisfactory performance as a Level 3	Written testament for each method in the certification period	1	4							

Attend NDT equipment or trade show	For each show attended	1	4								
Conduct external NDT audits	For each external audit conducted	2	6								
Development of new NDT processes, facilities or systems	For each documented contribution	4	8								
Submitting and/or obtaining a patent for an NDT product or process	Sole inventor	8	8								
	Co-inventor	4									
Total yearly											
Total cumulated for 5 years (minim 24 points)											

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ANNEX 2B

CREDIT POINTS INTERPRETATION FOR LEVEL 3 ACTIVITY

The Credit Points table is by its nature brief and generalised. An interpretation of each category of activity is provided below to ensure a consistency of understanding by those seeking to renew their Level 3 recognition. The interpretations are as follows:

1. Authoring or co-authoring technical NDT papers and presentations
Meaning: Self-Explanatory, but the work must be published or presented at a recognized conference or seminar. Examples of acceptable evidence are shown in Appendix A1.

2. Authoring, co-authoring or custodian for company or industry NDT specifications or standards.

Meaning: Being tasked with the management of the development or amendment of NDT specifications. This could be chairing a Standards committee or similar. Acceptable evidence: A letter from the organisation indicating the NDT Standard or specification, date and author(s).

3. Attending technical sessions, seminars, committee or panel meetings of national or international technical NDT societies or institutes, inter-company NDT teams comprised of members from several locations.
Meaning: Self-explanatory. Intercompany means the participation of more than one company not simply the involvement of persons from several locations or departments of the same company. Acceptable evidence: Minutes of meeting page showing attendance.

4. NDT Technical training instructor teaching courses which are designed to prepare students for NDT qualifications or other academic qualifications.
Meaning: Assisting Skills Training by delivering NDT courses or providing specialist training to staff on NDT methods and techniques. The training could be delivered internally or externally to the employer. Acceptable evidence is summary of courses delivered that includes course title, dates, client name and duration or course covers with the above information (A2).

5. Participating in technical courses or seminars.
Meaning: Attending courses or seminars to gain knowledge on an NDT subject, or participating in the delivery of the course or seminar. Certificates of attendance are acceptable evidence (A4).

6. Participating in technical courses or seminars for which academic credit is given. *Meaning: Training which is identified in a national framework as part of an award or qualification.* Copies of results from the Institute are required.

7. NDT Examiner
Meaning: Developing and marking a written examination or developing, administering and marking a practical examination. Statement from Examining body detailing subject, level and date of paper is acceptable.

8. NDT related technical and/or scientific publications published either internally or externally.
Meaning: Producing an NDT paper for publication either within the Level 3's employment or externally. Acceptable evidence: Copy of paper showing title, Author(s), place of publication (journal, book, etc.) date of publication and page numbers.

9. Documented NDT contributions to company, technical society or industry committee projects.
Meaning: Contributions to NDT standards development or other NDT related projects which result from the contributions from several persons or departments. Examples of acceptable evidence are shown in Appendix A5.

10. Documented participation in NDT related studies, developments or investigations.
Meaning: Producing detailed NDT investigations, evaluations or reports for engineering or management consideration. It does not mean a routine NDT report. It could include assessment of new NDT equipment. Copy of front page showing project name, participants, dates and summary of work done is acceptable evidence.

11. Documented continuous satisfactory performance as a Level 3.
Meaning: Annual successful revalidation of Level 3 company authorisation. This is mostly based on the attaining of sufficient points as outlined above. Accordingly, any points allocated for this are to be considered as extra to the 24 point rolling aggregate. Refer to Appendix B.

12. Conduct external NDT audit.
Meaning: Audits of non-company NDT facilities. Acceptable evidence is front page of audit sheet showing name of company audited and standard against which audit was carried out, see example A3.

13. Attend equipment or trade displays.
Meaning: Self-explanatory. However if a trade display is associated with a seminar, conference or other NDT technical meeting, only the meeting points may be credited. Copies of Trade Display entry passes or note from exhibitor are acceptable

ANNEX 3A

CHECKING GUIDE FOR PRACTICAL EXAMINATION
LEVEL _____ , METHOD:_____

Candidate Name: **Date :**

Max. Score allowable	Test Sample Code Actual Score		Steps targeted by the examiner	Obs.
KNOWING THE NDT EQUIPMENT				
5			System performance and functional checking	
5			Checking the parameters	
NDT METHOD APPLICATION				
5			Preparing the part (i.e. surface condition), including visual inspection	
10			Selection of the NDT technique and working conditions	
10			Adjusting the NDT and measure instruments	
20			Inspection performing – attention will be paid to handling of the parts	
5			Procedures after inspection (i.e.. demagnetisation, cleaning, preserving)	
DETECTING AND REPORTING OF DISCONTINUITIES / MEASUREMENTS				
10			Detecting of discontinuities	
10			Caracterization (type, position, orientation, sizing, etc.)	
10			Level 2 assesment of discontinuities according to criteria from valid specifications	
10			Drafting the inspection report	
Average				
Max. possible 100 %	Achieved:			

ANNEX 3B

CHECKING GUIDE FOR INSTRUCTION/PROCEDURE

LEVEL _____ METHOD:_____

Candidate Name: **Date :**

Max. Score allowable	Test Sample Code Actual Score	Steps targeted by the examiner	Obs.
DRAFTING AN WORK INSTRUCTION for NDT (acc. to EN4179, par. 3.34)			
5		Preamble (domain, reference documents, etc.)	
5		Authorised personnel	
10		Instruments to be used, including settings	
10		Data about inspected part (description or drawing, including area of interest or scope of the inspection)	
10		Inspection conditions including preparing for inspection	
20		Verificari de proces	
20		Detailed instructions for performing NDT	
10		Recording and classification for the inspection results	
5		Reporting of the inspection results	
5		Personnel and environment safety	
Max. possible 100 %	Achieved:		

ANNEX 4

QUALIFIED PERSONNEL EVIDENCE REGISTER (SAMPLE)

Certificate of Authorization	Inspector Name	CA releasing date	Method / Level	Recording Type	Releasing date	Expiring date
			MT3	AI		
				P		
				P		
				P		
				P		

ANNEX 5

MINIMUM RECOMMENDED THEMATICS FOR TRAINING COURSES

RADIOGRAPHY (RT)

1. Radiographic examination (physical principles)
2. Equipment, sources of radiation
3. Radiography
3.1 Radiant image
3.2 Scattered radiation. Mandatory backscatter radiation check using the letter "B" of Pb.
3.3 Lead intensive screens
3.4 Radiation filtering
3.5 Geometric factors that influence the exposure / incident angle of the beam
3.6 Geometric unsharpness / requirements
3.7 Sensitometry, Contrast, Radiographic Sensitivity / Sensitivity Levels Required
3.9 Exposure diagrams
3.10 Factors that the density depend on
3.11 Use of exposure charts (exposure calculation, exposure factors)
3.12 X-ray diffraction (limiting its effects)
3.13 Surface preparation for radiographic examination
4. Film
5. Interpretation of radiographic films, facilities
6. Personal safety
7. Glossary of terms used in radiography
8. Inspection techniques
9. Penetrameter / IQI
10. Checks

LIQUID PENETRANT (PT)

1. Introduction to inspection with penetrant liquids, physical principles
 1.1 Material discontinuities and their origin
 1.2 Basic principles of penetrant testing
 1.3 Purpose and scope of penetrant testing
 1.4 Comparison with other NDT methods
 1.5 Advantages and limitations
2. Physical properties of the materials used
 2.1 Physical quantities of physico-chemical properties of materials used in penetrant testing
  2.1.1 Viscosity, surface tension, penetration, wetability, solubility, toxicity, visibility, stability, volatility.
3. Materials used for penetrant testing
 3.1 Penetrants
 3.2 Materials used to remove penetrant in excess
 3.3 Developer
 3.4 Symbols for materials used for penetrating liquids
 3.5 Penetrant systems and applicable sensitivity levels
 3.6 Penetrant testing lines
4. Phases of Penetrant Liquids Examination
 4.1 Preparing the surface to be examined. Physical and mechanical cleaning methods. Cooling parts. Surface preparation by acid attack. Methods of application of acidic attackers. Acid attack local

4.2 Application of penetrants, penetration time. Parameters
4.3 Remove excess penetrant. Use of emulsifiers. Machinery, times, temperatures, pressures specific to the organization.
4.4. Drying. Temperatures
4.5 Application of developers
4.6 Examination and evaluation. Adapting to darkness, a prerequisite for a trusted inspection. Observation conditions: white and UV light. Inspection spaces, visual aids, handling and cleaning conditions
4.7 Post-cleaning and corrosion protection
5. Examination methods
5.1 Groups of materials, commodities, material compatibility
5.2 Examination methods. Special methods
5.3 Advantages and disadvantages
6. Equipment for examination with penetrating liquids
6.1 Conventional Methods
6.2 Semiautomatic and automatic equipment
6.3 Special Equipment
6.4 Illumination conditions: white and UV light
6.5 Materials: types and quality control of products
6.6 Product protection, toxicity.
7. Indications obtained from penetrating control
7.1 General
7.1.1 Indications of shapes and dimensions
7.1.2 Development time
7.1.3 Persistence of indications
7.1.4 Cracks, overlaps, porosities, lack of adhesion
7.1.5 Factors affecting the appearance of irrelevant indications
9. Checks
9.1 Verification of processing materials: penetrants / emulsifiers / developer / PSM 5
9.2 Equipment check: drying tanks / inspection booth / UV lamps and white light
9.3 Periodic calibration of equipment: radiometers / thermometers / pressure gauges / regulators temperature / uniformity of drying vats / instruments for determining the size of the indications.
10. Personal and environment safety

MAGNETIC PARTICLE (MT)
1. Introduction
1.1 General - Nature of defects
1.2 General principles - ferromagnetic materials, examination with magnetic particles
1.3 Comparison with other NDT methods
2. Classification of materials
2.1 Ferromagnetic, diamagnetic, paramagnetic materials
3. Defects
3.1 Defects of typical materials detected by magnetic particle examination
3.1 Surface and sub-surface defects
3.2 Forged, machined, cast, molded parts
4. Magnets, magnetic fields, electric theory
4.1 Nature of the fields, lines of force, flow density
4.2 The theory of magnetism, atoms, domains
4.3 Field strength, magnetization force.

5. Leakage fields
  5.1 Causes, nature
  5.2 Density, direction, positioning
  5.3 Measurement
6. Producing magnetic fields
  6.1 Currents, circular magnetism, fields in and around a conductor
  6.2 Magnetism longitudinal
  6.3 Right hand rule, effect on the magnetic compass
  6.4 Strength of magnetic field for effective magnetization.
7. Hysteresis
  7.1 Full description, B / H ratio
  7.2 Permeability, retention, reluctance
  7.3 Coercive force
8. Types of current
  8.1 Currents and production mode, displayed currents, values
  8.2 Depth of penetration, waveform influence, skin effect.
9. Defects orientation
  9.1 Maximum Sensitivity, Angle, Size, Shape, Depth
  9.2 Leakage flow lines, analogy to flow theory
10. Methods of magnetization
  10.1 Current flow, coil, auxiliary conductor
  10.2 Induction, applied coil, flexible cable
  10.3 The magnetization direction for each method, the preferred defect orientation for obtaining to a maximum sensitivity
11. Magnetisation equipment
  11.1 Installations using AC / CC, pulsating, fully rectified, half-wave rectified
  11.2 Power supplies
  11.3 Portable equipment
  11.4 Contact surfaces, arching
  11.5 Central conductors, insulation
  11.6 Magnetic Impulse
  11.7 Magnetisation equipment
12. Magnetic suspensions
  12.1 Types / materials applicable
  12.2 Wet / Dry Methods / Continuous Method
  12.3 Fluorescent methods
  12.4 Stirring, visibility, mobility, concentration
  12.5 Carrier liquids, ignition points
  12.6 Methods of application
13. Operating phases
  13.1 Basic Principles
  13.2 Choosing the right flow density value
  13.3 Triggered current
14. Preparing the parts
  14.1 Degreasing, demagnetization, surface finishing
  14.2 Colors, background, sprays
  14.3 Shot peening / sand jet cleaning, pickling.
15. Inspection
  15.1 Lighting conditions in the darkroom. Adapting to darkness, a prerequisite for a trusted inspection.

15.2 Instruments / aids for viewing, light levels
15.3 Corrosion protection
15.4 Number and frequency of examinations
16. Interpretation of indications
16.1 Relevant and irrelevant indications
16.2 Grinding operations, fatigue, heat treatments, cracks, inclusions
17. Demagnetisation
17.1 Decreasing CA coils, CC / CA yokes
17.2 Basic methods
17.3 Object material, geometry, homogeneity, hardness
17.4 Field strength during demagnetization, coercive force, Curie Point
17.5 Residual field checks and appropriate equipment
17.6 Executed steps and explanation
18. Checks for process control
18.1 Checking the lighting conditions: the intensity of the UV lamps and white light / white light ambient light and white light emission of UV lamps
18.2 Verification of magnetic suspension: concentration / reduction of fluorescence / contamination / viscosity
18.3 Verification of magnetization equipment: system performance, functional tests / efficacy test KETOS and AS5282 / internal short circuit / capacity test / quick break
18.4 Calibration: ampermeters / shunt / timers / indicators
19. Limits of magnetic particle examination
19.1 Penetrability, section variations, holes
19.2 Puncture holes in electron beam welding, welding
20 Documents in NDT Laboratory
20.1 Tracking Sheet. Operations plan. Operations tab. Checklists. Marking of the pieces. Acceptance standards applicable to customers.
21. Personal and environment safety

ULTRASONIC (UT)
1. Introduction
1.1 Definitions of origin of defects
1.2 General principles of ultrasound examination
1.3 Scope of application
1.4 Comparison with other NDT methods
2. Wave properties
2.1 Relationship between speed, wavelength and frequency
3. Propagation velocity
3.1 Speed for each waveform
4. Ultrasound properties
4.1 Relationship between sound pressure and particle velocity
4.2 Relationship between acoustic impedance and particle oscillation amplitude
5. Effects on sound propagation at smooth / rough surfaces
6. Incidence of waves
6.1 Normal wavelength incidence
6.2 Calculation of reflexion and transmission coefficients
6.3 Angled incidence, critical angles
7. Sonic fields and their characteristics
7.1 Beam divergence, near field, far field

8. Piezo-electricity
8.1 Piezoelectric materials, quartz
8.2 Piezoelectric effects in ceramics
8.3 Curie Temperature
9. Sound attenuation
10. Assessment of defect
10.1 Comparison with flat-bottomed artificial defects
12. Ultrasonic defectoscope
12.1 Impulse Generator
12.2 Display unit
12.3 Cathode tube
12.4 Amplifier
13. Characteristics of the equipment
13.1 Signal / Noise Ratio
13.2 Resolution
13.3 Linear Amplifier
13.4 Beam divergence
14. Transducers
14.1 Choosing the support material for the piezoelectric plate, membranes
14.2 Impedance matching with defectoscope
15. Characteristics of the transducer
15.1 Resonance frequency, spectrum, bandwidth
15.2 Sensitivity, resolution power, field of work
15.3 Focused transducers
16. Immersion examination of stepped parts
17. Automation
17.1 Distance-amplitude correction, gates, dynamic tests, calibration
18 Documents in NDT Laboratory
18.1 Tracking sheet. FCAN. Operations plan. Operations tab. Checklists. Marking of the pieces. Acceptance standards applicable to customers
19. Personal and environment safety

THERMOGRAPHY
1. Brief introduction on the appearance of the thermographic method
2. The basic principle of thermographic controls
3. Materials, equipment and work accessories
4. Faults and indications of defects
5. Sources of error
6. Calibration and preparation of the apparatus used in the NDT process
7. Personal and environment safety
8. Regulations of Certification Authorities

EDDY CURRENT

1. Theoretical training
2. Baseline flows of swirling currents
3. Factors that affect swirling currents
4. Coils and transducers
5. Basic electrical circuits
6. Phase analysis
7. Modulation analysis
8. Specific theoretical training
9. Practical training

DISTRIBUTION LIST

No.	RECEIVER	Copy No.	Receiving Signature (Addres No.)	Date
0	1	2	3	4
1.	RO-NANDTB	Master		
2.	AEROSTAR S.A. BACAU	1		
3.	IAR S.A. BRASOV	2		
4.	ROMAERO S.A. BUCURESTI	3		
5.	TURBOMECANICA S.A. BUCURESTI	4		
6.	AEROQ NDT BRASOV	5		
7.	AACR	6		