Recommended Practice No.

# SNT-TC-1A

# 2020 EDITION

## PERSONNEL QUALIFICATION AND CERTIFICATION IN NONDESTRUCTIVE TESTING

The American Society for Nondestructive Testing Inc.
ASNT...Creating a Safer World!®

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The American Society for Nondestructive Testing Inc.
*ASNT...Creating a Safer World!®*

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ASNT Mission Statement:
ASNT exists to create a safer world by advancing scientific, engineering, and technical knowledge in the field of nondestructive testing.

ASNT *Code of Ethics*:
The ASNT *Code of Ethics* was developed to provide members of the Society with broad ethical statements to guide their professional lives. In spirit and in word, each ASNT member is responsible for knowing and adhering to the values and standards set forth in the Society's Code. More information, as well as the complete version of the *Code of Ethics*, can be found on ASNT's website, asnt.org.

# FOREWORD

This Recommended Practice establishes the general framework for a qualification and certification program. In addition, the document provides the educational, experience, and training recommendations for the different test methods.

This recommended practice is not intended to be used as a strict specification. It is recognized, however, that contracts require programs, which meet the intent of this document. For such contracts, purchaser and supplier must agree upon acceptability of an employer's program.

The verb "should" has been used throughout this document to emphasize the recommendation presented herein. It is the employer's responsibility to address specific needs and to modify these guidelines as appropriate in a written practice. In the employer's written practice, the verb "shall" is to be used in place of "should" to emphasize the employer's needs.

The 2020 Edition of *SNT-TC-1A* is annotated so that users of the 2016 edition can quickly and easily locate new and updated material. The vertical lines in the margins of this document indicate that information in the text has been modified in some way.

An *SNT-TC-1A* Interpretation Panel is available to respond to written inquiries regarding the *SNT-TC-1A* guidelines. These responses clarify the intent of ASNT's Standards Development Committee (SDC) and the recommendations of *SNT-TC-1A* and are subject to the statement of "Scope" in each edition of *SNT-TC-1A*.

To make an inquiry, use the *SNT-TC-1A* Interpretation Request Form on page 37 of this Recommended Practice.

Inquiries related to this recommended practice should be directed to the chair of the *SNT-TC-1A* Interpretation Panel at the following address:

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# SNT-TC-1A SUBCOMMITTEE

Publication and review of this Recommended Practice was under the direction of the *SNT-TC-1A* Subcommittee which is a subcommittee of the Standards Development Committee (SDC). The SDC reports to the Board of Directors of The American Society for Nondestructive Testing.

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**Notice to users of this document:**
When certificates or wallet cards are issued and provided by the employer, the requirements of *ASNT Policy G-14* shall be followed to ensure appropriate usage of the ASNT name, acronym, and logo.

The certificate shall indicate that the certification is in accordance with the requirements of the employer's written practice.

See Section 9.5 for further guidance on properly issued certification certificates and wallet cards.

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# SUMMARY OF CHANGES

## Summary of Changes in the 2020 Edition
**(and 2018 addendum to the 2016 Edition)**

1. "Notice to Users" notification added on page vi to inform users of *ASNT Policy G-14* with regard to usage of ASNT's name and logo.
2. New paragraph 1.5 to explain proper usage of ASNT examinations as a substitute for examinations in Sections 8.4 and 8.5. The wording in Sections 8.4, 8.5, and 8.7 was removed in favor of the more general recommendation in new paragraph 1.5.
3. New term, "False Call," was added. The term was already in use within the document.
4. New term, "Detection Rate," was added. The term was already in use within the document.
5. New term, "Method," was added. The term was already in use within the document.
6. New term, "Personalized Instruction," was added. The term was added to clarify the multiple options available to industry for obtaining NDT training.
7. New terms, "Calibration, Instrument," paragraph 2.1.1 and "Standardization, Instrument," paragraph 2.1.20 adopted from *ASTM E1316*. This is the beginning of an effort to standardize terminology across all NDT methods in all ASNT publications. These additions are also reflected in paragraph 4.3.1 and 4.3.2.
8. Revision of the term, "Employer," paragraph 2.1.9, to address the evolution of our changing workforce and acknowledge the reality that some personnel are not permanent employees but are provided through agencies and other means.
9. New term, "Third-Party Agency," paragraph 2.1.22 is defined because the phrase is used in new definition of "Employer," paragraph 2.1.9.
10. Paragraph 8.1.5, changed the Practical examination score from 70 to 80%.
11. Removed the 20 radiograph image requirement in paragraph 8.5.2.2 and made the NDT Level III responsible for determining the proper amount for the employer's application.
12. Paragraph 8.5.4 and 8.5.5, added "The Written Practice should address detection rates as well as the maximum number of false calls acceptable."
13. New Section 9.5 to provide guidance on how to properly develop an NDT Certification certificate and wallet card and stay within the ASNT logo and name use policies.
14. Tables 6.3.1 A and 8.3.4, added a new Technique under Ultrasonic Testing; Full Matrix Capture.
15. Table 6.3.1 A, increased experience requirements for PAUT and TOFD to 320 hours from 160.
16. Table 8.3.4, added a general examination requirement for PAUT and TOFD.
17. Table 6.3.1 B, removed footnote 1, which recommended that while gaining work experience, 1000 radiographs should be reviewed.

# SNT-TC-1A

## Recommended Practice No. SNT-TC-1A Personnel Qualification and Certification in Nondestructive Testing

**1.0 Scope**

1.1 It is recognized that the effectiveness of nondestructive testing (NDT) applications depends upon the capabilities of the personnel who are responsible for, and perform, NDT. This Recommended Practice has been prepared to establish guidelines for the qualification and certification of NDT personnel whose specific jobs require appropriate knowledge of the technical principles underlying the nondestructive tests they perform, witness, monitor, or evaluate.

1.2 This document provides guidelines for the establishment of a qualification and certification program.

1.3 These guidelines have been developed by The American Society for Nondestructive Testing Inc. to aid employers in recognizing the essential factors to be considered in qualifying personnel engaged in any of the NDT methods listed in Section 3.

1.4 It is recognized that these guidelines may not be appropriate for certain employer's circumstances and/or applications. In developing a written practice as required in Section 5, the employer should review the detailed recommendations presented herein and modify them, as necessary, to meet particular needs. Such modification may alter but shall not eliminate basic provisions of the program such as training, experience, testing, and recertification. Supporting technical rationale for modification of detailed recommendations should be provided in an Annex to the written practice.

1.5 The use of third-party central certifications (e.g., ACCP, ASNT NDT Level II, and other internationally recognized third-party certification programs) may be used in place of employer examinations, as applicable, provided there is no conflict with the governing industry code or standard.

1.5.1 For Level II specific and practical examinations, the NDT Level III should ensure that the content of these examinations satisfies the requirements in Sections 8.4 and 8.5, respectively in the employer's program.

1.5.2 The use of third-party central certifications satisfying the requirements for employer-based examinations shall be documented in the employer's written practice.

**2.0 Definitions**

2.1 Terms included in this document are defined as follows:

2.1.1 **Calibration, Instrument:** the comparison of an instrument with, or the adjustment of an instrument to, a known reference(s) often traceable to the applicable country's national institute or standards body. (See also **Standardization, Instrument.**)

2.1.2 **Certification:** written testimony of qualification.

2.1.3 **Certifying Authority:** the person or persons properly designated in the written practice to sign certifications on behalf of the employer.

2.1.4 **Certifying Agency:** the employer of the personnel being certified.

2.1.5 **Closed-Book Examination:** an examination administered without access to reference material except for materials supplied with or in the examination. (See 8.1.3.)

2.1.6 **Comparable:** being at an equivalent or similar level of NDT responsibility and difficulty as determined by the employer's NDT Level III.

2.1.7 **Detection Rate:** the number or percentage of false calls allowed for a test specimen as defined by the NDT Level III.

2.1.8 **Documented:** the condition of being in written form.

2.1.9 **Employer:** the corporate, private, or public entity, which employs personnel directly or indirectly for wages, salary, fees, or other considerations. This would include employers who obtain their qualified supplemental workforce personnel through third-party agencies, providing the use and certification of those supplemental employees is addressed in the employer's written practice.

2.1.10 **Experience:** work activities accomplished in a specific NDT method under the direction of qualified supervision including the performance of the NDT method and related activities but not including time spent in organized training programs.

2.1.11 **False Call:** when an indication and/or grading unit is incorrectly identified as being a defect.

2.1.12 **Grading Unit:** a Qualification Specimen can be divided into sections called grading units, which do not have to be equal length or be equally spaced. Grading units are unflawed or flawed and the percentage of flawed/unflawed grading units required should be approved by the NDT Level III.

2.1.13 **Limited Certification:** nondestructive test methods may be further subdivided into limited disciplines or techniques to meet specific employer's needs; these are NDT Level II certifications, but to a limited scope.

2.1.14 **Method:** one of the disciplines of NDT; for example, ultrasonic testing, within which various test techniques may exist.

2.1.15 **Nondestructive Testing:** a process that involves the inspection, testing, or evaluation of materials, components, and assemblies for materials' discontinuities, properties, and machine problems without further impairing or destroying the part's serviceability. Throughout this document the term NDT applies equally to the NDT inspection methods used for material inspection, flaw detection, or predictive maintenance (PdM) applications.

2.1.16 **Outside Agency:** a company or individual who provides NDT Level III services and whose qualifications to provide these services have been reviewed by the employer engaging the company or individual.

2.1.17 **Personalized Instruction:** may consist of blended classroom, supervised laboratory, and/or hybrid online competency-based course delivery. Modular content is covered through online presentations, in the classroom, and/or in small groups. Personalized instruction also enables students to achieve competency using strategies that align with their knowledge, skills and learning styles.

2.1.18 **Qualification:** demonstrated skill, demonstrated knowledge, documented training, and documented experience required for personnel to properly perform the duties of a specific job.

2.1.19 **Recommended Practice:** a set of guidelines to assist the employer in developing uniform procedures for the qualification and certification of NDT personnel to satisfy the employer's specific requirements.

2.1.20 **Standardization, Instrument:** the adjustment of an NDT instrument using an appropriate reference standard, to obtain or establish a known and reproducible response. (This is usually done prior to an examination, but can be carried out anytime there is concern about the examination or instrument response.) (See also **Calibration, Instrument.**)

2.1.21 **Technique:** a category within an NDT method; for example, ultrasonic thickness testing.

2.1.22 **Third-Party Agency:** a company or organization, without an established written practice, providing supplemental workforce to the employer; for example, a temporary staffing company.

2.1.23 **Training:** an organized program developed to impart the knowledge and skills necessary for qualification.

2.1.24 **Written Practice:** a written procedure developed by the employer that details the requirements for qualification and certification of its employees.

## 3.0 Nondestructive Testing Methods

3.1 Qualification and certification of NDT personnel in accordance with this Recommended Practice is applicable to each of the following methods:

Acoustic Emission Testing
Electromagnetic Testing
Ground Penetrating Radar
Guided Wave Testing
Laser Methods Testing
Leak Testing
Liquid Penetrant Testing
Magnetic Flux Leakage Testing
Magnetic Particle Testing
Microwave Technology Testing
Neutron Radiographic Testing
Radiographic Testing
Thermal/Infrared Testing
Ultrasonic Testing
Vibration Analysis
Visual Testing

**4.0 Levels of Qualification**

4.1 There are three basic levels of qualification. The employer may subdivide these levels for situations where additional levels are deemed necessary for specific skills and responsibilities.

4.2 While in the process of being initially trained, qualified, and certified, an individual should be considered a trainee. A trainee should work with a certified individual. The trainee should not independently conduct, interpret, evaluate, or report the results of any NDT test.

4.3 The recommended technical knowledge and skill sets for the three basic levels of qualification are as follows:

4.3.1 NDT Level I. An NDT Level I individual should have sufficient technical knowledge and skills to be qualified to properly perform specific standardizations, specific NDT, and specific evaluations for acceptance or rejection determinations according to written instructions and to record results. The NDT Level I should receive the necessary instruction and supervision from a certified NDT Level II or III individual.

4.3.2 NDT Level II. An NDT Level II individual should have sufficient technical knowledge and skills to be qualified to set up and standardize equipment and to interpret and evaluate results with respect to applicable codes, standards, and specifications. The NDT Level II should be thoroughly familiar with the scope and limitations of the methods for which qualified and should exercise assigned responsibility for on-the-job training and guidance of trainees and NDT Level I personnel. The NDT Level II should be able to organize and report the results of NDT tests.

4.3.3 NDT Level III. An NDT Level III individual should have sufficient technical knowledge and skills to be capable of developing, qualifying, and approving procedures; establishing and approving techniques; interpreting codes, standards, specifications, and procedures; and designating the particular NDT methods, techniques, and procedures to be used. The NDT Level III should be responsible for the NDT operations for which qualified and assigned and should be capable of interpreting and evaluating results in terms of existing codes, standards, and specifications. The NDT Level III should have sufficient practical background in applicable materials, fabrication, and product technology to establish techniques and to assist in establishing acceptance criteria when none are otherwise available. The NDT Level III should have general familiarity with other appropriate NDT methods, as demonstrated by an ASNT Level III Basic examination or other means. The NDT Level III, in the methods in which certified, should have sufficient technical knowledge and skills to be capable of training and examining NDT Level I, II, and III personnel for certification in those methods.

**5.0 Written Practice**

5.1 The employer shall establish a written practice for the control and administration of NDT personnel training, examination, and certification.

5.2 The employer's written practice should describe the responsibility of each level of certification for determining the acceptability of materials or components in accordance with the applicable codes, standards, specifications, and procedures.

5.3 The employer's written practice should describe the training, experience, and examination requirements for each level of certification by method and technique, as applicable.

5.4 The employer's written practice should identify the test techniques within each test method applicable to its scope of operations.

5.5 The employer's written practice shall be reviewed and approved by the employer's NDT Level III.

5.6 The employer's written practice shall be maintained on file.

**6.0 Education, Training, and Experience Requirements for Initial Qualification**

6.1 Candidates for certification in NDT should have sufficient education, training, and experience to ensure qualification in those NDT methods in which they are being considered for certification. Documentation of prior certification may be used by an employer as evidence of qualification for comparable levels of certification.

6.2 Documented training and/or experience gained in positions and activities comparable to those of Levels I, II, and/or III prior to establishment of the employer's written practice may be considered in satisfying the criteria of Section 6.3.

6.3 To be considered for certification, a candidate should satisfy one of the following criteria for the applicable NDT level:

## Table 6.3.1 A. Recommended Initial Training and Experience Levels

| Examination Method | NDT Level | Technique | Training Hours | Experience | |
|---|---|---|---|---|---|
| | | | | Minimum Hours in Method or Technique | Total Hours in NDT |
| Acoustic Emission Testing | I | | 40 | 210 | 400 |
| | II | | 40 | 630 | 1200 |
| Electromagnetic Testing | I | AC Field Measurement | 40 | 210 | 400 |
| | II | | 40 | 630 | 1200 |
| | I | Eddy Current Testing | 40 | 210 | 400 |
| | II | | 40 | 630 | 1200 |
| | I | Remote Field Testing | 40 | 210 | 400 |
| | II | | 40 | 630 | 1200 |
| Ground Penetrating Radar | I | | 8 | 60 | 120 |
| | II | | 20 | 420 | 800 |
| Guided Wave Testing | I | | 40 | 240 | 460 |
| | II | | 40 | 240 | 460 |
| Laser Methods Testing | I | Profilometry | 8 | 70 | 130 |
| | II | | 24 | 140 | 260 |
| | I | Holography/ Shearography | 40 | 210 | 400 |
| | II | | 40 | 630 | 1200 |
| Leak Testing | I | Bubble Leak Testing | 2 | 3 | 15 |
| | II | | 4 | 35 | 80 |
| | I | Pressure Change Leak Testing | 24 | 105 | 200 |
| | II | | 16 | 280 | 530 |
| | I | Halogen Diode Leak Testing | 12 | 105 | 200 |
| | II | | 8 | 280 | 530 |
| | I | Mass Spectrometer Leak Testing | 40 | 280 | 530 |
| | II | | 24 | 420 | 800 |
| Liquid Penetrant Testing | I | | 4 | 70 | 130 |
| | II | | 8 | 140 | 270 |
| Magnetic Flux Leakage | I | | 16 | 70 | 130 |
| | II | | 12 | 210 | 400 |
| Magnetic Particle Testing | I | | 12 | 70 | 130 |
| | II | | 8 | 210 | 400 |
| Microwave Technology Testing | I | | 40 | 210 | 400 |
| | II | | 40 | 630 | 1200 |
| Neutron Radiographic Testing | I | | 28 | 420 | 800 |
| | II | | 40 | 1680 | 2400 |
| Radiographic Testing | I | Radiography | 40 | 210 | 400 |
| | II | | 40 | 630 | 1200 |
| | I | Computed Radiography | 40 | 210 | 400 |
| | II | | 40 | 630 | 1200 |
| | I | Computed Tomography | 40 | 210 | 400 |
| | II | | 40 | 630 | 1200 |
| | I | Digital Radiography | 40 | 210 | 400 |
| | II | | 40 | 630 | 1200 |
| Thermal/ Infrared Testing | I | | 32 | 210 | 400 |
| | II | Building Diagnostics | 34 | 1260 | 1800 |
| | II | Electrical and Mechanical | 34 | 1260 | 1800 |
| | II | Materials Testing | 34 | 1260 | 1800 |
| Ultrasonic Testing | I | | 40 | 210 | 400 |
| | II | | 40 | 630 | 1200 |
| | II | Full Matrix Capture | 80 | 320 | n/a |
| | II | Phased Array Ultrasonic Testing | 80 | 320 | n/a |
| | II | Time of Flight Diffraction | 40 | 320 | n/a |
| Vibration Analysis | I | | 24 | 420 | 800 |
| | II | | 72 | 1680 | 2400 |
| Visual Testing | I | | 8 | 70 | 130 |
| | II | | 16 | 140 | 270 |

**Table 6.3.1 A Notes:**

1.0 A person may be qualified directly to NDT Level II with no time as a certified NDT Level I, providing the recommended training and experience consists of the sum of the hours recommended for NDT Level I and Level II.

2.0 For NDT Level III certification, the experience should consist of the sum of the hours for NDT Level I and Level II, plus the additional time in 6.3.2, as applicable. The formal training should consist of the NDT Level I and Level II training, plus any additional formal training as defined in the employer's written practice.

3.0 Listed training hours may be adjusted as described in the employer's written practice depending on the candidate's actual education level, e.g. grammar school, college graduate in engineering, etc.

4.0 Training should be outlined in the employer's written practice. MT training hours may be counted toward MFL training hours as defined in employer's written practice.

5.0 If an individual is currently certified in an ET technique and a full-course format was used to meet the initial qualifications in that technique, the minimum training hours to qualify in another ET technique at the same NDT level may be reduced up to 40% if so defined in the employer's written practice. If an individual is certified in an ET technique, the minimum experience to qualify for another ET technique at the same level or to the next level may be reduced by up to 50% if so defined in the employer's written practice.

6.0 While fulfilling total NDT experience requirement, experience may be gained in more than one method, however, the minimum hours must be met for each method.

7.0 If an individual is currently certified in an RT technique and a full-course format was used to meet the initial qualifications in that technique, the minimum additional training hours to qualify in another technique at the same level should be 24 hours (of which at least 16 hours should be equipment familiarization). The training outline should be as defined in the employer's written practice. If an individual is certified in a technique, the minimum additional experience required to qualify for another technique at the same level may be reduced by up to 50%, as defined in the employer's written practice.

8.0 Independent of the training recommended for Level I and Level II certification, a trainee is required to receive radiation safety training as required by the regulatory jurisdiction.

9.0 If an individual is currently certified in one IR technique and a full-course format was used to meet the initial qualifications in that technique, the minimum additional training hours to qualify in another technique at the same level should be 20 hours (of which at least 16 hours should be specific technique familiarization). The training outline should be as defined in the employer's written practice. If an individual is certified in a technique, the minimum additional experience required to qualify for another technique at the same level may be reduced by up to 50%, as defined in the employer's written practice.

10.0 Full Matrix Capture, Time of Flight Diffraction, and Phased Array Ultrasonic Testing require Ultrasonic Testing Level II certification as a prerequisite.

11.0 In addition to the training recommended in this table for FMC, TOFD, and PAUT, supplemental specific hardware and software training should be required for automated or semiautomated technique applications. The employer's written practice should fully describe the nature and extent of the additional training required for each specific acquisition or analysis software and instrument/system used. The employer's written practice should also describe the means by which the examiner's qualification will be determined for automated and semiautomated techniques.

## Table 6.3.1 B. Recommended Initial Training and Experience Levels for NDT Level II Limited Certifications

| Examination Method | Limited Certification Technique | Technician's Starting Point | Formal Training | Minimum Work Experience in Technique (Hours) |
|---|---|---|---|---|
| Radiographic Testing | Film Interpretation | Non-Radiographer | 40 | 220 |
| | Film Interpretation | RT Level I | 24 | 220 |
| Ultrasonic Testing | Digital Thickness Measurement (numeric output only) | Trainee | 8 | 40 |
| | A-scan Thickness Measurement | Trainee | 24 | 175 |

6.3.1 NDT Levels I and II

Table 6.3.1 A lists the recommended training and experience hours to be considered by the employer in establishing written practices for initial qualification of NDT Level I and Level II individuals.

Table 6.3.1 B lists initial training and experience hours, which may be considered by the employer for specific limited applications as defined in the employer's written practice. Limited certifications should apply to individuals who do not meet the full training and experience of Table 6.3.1 A. Limited certifications issued in any method should be approved by the NDT Level III and documented in the certification records.

6.3.2 NDT Level III

6.3.2.1 Have a bachelor's degree (or higher) in engineering or science, plus one additional year of experience beyond the Level II requirements in NDT in an assignment comparable to that of an NDT Level II in the applicable NDT method(s), or:

6.3.2.2 Have completed with passing grades at least two years of engineering or science study at a university, college, or technical school, plus two additional years of experience beyond the NDT Level II requirements in NDT in an assignment at least comparable to that of NDT Level II in the applicable NDT method(s), or:

6.3.2.3 Have four years of experience beyond the NDT Level II requirements in NDT in an assignment at least comparable to that of an NDT Level II in the applicable NDT method(s).

The above NDT Level III requirements may be partially replaced by experience as a certified NDT Level II or by assignments at least comparable to NDT Level II as defined in the employer's written practice.

## 7.0 Training Programs

7.1 Personnel being considered for initial certification should complete sufficient organized training. The organized training may include instructor-led training, personalized instruction, virtual instructor-led training, computer-based training, or web-based training. Computer-based training and web-based training should track hours and content of training with student examinations in accordance with 7.2. The sufficiently organized training shall be such as to ensure the student is thoroughly familiar with the principles and practices of the specified NDT method related to the level of certification desired, and applicable to the processes to be used and the products to be tested. All training programs should be approved by the NDT Level III responsible for the applicable method.

7.2 The training program should include sufficient examinations to ensure understanding of the necessary information.

7.3 Recommended training course outlines and references for NDT Levels I, II, and III personnel, which may be used as technical source material, are contained in *ANSI/ASNT CP-105: ASNT Standard Topical Outlines for Qualification of Nondestructive Testing Personnel.*

7.4 The employer who purchases outside training services is responsible for assuring that such services meet the requirements of the employer's written practice.

## 8.0 Examinations

8.1 Administration and Grading

8.1.1 All qualification examination questions shall be approved by the NDT Level III responsible for the applicable method.

8.1.2 An NDT Level III should be responsible for the administration and grading of examinations specified in Section 8.3 through 8.8 for NDT Level I, II, or other Level III personnel. The administration and grading of examinations may be delegated to a qualified representative of the NDT Level III and so recorded. A qualified representative of the employer may perform the actual administration and grading of NDT Level III examinations specified in 8.7.

8.1.2.1 To be designated as a qualified representative of the NDT Level III for the administration and grading of NDT Level I and Level II personnel qualification examinations, the designee should have documented, appropriate instruction by the NDT Level III in the proper administration and grading of qualification examinations prior to conducting and grading independent qualification examinations for NDT personnel. Additionally, the practical examination should be administered by a person certified in the applicable NDT method as NDT Level II or III.

8.1.3 All NDT Level I, II, and III written examinations should be closed-book except that necessary data, such as graphs, tables, specifications, procedures, codes, etc., may be provided with or in the examination. Questions utilizing such reference materials should require an understanding of the information rather than merely locating the appropriate answer.

8.1.4 For NDT Level I and II personnel, a composite grade should be determined by simple averaging of the results of the general, specific, and practical examinations described below. For NDT Level III personnel, the composite grade should be determined by simple averaging of the results of the basic, method, and specific examinations described below.

8.1.5 Examinations administered by the employer for qualification should result in a passing composite grade of at least 80%, with no individual written examination having a passing grade less than 70%. The practical examination should have a passing grade of at least 80%.

8.1.6 When an examination is administered and graded for the employer by an outside agency and the outside agency issues grades of pass or fail only, on a certified report, then the employer may accept the pass grade as 80% for that particular examination.

8.1.7 The employer who purchases outside services is responsible for ensuring that the examination services meet the requirements of the employer's written practice.

8.1.8 In no case shall an examination be administered by one's self or by a subordinate.

8.2 Vision Examinations

8.2.1 Near-Vision Acuity. The examination should ensure natural or corrected near-distance acuity in at least one eye such that the applicant is capable of reading a minimum of Jaeger Number 2 or equivalent type and size letter at the distance designated on the chart but not less than 12 in. (30.5 cm) on a standard Jaeger test chart. The ability to perceive an Ortho-Rater minimum of 8 or similar test pattern is also acceptable. This should be administered annually.

8.2.2 Color Contrast Differentiation. The examination should demonstrate the capability of distinguishing and differentiating contrast among colors or shades of gray used in the method as determined by the employer. This should be conducted upon initial certification and at five-year intervals thereafter.

8.2.3 Vision examinations expire on the last day of the month of expiration.

8.3 General (Written – for NDT Levels I and II)

8.3.1 The general examinations should address the basic principles of the applicable method.

8.3.2 In preparing the examinations, the NDT Level III should select or devise appropriate questions covering the applicable method to the degree required by the employer's written practice.

8.3.3 See Appendix A for example questions.

8.3.4 The minimum number of questions that should be given is shown in Table 8.3.4.

8.3.5 A valid ACCP Level II or ASNT NDT Level II certificate may be accepted as fulfilling the general examination criteria for each applicable method if the NDT Level III has determined that the ASNT examinations meet the requirements of the employer's written practice.

8.4 Specific (Written – for NDT Levels I and II)

8.4.1 The specific examination should address the equipment, operating procedures, and NDT techniques that the individual may encounter during specific assignments to the degree required by the employer's written practice.

8.4.2 The specific examination should also cover the specifications or codes and acceptance criteria used in the employer's NDT procedures.

8.4.3 The minimum number of questions that should be given is shown in Table 8.3.4.

## Table 8.3.4. Minimum Number of Examination Questions

| Method/Technique | General | | Specific | |
|---|---|---|---|---|
| | Level I | Level II | Level I | Level II |
| **Acoustic Emission Testing** | 40 | 40 | 20 | 20 |
| **Electromagnetic Testing** | | | | |
| Alternating Current Field Measurement | 40 | 40 | 20 | 20 |
| Eddy Current Testing | 40 | 40 | 20 | 20 |
| Remote Field Testing | 30 | 30 | 20 | 20 |
| Ground Penetrating Radar | 30 | 40 | 20 | 20 |
| Guided Wave Testing | 40 | 40 | 20 | 20 |
| **Laser Methods Testing** | | | | |
| Profilometry | 30 | 30 | 20 | 20 |
| Holography/Shearography | 30 | 30 | 20 | 20 |
| **Leak Testing** | | | | |
| Bubble Leak Testing | 20 | 20 | 15 | 15 |
| Pressure Change Leak Testing | 20 | 20 | 15 | 15 |
| Halogen Diode Leak Testing | 20 | 20 | 15 | 15 |
| Mass Spectrometer Leak Testing | 20 | 20 | 20 | 40 |
| **Liquid Penetrant Testing** | 40 | 40 | 20 | 20 |
| **Magnetic Flux Leakage Testing** | 20 | 20 | 20 | 15 |
| **Magnetic Particle Testing** | 40 | 40 | 20 | 20 |
| **Microwave Technology Testing** | 40 | 40 | 20 | 20 |
| **Neutron Radiographic Testing** | 40 | 40 | 20 | 20 |
| **Radiographic Testing** | | | | |
| Radiography | 40 | 40 | 20 | 20 |
| Radiographic Film Interpretation – Non-Radiographer | | 40 | | 20 |
| Radiographic Film Interpretation – Radiographer (Certified RT NDT Level I) | | 20 | | 15 |
| Computed Radiography | 40 | 40 | 20 | 20 |
| Computed Tomography | 40 | 40 | 20 | 20 |
| Digital Radiography | 40 | 40 | 20 | 20 |
| **Thermal/Infrared Testing** | 40 | | 20 | |
| Building Diagnostics | | 50 | | 40 |
| Electrical and Mechanical Testing | | 50 | | 40 |
| Materials Testing | | 50 | | 40 |
| **Ultrasonic Testing** | 40 | 40 | 20 | 20 |
| Full Matrix Capture | | 40 | | 30 |
| Phased Array Ultrasonic Testing | | 40 | | 30 |
| Time of Flight Diffraction | | 40 | | 30 |
| Digital Thickness Measurement (numeric output only) | | 20 | | 10 |
| A-scan Thickness Measurement | | 30 | | 15 |
| **Vibration Analysis** | 40 | 40 | 20 | 60 |
| **Visual Testing** | 40 | 40 | 20 | 20 |

8.5 Practical (for NDT Level I and II)

8.5.1 The candidate should demonstrate familiarity with and ability to operate the necessary NDT equipment, record, and analyze the resultant information to the degree required.

8.5.2 At least one flawed specimen or component should be tested and the results of the NDT analyzed by the candidate.

8.5.2.1 Phased Array and Time of Flight Diffraction Practical Examination. Flawed samples used for practical examinations should be representative of the components and/or configurations that the candidates would be testing under this endorsement and approved by the NDT Level III.

8.5.2.2 For Film Interpretation Limited Certification, the practical examination should consist of review and grading of a sufficient number of radiographs to demonstrate satisfactory performance to the satisfaction of the NDT Level III. The number of radiographs should be addressed in the employer's written practice.

8.5.3 The description of the specimen, the NDT procedure, including checkpoints, and the results of the examination should be documented.

8.5.4 NDT Level I Practical Examination. Proficiency should be demonstrated in performing the applicable NDT technique on one or more specimens or machine problems approved by the NDT Level III and in evaluating the results to the degree of responsibility as described in the employer's written practice. At least ten (10) different checkpoints requiring an understanding of test variables and the employer's procedural requirements should be included in this practical examination. The candidate should detect all discontinuities and conditions specified by the NDT Level III. The written practice should address detection rates as well as the maximum number of false calls acceptable.

**Note:** While it is normal to score the practical on a percentile basis, practical examinations should contain checkpoints that failure to successfully complete will result in failure of the examination.

8.5.5 NDT Level II Practical Examination. Proficiency should be demonstrated in selecting and performing the applicable NDT technique within the method and interpreting and evaluating the results on one or more specimens or machine problems approved by the NDT Level III. At least ten (10) different checkpoints requiring an understanding of NDT variables and the employer's procedural requirements should be included in this practical examination. The candidate should detect all discontinuities and conditions specified by the NDT Level III. The written practice should address detection rates as well as the maximum number of false calls acceptable. An example of a practical examination checklist is attached as Appendix B to this Recommended Practice. The example checklist has been provided as guidance on development of practical examinations for any method or level.

**Note:** While it is normal to score the practical on a percentile basis, practical examinations should contain checkpoints that failure to successfully complete will result in failure of the examination.

8.6 Sample questions for general examinations are presented in the separate question booklets that can be obtained from the ASNT International Service Center. These questions are intended as examples only and should not be used verbatim for qualification examinations. The following ASNT Questions & Answers Books are available from the ASNT International Service Center:

| Test Method | Question Booklets |
|---|---|
| Acoustic Emission Testing | G |
| Electromagnetic Testing | E |
| 1. Alternating Current Field Measurement | EA |
| 2. Eddy Current Testing | EE |
| 3. Remote Field Testing | ER |
| Ground Penetrating Radar | GP* |
| Guided Wave Testing | GW* |
| Laser Testing | |
| 1. Profilometry | LP* |
| 2. Holography/Shearography | LH* |
| Leak Testing | |
| 1. Bubble Leak Testing | HB |
| 2. Pressure Change Measurement Testing | HP |
| 3. Halogen Diode Leak Testing | HH |
| 4. Mass Spectrometer Leak Testing | HM |
| Liquid Penetrant Testing | D |
| Magnetic Flux Leakage Testing | MF |
| Magnetic Particle Testing | B |
| Microwave Technology Testing | MWV* |
| Neutron Radiographic Testing | F |
| Radiographic Testing | |
| 1. Radiography | A |
| 2. Computed Radiography | AA* |
| 3. Computed Tomography | AB* |
| 4. Digital Radiography | AC* |
| Thermal/Infrared Testing | J |
| Ultrasonic Testing | C |
| Vibration Analysis | K* |
| Visual Testing | I |

* In course of preparation

8.7 NDT/PdM Level III Examinations

8.7.1 Basic Examinations

8.7.1.1 NDT Basic Examination (need not be retaken to add another test method as long as the candidate holds a current Level III certificate or certification). The minimum number of questions that should be given is as follows:

8.7.1.1.1 Fifteen questions relating to understanding the *SNT-TC-1A* document

8.7.1.1.2 Twenty questions relating to applicable materials, fabrication, and product technology.

8.7.1.1.3 Twenty questions that are similar to published NDT Level II questions for other appropriate NDT methods.

8.7.1.2 PdM Basic Examination (need not be retaken to add another test method as long as the candidate holds a current Level III certificate or certification). The minimum number of questions that should be given is as follows:

8.7.1.2.1 Fifteen questions relating to understanding the *SNT-TC-1A* document.

8.7.1.2.2 Twenty questions relating to applicable machinery technology.

8.7.1.2.3 Thirty questions that are similar to published NDT Level II questions for other appropriate PdM methods.

8.7.2 Method Examination (for each method).
8.7.2.1 Thirty questions relating to fundamentals and principles that are similar to published ASNT NDT Level III questions for each method, and
8.7.2.2 Fifteen questions relating to application and establishment of techniques and procedures that are similar to the published ASNT NDT Level III questions for each method, and
8.7.2.3 Twenty questions relating to capability for interpreting codes, standards, and specifications relating to the method.
8.7.3 Specific Examination (for each method).
8.7.3.1 Twenty questions relating to specifications, equipment, techniques, and procedures applicable to the employer's product(s) and methods employed and to the administration of the employer's written practice.
8.7.4 A valid endorsement on an ASNT NDT Level III certificate or ACCP Professional Level III certificate fulfills the examination criteria described in 8.7.1 and 8.7.2 for each applicable NDT method.

8.8 Reexamination
8.8.1 Those failing to attain the required grades should wait at least 30 days or receive suitable additional training as determined by the NDT Level III before reexamination.

**9.0 Certification**

9.1 Certification of NDT personnel to all levels of qualification is the responsibility of the employer.
9.2 Certification of NDT personnel should be based on demonstration of satisfactory qualification in accordance with Sections 6, 7, and 8, as described in the employer's written practice.
9.3 At the option of the employer, an outside agency may be engaged to provide NDT Level III services. In such instances, the responsibility of certification of the employees shall be retained by the employer.
9.4 Personnel certification records should be maintained on file by the employer for the duration specified in the employer's written practice and should include the following:
9.4.1 Name of certified individual.
9.4.2 Level of certification, NDT method and/or technique, as applicable, and limitations (if any), as applicable.
9.4.3 Educational background and experience of certified individuals.
9.4.4 Statement indicating satisfactory completion of training in accordance with the employer's written practice.
9.4.5 Results of the vision examinations prescribed in 8.2 for the current certification period.
9.4.6 Current examination copy(ies) or evidence of successful completion of examinations.
9.4.7 Composite grade(s) or suitable evidence of grades.
9.4.8 Signature of the NDT Level III that verified qualifications of candidate for certification.
9.4.9 Dates of certification and/or recertification.
9.4.10 Certification expiration date.
9.4.11 Signature of employer's certifying authority.
9.5 Certification certificates and wallet cards. The following recommendations are considered best practice and should be followed:
9.5.1 The legal name of the employer should be clearly identified followed by the document number and revision/edition number of the written practice.
9.5.2 The certificate should indicate "*SNT-TC-1A*" followed by the four-digit year of the applicable edition of *SNT-TC-1A* that the written practice was developed to follow.
9.5.3 Full legal name of the certified individual in the ISO basic Latin alphabet. Additional characters may also be used where customary to accommodate local languages.
9.5.4 Level of certification, NDT method and/or technique, as applicable and limitations (if any).
9.5.5 Limitations of certification authorization should be clearly defined, when appropriate for the employer, which may include restrictions on product forms, industry sectors, codes, standards, and examination procedures.

9.5.6 The full printed legal name and signature of both the designated NDT Level III that verified the qualifications of the candidate for certification and the designated certifying aAuthority when the Level III and certifying authority are identified as separate positions in the employer's written practice.

9.5.6.1 If applicable, the ASNT issued Level III identification number, when either or both of the signers hold ASNT Level III certifications.

9.5.7 The certificate or wallet card should be fully completed at the time of signing by the designated NDT Level III and/or certifying authority so that no fill-in-the-blank data remains to be completed by others.

9.5.7.1 Changes to certificates or wallet cards should require that a new certificate or wallet card be issued whenever changes or alterations are necessitated.

9.5.8 Dates of certification and expiration.

**10.0 Technical Performance Evaluation**

10.1 NDT personnel may be reexamined anytime at the discretion of the employer and have their certificates extended or revoked.

10.2 Periodically, as defined in the employer's written practice, NDT Level I and II personnel should be reevaluated by the NDT Level III administering a practical examination. The practical examination should follow the format and guidelines described in Section 8.5.

**11.0 Interrupted Service**

11.1 The employer's written practice should include rules covering the types and duration of interrupted service that requires reexamination and recertification.

11.2 The written practice should specify the requirements for reexamination and/or recertification for the interrupted service.

**12.0 Recertification**

12.1 All levels of NDT personnel shall be recertified periodically in accordance with one of the following criteria:

12.1.1 Evidence of continuing satisfactory technical performance.

12.1.2 Reexamination in those portions of the examinations in Section 8 deemed necessary by the employer's NDT Level III.

12.2 The recommended maximum recertification intervals are 5 years for all certification levels. Certifications expire on the last day of the month of expiration.

12.3 When new techniques are added to the employer's written practice and the NDT Level III personnel is assigned to perform examinations using these new techniques, the NDT Level III personnel should receive applicable training, take applicable examinations and obtain the necessary experience, such that the NDT Level III meets the requirements of the new techniques in Table 6.3.1 A, prior to their next recertification date, in the applicable method.

**13.0 Termination**

13.1 The employer's certification shall be deemed revoked when employment is terminated.

13.2 An NDT Level I, Level II, or Level III whose certification has been terminated may be certified to the former NDT level by a new employer based on examination, as described in Section 8, provided all of the following conditions are met to the new employer's satisfaction:

13.2.1 The employee has proof of prior certification.

13.2.2 The employee was working in the capacity to which certified within six months of termination.

13.2.3 The employee is being recertified within six months of termination.

13.2.4 Prior to being examined for certification, employees not meeting the above requirements should receive additional training as deemed appropriate by the NDT Level III.

**14.0 Reinstatement**

14.1 An NDT Level I, Level II, or Level III whose certification has been terminated may be reinstated to the former NDT level, without a new examination, provided all of the following conditions are met:

14.1.1 The employer has maintained the personnel certification records required in Section 9.4.

14.1.2 The employee's certification did not expire during termination.

14.1.3 The employee is being reinstated within six months of termination.

**15.0 Referenced Publications**

15.1 The following documents contain provisions which, through reference in this text, constitute provisions of this Recommended Practice. Copies may be obtained from The American Society for Nondestructive Testing Inc., 1711 Arlingate Lane, PO Box 28518, Columbus, OH 43228-0518, USA.

15.1.1 *ANSI/ASNT CP-105: ASNT Standard Topical Outlines for Qualification of Nondestructive Testing Personnel*, latest edition.

15.1.2 ASNT Central Certification Program, *ASNT Document CP-1*, latest edition.

15.1.3 *ASNT Policy G-14 – Use of the ASNT Name and ASNT Marks*, latest edition.

15.2 The following document contains specific NDT terms which, though referenced in this text, constitute provisions of this Recommended Practice. Copies may be obtained from ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, USA.

15.2.1 *ASTM E1316* (latest edition) – *Standard Terminology for Nondestructive Examinations, Section A – Common NDT Terms.*

# APPENDIXES

## Appendix A: Example Questions

The purpose of this appendix is to provide a guideline for the preparation of the General, Level I and Level II written examinations. Extensive examples of representative questions for degree of difficulty, type, etc., are provided in separate question booklets, which can be obtained from the ASNT International Service Center. These questions are intended as examples only and should not be used verbatim for qualification examinations.

Note: All questions and answers should be referenced to a recognized source.

### Acoustic Emission Testing

#### Level I

1. A qualitative description of the sustained signal level produced by rapidly occurring acoustic emission events is the accepted definition for:

   a. burst emission.
   b. acoustic emission signature.
   c. acoustic emission signal.
   d. continuous emission.

2. Attenuation of a wave is best defined by which statement?

   a. A decrease in frequency with distance traveled.
   b. A decrease in amplitude with distance traveled.
   c. A decrease in wave speed with distance traveled.
   d. A change in direction as a function of time.

3. The number of times the acoustic emission signal exceeds a preset threshold during any selected portion of a test is called the acoustic emission _____.

   a. response
   b. count
   c. count rate
   d. energy

#### Level II

1. When detecting impulsive acoustic emission signals on large objects, the peak of the signals normally decreases with increasing distance from the source. This alteration, dependent on distance, cannot be explained by:

   a. absorption: the elastic pulse gradually converts into heat.
   b. dispersion: the pulse gradually spreads out in time because the different waves involved travel with different velocities.
   c. the geometric factors: the energy in the pulse is distributed into ever-larger volumes.
   d. density: the more dense (hard) the material, the harder it is to move sound through the object.

2. Which of the following factors will tend to produce low-amplitude acoustic emission response during a tensile test?

   a. Low temperature.
   b. High strain rate.
   c. Plastic deformation.
   d. Crack propagation.

3. The kaiser effect is:

   a. valid only when testing composites.
   b. a physical law of nature that is never violated.
   c. not applicable when an rms recording is being made.
   d. the absence of detectable acoustic emission until previously applied stress levels are exceeded.

# Electromagnetic Testing

## Alternating Current Field Measurement

### Level I

1. What is the medium between an alternating current field measurement (ACFM) probe and a metal surface when operating in air?

   a. An electric current.
   b. Air.
   c. Magnetic field.
   d. Couplant.

2. For which of the following inspection requirements could you NOT normally use ACFM for defect detection?

   a. Fatigue cracks in welded joints of high strength steel.
   b. Subsurface cracks in welded joints of mild steel.
   c. Inspection for cracks in a weld of high strength steel under paint coating.
   d. Surface fatigue in mild steel welds.

3. A fatigue crack perpendicular to the induced current will cause the induced current to:

   a. disperse from the central area of the crack and concentrate around the ends.
   b. disperse from the ends of the crack and concentrate in the central area.
   c. stop flowing in the part.
   d. increase in velocity.

### Level II

1. During an ACFM weld inspection, the measurement of crack depth is NOT dependent on:

   a. the frequency of the inspection.
   b. the length of the crack.
   c. the depth of penetration of the alternating current field.
   d. contact with the part.

2. What effect would you expect if the coils in an ACFM probe were smaller and closer together?

   a. No effect.
   b. Improved detection of smaller defects.
   c. Improved sizing on larger defects.
   d. Improved signal-to-noise ratio.

3. The $B_x$ magnetic field can best be described as:

   a. parallel to the plate surface and perpendicular to the current flow.
   b. perpendicular to the weld.
   c. parallel to the plate surface and parallel to the current flow.
   d. perpendicular to the plate surface and parallel to the current flow.

## Eddy Current Testing

### Level I

1. The impedance of an eddy current test coil will increase if the:

   a. test frequency increases.
   b. inductive reactance of the coil decreases.
   c. inductance of the coil decreases.
   d. resistance of the coil decreases.

2. Which of the following test frequencies would produce eddy currents with the largest depth of penetration?

   a. 100 Hz
   b. 10 kHz
   c. 1 MHz
   d. 10 MHz

3. To generate measurable eddy currents in a test specimen, the specimen must be:

   a. a conductor.
   b. an insulator.
   c. either a conductor or an insulator.
   d. a ferromagnetic material.

### Level II

1. The fill factor when a 1.26 cm (0.5 in.) diameter bar is inserted in a 2.54 cm (1 in.) diameter coil is:

   a. 0.5 (50%).
   b. 0.75 (75%).
   c. 1.0 (100%).
   d. 0.25 (25%).

2. If the characteristic frequency (fg) of a material is 125 Hz, the test frequency required to give an f/fg ratio of 10 would be:

   a. 1.25 Hz
   b. 12.5 Hz
   c. 1.25 kHz
   d. 12.5 kHz

3. For age-hardened aluminum and titanium alloys, changes in hardness are indicated by changes in:

   a. retentivity.
   b. permeability.
   c. conductivity.
   d. magnetostriction.

## Remote Field Testing

### Level I

1. The dominant electromagnetic energy distribution process in remote field testing (RFT) is said to be:

   a. reflected impedance.
   b. through-transmission.
   c. piezoelectric energy conversion.
   d. magnetic motive force.

2. In a properly designed RFT probe, the detector coil is positioned in the:

   a. direct field zone.
   b. transition zone.
   c. remote field zone.
   d. junction between remote field zone and transition zone.

3. The zone next to the near zone is called the:

   a. transition zone.
   b. normal zone.
   c. near field extension zone.
   d. remote field zone.

### Level II

1. In the remote field zone with distance, the magnetic field distribution decays:

   a. linearly.
   b. exponentially.
   c. logarithmically.
   d. and then increases with distance.

2. The exciter and the receiver coil/coils in a remote field probe are separated by a distance greater than _____ the tube diameter.

   a. twice
   b. three times
   c. one time
   d. four times

3. Frequencies selected for RFT inspection are:

   a. higher than used in eddy current.
   b. lower than used in eddy current.
   c. carefully selected and must never be changed during an inspection.
   d. higher than used in ultrasonic testing (UT).

## Ground Penetrating Radar

### Level I

1. The most common form of ground penetrating radar (GPR) measurement is:

   a. using a single transceiver device similar to equipment used in shear wave UT.
   b. by deploying a transmitter and a receiver in fixed geometry over the surface.
   c. microwave propagation through a constant time vector.
   d. inspection for landmines.

2. What are the key wave field properties for GPR?

   a. Time, distance, and velocity.
   b. Reflection, refraction, and direction of travel.
   c. Velocity, attenuation, and EM impedance.
   d. Antenna size, shape, and angle of incidence.

3. Electromagnetic waves separate into two independent components. What are they?

   a. Transverse electric field and transverse magnetic field.
   b. Resolution zone and refraction zone.
   c. High impedance and low impedance.
   d. Focused energy and attenuation.

### Level II

1. The ratio of the largest receivable signal and the minimal detectable signal is called the:

   a. system detection factor.
   b. peak performance ratio.
   c. dynamic range.
   d. maximum depth of detection.

2. What is gating?

   a. A method of expanding the depth of penetration by viewing only a portion of the total signal.
   b. The ability to control the shape of the transmitted signal.
   c. A method of reducing the signal bandwidth.
   d. Timing the transmit and receiver signals to avoid detrimental effects from strong signals.

3. Why is dewowing important?

   a. It acts as a biomonitor.
   b. It helps to produce a stable image of unstable soils.
   c. It allows positive and negative color filling to be used in the recorded trace.
   d. It is generally used to improve section resolution and create more spatial realistics.

## Guided Wave Testing

### Level I

1. The velocity of guided waves depends on all of the following except:

   a. the material properties.
   b. the boundary conditions of the component or part.
   c. the dimensions of the component or part.
   d. the dimension of the transducer.

2. Which of the following is NOT a propagating guided wave mode in pipe?

   a. Bulk compression wave.
   b. Bulk shear wave.
   c. Torsion wave.
   d. Horizontal shear wave.

3. Guided wave testing (GW) of long lengths of pipe:

   a. is used to measure remaining wall thickness.
   b. can determine the change in pipe wall cross section.
   c. is used to measure the exact length of any wall loss.
   d. can determine the exact geometry of any corrosion.

### Level II

1. How are GW results typically calibrated?

   a. Using a target reflector (flat-bottomed hole) machined in a calibration pipe of the same diameter and thickness.
   b. Calibration is not required for GW.
   c. Using an assumed amplitude and known reflectors such as welds.
   d. The results are always calibrated using flange reflections.

2. The dispersion curves for guided waves in steel pipes are MOST influenced by:

   a. changes to the boundary conditions.
   b. changes to the material properties of steel.
   c. temperature changes.
   d. high pressure gas products.

3. Which of the following is a guided wave in plate?

   a. Longitudional waves.
   b. Flexural waves.
   c. Love waves.
   d. Scholte waves.

## Leak Testing

### Bubble Leak Testing

#### Level I

1. Before performing a vacuum box leak test, which of the following should be checked for required calibration?

   a. Leak-detector solution.
   b. Evacuation device or equipment.
   c. Lighting equipment.
   d. Pressure (or vacuum) gauge.

2. Which factor can most affect the sensitivity attainable by a pressure bubble leak test?

   a. Operator alertness and technique.
   b. Size and shape of the test specimen.
   c. Time of day testing is performed.
   d. Number of test technicians.

3. What does the abbreviation psia stand for?

   a. Pressure referred to National Institute of Standards and Technology's absolute pressure.
   b. Pascals per square inch absolute.
   c. Pressure standard in absolute units.
   d. Pounds per square inch absolute.

#### Level II

1. Which of the following factors directly determines the size of the bubble formation when using the bubble leak test method?

   a. Method of application of bubble solution.
   b. Ambient temperature and barometric pressure.
   c. Amount of leakage from a defect or leak.
   d. Size of the test specimen.

2. When a vacuum gauge is marked with a range of 0-30 with the notation "vacuum" on the face, the units of measurement are:

   a. inches of mercury.
   b. pounds per square inch.
   c. centimeters of vacuum.
   d. feet of water.

3. The type of leaks that are most likely to go undetected during a bubble leak test are:

   a. very small leaks and very large leaks.
   b. leaks occurring at welded joints.
   c. corner-configuration joints.
   d. leaks occurring at fittings.

## Halogen Diode Leak Testing

### Level I

1. Good operating practice dictates that the period of time to allow for warm up of the halogen diode detector prior to calibrating is:

   a. 30 minutes.
   b. 15 minutes.
   c. 1 hour.
   d. recommended by the manufacturer.

2. While adjusting a reservoir-type variable-halogen standard leak, the operator accidentally vents the gas from the only standard leak available. Which of the following actions would quickly resolve the problem?

   a. Replace the standard leak.
   b. Replace the cylinder in the standard leak.
   c. Recharge the standard leak.
   d. Send the standard leak to the manufacturer for recharging.

3. While performing a halogen diode leak test, the leak detector becomes difficult to zero, and the pointer on the leak rate meter repeatedly swings up scale. The most likely cause of the problem could be the use of too high a sensitivity range, a shorted element, an excessive heater voltage, or:

   a. poor airflow.
   b. a sensing element that is too new.
   c. a high halogen background.
   d. a faulty leak-rate meter.

### Level II

1. Most leaks detected during a halogen sniffer test could have been detected and usually can be verified by:

   a. a bubble leak test.
   b. an ultrasonic examination.
   c. a visual examination.
   d. a pressure change test.

2. The presence of small traces of halogen vapors in the halogen diode detector:

   a. increases the emission of negative ions.
   b. decreases the emission of positive ions.
   c. increases the emission of positive ions.
   d. decreases the emission of negative ions.

3. A halogen standard leak of a certain size produces a known signal on a halogen leak detector. To receive this same intensity signal on the instrument during the test of an object containing a 2% by volume halogen-air mixture, the size of the leak in the object causing the signal would theoretically have to be at least _____ times larger than the standard leak.

   a. 20
   b. 50
   c. 40
   d. 10

## Mass Spectrometer Leak Testing

### Level I

1. The sensitivity of a mass spectrometer leak detection system is the mass flow rate of tracer gas:

   a. that gives a maximum measurable signal.
   b. that gives a minimum measurable signal.
   c. at standard temperature and pressure.
   d. in a leak.

2. The diffusion pump and mechanical fore pump in a mass spectrometer leak detection system:

   a. use the same type of oil.
   b. use different types of oil.
   c. operate using the same motor.
   d. use the same principle of operation.

3. The helium mass spectrometer detector-probe pressure-test technique is:

   a. a quantitative test.
   b. a qualitative test.
   c. a semiautomatic test.
   d. an automatic test.

### Level II

1. A torr is defined as:

   a. 14.7 psia.
   b. 1 mm of Hg.
   c. 1/760 of a standard atmosphere.
   d. 760 mm of Hg.

2. When conducting helium mass spectrometer test of a vacuum vessel in the pressure range of $10^{-4}$ to $10^{-8}$ mm Hg, which type gauge could be used to measure the pressure?

   a. Alphatron gauge.
   b. Thermionic ionization gauge.
   c. Pirani gauge.
   d. Thermocouple gauge.

3. Helium standard leaks in the range of $10^{-6}$ to $10^{-10}$ atm cc/s are known in general terms as:

   a. reservoir standard leaks.
   b. capillary standard leaks.
   c. permeation standard leaks.
   d. adjustable standard leaks.

## Pressure Change Measurement Testing

### Level I

1. A pressure of 66.0 psig, in terms of absolute pressure at sea level and standard temperature, would be approximately:

   a. 96.0 psia
   b. 80.7 psia
   c. 51.3 psia
   d. 36.0 psia

2. When conducting a long-duration pressure change test, it is necessary to measure absolute pressure or gauge pressure plus barometric pressure because the barometric pressure will:

   a. always fall.
   b. always rise.
   c. remain constant.
   d. tend to vary.

3. Which one of the following is the correct relationship for converting temperature in degrees rankine (°R) to temperature in kelvin (K)?

   a. K = (5/9) °R
   b. K = (5/9) °R + 273
   c. K = 460 + °R
   d. K = 273 °R

### Level II

1. When a system's internal dry bulb's internal temperature and, in turn, total pressure, increase during a pressure change leakage-rate test, the water vapor pressure in the system under test would normally:

   a. increase.
   b. remain the same.
   c. decrease.
   d. oscillate.

2. For a pneumatically pressurized constant-volume system at an internal temperature of 27 °C, what approximate percentage change in the system absolute pressure can be expected for a system internal temperature change of 1 °C?

   a. 3%
   b. 6%
   c. 0.3%
   d. 10%

3. One set of internal dry bulb temperature data for a pressure change leakage-rate test is:

   a. $(T_1 + T_2 + T_3)/3 = 71.87$ °F
   b. $(T_4 + T_5)/2 = 72.32$ °F
   c. $(T_6 + T_7)/2 = 72.68$ °F
   d. $(T_8 + T_9 + T_{10})/3 = 73.07$ °F

## Liquid Penetrant Testing

### Level I

1. Which of the following is generally the more acceptable method for cleaning parts prior to liquid penetrant testing?

   a. Sand blasting.
   b. Wire brushing.
   c. Grinding.
   d. Vapor degreasing.

2. The term used to define the tendency of certain liquids to penetrate into small openings such as cracks or fissures is:

   a. saturation.
   b. capillary action.
   c. blotting.
   d. wetting agent.

3. Which of the following is the most commonly used method for removing non-water-washable visible dye penetrant from the surface of a test specimen?

   a. Dipping in a solvent.
   b. Spraying.
   c. Hand wiping.
   d. Blowing.

### Level II

1. When conducting a penetrant test, spherical indications on the surface of a part could be indicative of:

   a. fatigue cracks.
   b. porosity.
   c. weld laps.
   d. hot tears.

2. A commonly used method of checking on the overall performance of a penetrant material system is by:

   a. determining the viscosity of the penetrant.
   b. measuring the wettability of the penetrant.
   c. comparing two sections of artificially cracked specimens.
   d. measuring the brightness of the penetrant.

3. Which of the following is a discontinuity that might be found in a forging?

   a. Shrinkage crack.
   b. Lap.
   c. Hot tear.
   d. Lamination.

## Magnetic Flux Leakage Testing

### Level I

1. Flux leakage inspection can normally be applied to:

   a. ferromagnetic and nonmagnetic material.
   b. nonmagnetic materials only.
   c. ferromagnetic materials only.
   d. nonconductors only.

2. The ratio $B/H$ is equivalent to a material's:

   a. field strength.
   b. reluctance.
   c. permeability.
   d. relative permeability.

3. Flux leakage techniques can normally be used to detect:

   a. surface discontinuities only.
   b. subsurface discontinuities only.
   c. discontinuities at any location.
   d. surface and near-surface discontinuities.

### Level II

1. The highest sensitivity of a hall effects sensor is obtained when the direction of the magnetic field in relation to the largest surface of the hall probe is:

   a. parallel.
   b. at an angle of 45°.
   c. at an angle of 30° or 60°.
   d. perpendicular.

2. What particular type of defect is not indicated by flux leakage techniques?

   a. Overlap.
   b. Slag inclusion with crack.
   c. Surface contamination.
   d. Longitudinal seam.

3. Flux leakage is created at a discontinuity because of the change in:

   a. resistivity.
   b. inductance.
   c. permeability.
   d. capacitance.

## Magnetic Particle Testing

### Level I

1. Which type of current has a skin effect?

   a. Alternating current.
   b. Direct current.
   c. Half-wave current.
   d. Full-wave current.

2. The best type of magnetic field to use to inspect a tubular product for surface defects along its length is a:

   a. longitudinal field.
   b. circular field.
   c. swinging field.
   d. yoke magnetization.

3. Which of the following is most often used for dry magnetic particle inspection?

   a. Full-cycle direct current.
   b. Half-wave current.
   c. High-voltage, low-amperage current.
   d. Direct current from electrolytic cells.

### Level II

1. When testing a bar with an L/D ratio of 4 in a 10-turn coil, the required current would be:

   a. 45 000 A.
   b. unknown; more information is needed.
   c. 18 000 A.
   d. 1125 A.

2. Which of these cracks may appear as an irregular, checked, or scattered pattern of fine lines usually caused by local overheating?

   a. Fatigue cracks.
   b. Grinding cracks.
   c. Crater cracks.
   d. HAZ cracks.

3. If a copper conductor is placed through a ferrous cylinder and a current is passed through the conductor, then the magnetic field (flux density) in the cylinder will be:

   a. the same intensity and pattern as in the conductor.
   b. greater than in the conductor.
   c. less than in the conductor.
   d. the same regardless of its proximity to the cylinder wall.

## Microwave Technology Testing

### Level I

1. The microwave electromagnetic signal will not propagate through which medium between the probe and the part being tested?

   a. A dielectric plastic.
   b. A vacuum.
   c. A thin metal foil.
   d. Air.

2. In standing wave microwave interferometry, how is the electromagnetic signal transmitted and received?

   a. The signal is transmitted from an emitter through the part and received in a separate receiver on the opposite side.
   b. The signal is generated in an emitter, transmitted past the receiver to the part, and reflected back to the receiver from the part.
   c. The signal is generated in an emitter and reflected from the part back to a separate receiver.
   d. The signal is generated in an emitter, which receives the reflected signal from the part.

3. When microwave energy is reflected and refracted within the volume of the part there is:

   a. a change in dielectric constant in the part.
   b. a change in frequency.
   c. an elastic energy loss.
   d. a conductive surface in the part.

### Level II

1. The approximate wavelength of the microwave electromagnetic signal at 10 GHz in a material with $\varepsilon = 4.0$ is:

   a. 7 mm
   b. 23 mm
   c. 15 mm
   d. 24 mm

2. The least microwave energy penetration (in depth) would be achieved in material with which properties?

   a. nitrile rubber: $\varepsilon = 2.5$, $\tan \delta = 0.05$
   b. sapphire: $\varepsilon = 9.0$, $\tan \delta = 0.0004$
   c. teflon: $\varepsilon = 2.1$, $\tan \delta = 0.0002$
   d. natural rubber: $\varepsilon = 2.1$, $\tan \delta = 0.005$

3. The mechanism of microwave wave interaction with matter to create images is:

   a. ionic conduction in conductive materials.
   b. molecular dipole interactions and ionic conduction.
   c. nuclear scattering.
   d. electron excitation.

## Neutron Radiographic Testing

### Level I

1. Neutron penetration is greatest in which of the following materials?

   a. Hydrogenous material.
   b. Water.
   c. Lead.
   d. Boron carbide.

2. Gadolinium conversion screens are usually mounted in rigid holders called:

   a. film racks.
   b. cassettes.
   c. emulsifiers.
   d. diaphragms.

3. Which element is commonly used for direct neutron radiography?

   a. Cadmium
   b. Indium
   c. Dysprosium
   d. Gadolinium

### Level II

1. Which of the following conversion screens has the longest half-life?

   a. Dysprosium.
   b. Indium.
   c. Cadmium.
   d. Gadolinium.

2. Neutron radiography can be used for inspecting which of the following applications?

   a. Presence of explosives in a metal device.
   b. Presence of chaplets in castings.
   c. Presence of copper wire in steel sleeves.
   d. Presence of heavy metal inclusions in castings.

3. Real-time imaging of thermal neutron radiography can be performed with which of the following detectors?

   a. Gadolinium.
   b. Dysprosium.
   c. Zinc sulfide + lithium fluoride.
   d. Europium.

## Radiographic Testing

### Radiography

### Level I

1. The most widely used unit of measurement for measuring the rate at which the output of a gamma ray source decays is the:

   a. curie.
   b. roentgen.
   c. half-life.
   d. MeV.

2. If an exposure time of 60 seconds were necessary using a 1.2 m (4 ft) source-to-film distance for a particular exposure, what time would be necessary if a 0.61 m (2 ft) source-to-film distance is used and all other variables remain the same?

   a. 120 seconds
   b. 30 seconds
   c. 15 seconds
   d. 240 seconds

3. The sharpness of the outline in the image of the radiograph is a measure of:

   a. subject contrast.
   b. radiographic definition.
   c. radiographic contrast.
   d. film contrast.

### Level II

1. When radiographing to the 2-2T quality level, an image quality indicator (IQI) for 6.35 cm (2.5 in.) steel has a thickness of:

   a. 1.27 cm (0.5 in.).
   b. 63.5 mm ($2.5 \times 10^{-3}$ in.).
   c. 127 mm ($5 \times 10^{-3}$ in.).
   d. 1270 mm ($5 \times 10^{-2}$ in.).

2. The approximate radiographic equivalence factors for steel and copper at 220 kV are 1.0 and 1.4, respectively. If it is desirable to radiograph a 1.27 cm (0.5 in.) plate of copper, what thickness of steel would require about the same exposure characteristics?

   a. 1.78 cm (0.7 in.) of steel
   b. 0.89 cm (0.35 in.) of steel
   c. 3.56 cm (1.4 in.) of steel
   d. 2.54 cm (1.0 in.) of steel

3. If a specimen were radiographed at 40 kV and again at 50 kV, with time compensation to give the radiographs the same density, which of the following statements would be true?

   a. The 40 kV exposure would have lower contrast and greater latitude than the 50 kV exposure.
   b. The 40 kV exposure would have higher contrast and greater latitude than the 50 Kv exposure.
   c. The 50 kV exposure would have lower contrast and greater latitude than the 40 kV exposure.
   d. The 50 kV exposure would have higher contrast and greater latitude than the 40 kV exposure.

## Computed Radiography

### Level I

1. Digital detectors used for computed radiography (CR) employ a unique crystalline material that can best be described as a _____ when exposed to ionizing radiation.

   a. phosphor that stores light energy
   b. phosphor that stores radiation
   c. crystal that stores electrons
   d. phosphor that stores a latent image

2. CR uses changes in _____ in lieu of changes in optical density change to produce a visual image.

   a. bits and bytes
   b. pixels
   c. shades of gray
   d. digital values

3. CR uses a _____ in lieu of a film densitometer to determine exposure adequacy.

   a. lasso tool
   b. pixel value tool
   c. digital gauge
   d. analog gauge

### Level II

1. A commercial computed radiographic system classification, such as *ASTM E 2446*, groups CR systems using a _____ rating in order to characterize their relative performance levels.

   a. standard image quality
   b. light photometer
   c. equivalent IQI
   d. ISO index

2. The phenomenon that causes materials to emit light in response to external stimuli is known as:

   a. stimulation.
   b. fluorescence.
   c. reticulation.
   d. vibration.

3. Photo stimulated luminescence (PSL) is a process in which a phosphor that has ceased emitting light because of removal of the stimulus once again emits light when excited by light with a _____ than the emission wavelength.

   a. shorter wavelength
   b. longer wavelength
   c. higher frequency
   d. lower frequency

## Computed Tomography

### Level I

1. The mechanical/manipulation system has the function of _____ and _____.

   a. positioning the test object between source and detector; storing the data
   b. holding the test object; positioning the computer
   c. moving the source and detector; positioning the test object between source and detector
   d. holding the test object; positioning the test object between source and detector

2. The purpose of the radiation detector is to convert the measured transmission of X-rays through the object into _____ to be handled by electronic processing.

   a. a phosphor
   b. a crystal
   c. an electrical signal
   d. a digital signal

3. The extent to which a computed tomography (CT) image reproduces an object or feature within an object is influenced by spatial resolution:

   a. detector type, source-to-object distance, and radiation source.
   b. statistical noise, slice plane thickness, and artifacts.
   c. radiation source, statistical noise, and detectors.
   d. statistical noise, detector type, and radiation source.

### Level II

1. A CT image is a representative map of _____ at each point in the plane.

   a. density measurements
   b. linear X-ray attenuation coefficients
   c. noise measurements
   d. X-ray scattered photons

2. Spatial resolution has a limiting value determined by the _____ of the system and the amount of data and _____.

   a. design and construction; sampling schema
   b. size; X-ray source energy
   c. design and construction; X-ray source energy
   d. size; sampling schema

3. Contrast sensitivity refers to the ability to _____ the presence or absence of features in an image.

   a. mask
   b. calculate
   c. detect
   d. neglect

## Digital Radiography

### Level I

1. A digital detector array (DDA) can best be defined by:

   a. a device that utilizes a flexible phosphor plate and an electrical scanning device.
   b. a device that converts the analog radiographic film into a discrete electronic output and is then digitized for display on a computer monitor.
   c. a device utilizing a digital camera system in conjunction with a phosphor plate providing real-time or static image capture.
   d. an electronic device that converts penetrating radiation into an analog signal and then digitizes it for display on a computer monitor.

2. What is one of the prime reasons to perform a DDA calibration?

   a. To ensure all measurements will be calibrated with an object of known dimensions to compensate for geometric enlargement if the object is not directly in contact with the detector.
   b. To increase the photon collection rate.
   c. Optimize the performance of the DDA.
   d. To minimize the backscatter to an acceptable level especially at high energies.

3. Changes in the thickness of the specimen are indicated by _____ in the digital image.

   a. a change in area
   b. a change in gray scale
   c. a lack of resolution in the image sharpness
   d. the relationship between exposure and the resultant pixel pitch of the detector

### Level II

1. The term "bad pixel" is best described as a pixel:

   a. of a DDA that has performance outside the specification range.
   b. that is processed or sampled due to frame averaging.
   c. that must receive some type of correction to ensure all indications regardless of size resulting from rejectable discontinuities will be evaluated.
   d. that does not operate at all.

2. A pixel is:

   a. a three-dimensional representation of data.
   b. the average addressable element in a display device.
   c. the largest addressable element in a display device.
   d. the smallest addressable element in a display device.

3. One of the main advantages of digital radiography, or flat panel utilization, as compared to CR to accomplish an inspection task is typically:

   a. portability.
   b. inspection speed.
   c. initial cost.
   d. detector flexibility.

## Thermal/Infrared Testing

### Level I

1. Which of the following infrared camera settings may affect a radiometric temperature measurement?

   a. Span.
   b. Level.
   c. Palette.
   d. Focus.

2. Thermal infrared radiation occurs at wavelengths:

   a. shorter than X-rays.
   b. shorter than visible light.
   c. longer than visible light.
   d. longer than radio waves.

3. Which of the following camera parameters is not adjustable in post-processing computer software?

   a. Span.
   b. Level.
   c. Emissivity.
   d. Range.

### Level II

1. Latent heat energy can be described as the energy:

   a. that creates or breaks the molecular bonds of the phase state of a material.
   b. that when added to a material will cause its temperature to increase.
   c. released by a material that will cause its temperature to decrease.
   d. released by an object that will break the molecular bonds of a material.

2. Which of the following surfaces will provide the most accurate radiometric temperature measurement?

   a. Thin film plastic.
   b. Oxidized aluminum.
   c. Glass.
   d. Water-based paint.

3. How hot does an electrical connection need to be for it to be classified as a serious problem?

   a. 1 to 5 °C (33.8 to 41 °F).
   b. 5 to 15 °C (41 to 59 °F).
   c. Greater than 15 °C (59 °F).
   d. Depends on the criticality of equipment to continued safe operation.

## Ultrasonic Testing

### Level I

1. The amount of beam divergence from a transducer element is primarily dependent on the:

   a. type of test.
   b. tightness of the transducer element backing in the search unit.
   c. frequency and transducer element size.
   d. refraction.

2. On the area-amplitude ultrasonic standard test blocks, the flat-bottomed holes in the blocks are:

   a. all of the same diameter.
   b. different in diameter, increasing by 1/64 in. (0.39 mm) increments from the No. 1 block to the No. 8 block.
   c. largest in the No. 1 block and smallest in the No. 8 block.
   d. drilled to different depths from the front surface of the test block.

3. On many UT instruments, an operator conducting an immersion test can remove that portion of the screen presentation that represents water distance by adjusting a:

   a. pulse-length control.
   b. reject control.
   c. sweep-delay control.
   d. sweep-length control.

### Level II

1. If a contact angle-beam transducer produces a 45° shear wave in steel (VS = 0.323 cm/s), the angle produced by the same transducer in an aluminum specimen (VS = 0.310 cm/s) would be:

   a. less than 45°.
   b. greater than 45°.
   c. 45°.
   d. more information is required.

2. A discontinuity is located having an orientation such that its long axis is parallel to the sound beam. The indication from such a discontinuity will be:

   a. large in proportion to the length of the discontinuity.
   b. small in proportion to the length of the discontinuity.
   c. representative of the length of the discontinuity.
   d. such that complete loss of back-reflection will result.

3. An ultrasonic longitudinal wave travels in aluminum with a velocity of 635 000 cm/s and has a frequency of 1 MHz. The wavelength of this ultrasonic wave is:

   a. 6.35 ft
   b. 3.10 in.
   c. 6.35 mm
   d. 30 000 Å

### Phased Array Ultrasonic Testing

#### Level II

1. Identify the factors that would produce the largest beam steering angles:

   a. large elements, small pitch, high-frequency testing low-velocity materials.
   b. small elements, small pitch, high-frequency testing low-velocity materials.
   c. large elements, small pitch, low-frequency testing high-velocity materials.
   d. small elements, small pitch, low-frequency testing high-velocity materials.

2. Which of the following best fits this description "the ultrasonic capabilities of resolving two adjacent defects along the acoustical axis through a small ultrasonic path"?

   a. Lateral resolution.
   b. Axial resolution.
   c. Resolution.
   d. Sensitivity.

3. What happens to the beam spread at higher beam angles when using a swept angle scan from 45° to 70°?

   a. The beam spread decreases.
   b. The beam spread increases.
   c. The beam spread does not change.
   d. Beam spread cannot be changed with angle.

### Time of Flight Diffraction

#### Level II

1. Frequencies used for TOFD inspection are most dependent on:

   a. near field, beam spread, and the reflection factor of the material.
   b. acoustic impedance, beam spread, and penetrating ability.
   c. the thickness of the thinner part.
   d. sensitivity, beam spread, and penetrating ability.

2. Calculate the probe center spacing (PCS) to focus at a 15 mm depth using a pair of 70° probes.

   a. 41.3 mm
   b. 54.6 mm
   c. 82.4 mm
   d. 93.8 mm

3. Calculate the depth of a defect given the following information:

   Tx probe delay: 7.8 µs (pulse-echo measured)
   Rx probe delay: 6.2 µs (pulse-echo measured)
   PCS 59.6 mm
   Bottom tip signal 30 µs
   Material velocity 5960 m/s longitudinal
   3230 m/s transverse
   3010 m/s surface

   a. 29.8 mm
   b. 37.2 mm
   c. 61.7 mm
   d. 69.2 mm

## Vibration Analysis

#### Level I

1. The vibration amplitude is a response that is:

   a. inversely proportional to the dynamic resistance in the system.
   b. proportional to the amount of displacement in the signal.
   c. not related at all to the dynamic forces in the system.
   d. meaningless unless it has been initially taken in acceleration units.

2. If a magnet is attached to an accelerometer, it will:

   a. lower the frequency range capability of the accelerator.
   b. increase the frequency range capability of the accelerator.
   c. not allow the accelerometer to read in acceleration units anymore.
   d. increase the amplitude range of the accelerometer.

3. The enter or store key on a programmable FFT-Analyzer/Data collector should be pressed:

   a. as soon as the accelerator is attached to the mounting surface.
   b. after a pause of 30 seconds from the time the accelerometer is mounted.
   c. after the readings have settled down (usually 3 seconds or longer).
   d. immediately when a display appears on the screen (to save time).

### Level II

1. A lissajous orbit that has a long elliptical (cigar shape) appearance is an indication of:

   a. unbalance.
   b. misalignment.
   c. an oil whirl.
   d. a rub event.

2. The purpose of a bode or polar (nyquist) plot is to verify the presence of:

   a. an eccentricity.
   b. a defective bearing.
   c. a resonance.
   d. a bent shaft.

3. The two most common problems that will produce a higher amplitude at 2× RPM than at 1× RPM in a vibration spectrum are:

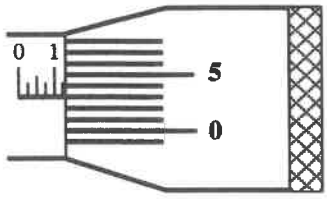
   a. an eccentric pulley and mechanical looseness (Type A).
   b. offset misalignment and mechanical looseness (Type B).
   c. a shaft bent between its bearings and worn gear teeth.
   d. an unbalanced shaft and mechanical looseness (Type C).

## Visual Testing

### Level I

1. Which of the following is true?

   a. All discontinuities are defects.
   b. Defects that affect the product's usefulness are called discontinuities.
   c. Discontinuities that affect the product's usefulness are called defects.
   d. All discontinuities are unacceptable.




2. The dimension indicated on the sketch of a micrometer is:

   a. 3.25 mm (0.128 in.)
   b. 5.97 mm (0.235 in.)
   c. 3.20 mm (0.126 in.)
   d. 8.33 mm (0.328 in.)

3. As a visual examiner, you shall have your eyes checked at least:

   a. every 3 months.
   b. every 6 months.
   c. every year.
   d. every 3 years.

**Level II**

1. Handheld magnifiers should fall into which of the following ranges?

   a. 2× to 4×
   b. 5× to 10×
   c. 10× to 20×
   d. 20× to 3×

2. Visual examiners who perform visual exams using borescopes and fiber borescopes must be:

   a. color blind.
   b. able to meet far-vision requirements (Snellen 20/30).
   c. competent in their use.
   d. ambidextrous.

3. A narrow field of view produces:

   a. higher magnification and a greater depth of field.
   b. higher magnification and a shorter depth of field.
   c. less magnification and a greater depth of field.
   d. less magnification and a shorter depth of field.

## Answers to Example Questions

### ACOUSTIC EMISSION TESTING

| Level I | Level II |
|---|---|
| 1. d | 1. d |
| 2. b | 2. c |
| 3. b | 3. d |

### ELECTROMAGNETIC TESTING

#### Alternating Current Field Measurement

| Level I | Level II |
|---|---|
| 1. b | 1. d |
| 2. b | 2. b |
| 3. a | 3. a |

#### Eddy Current Testing

| Level I | Level II |
|---|---|
| 1. a | 1. d |
| 2. a | 2. c |
| 3. a | 3. c |

#### Remote Field Testing

| Level I | Level II |
|---|---|
| 1. b | 1. a |
| 2. c | 2. a |
| 3. a | 3. b |

### GROUND PENETRATING RADAR

| Level I | Level II |
|---|---|
| 1. b | 1. c |
| 2. c | 2. d |
| 3. a | 3. c |

### GUIDED WAVE TESTING

| Level I | Level II |
|---|---|
| 1. d | 1. c |
| 2. d | 2. a |
| 3. b | 3. b |

### LEAK TESTING

#### Bubble Leak Testing

| Level I | Level II |
|---|---|
| 1. d | 1. c |
| 2. a | 2. a |
| 3. d | 3. a |

#### Halogen Diode Leak Testing

| Level I | Level II |
|---|---|
| 1. d | 1. a |
| 2. c | 2. c |
| 3. c | 3. b |

#### Mass Spectrometer Leak Testing

| Level I | Level II |
|---|---|
| 1. b | 1. c |
| 2. b | 2. b |
| 3. b | 3. c |

#### Pressure Change Leak Testing

| Level I | Level II |
|---|---|
| 1. b | 1. a |
| 2. d | 2. c |
| 3. a | 3. a |

### LIQUID PENETRANT TESTING

| Level I | Level II |
|---|---|
| 1. d | 1. b |
| 2. b | 2. c |
| 3. c | 3. b |

### MAGNETIC FLUX LEAKAGE TESTING

| Level I | Level II |
|---|---|
| 1. c | 1. d |
| 2. c | 2. c |
| 3. d | 3. c |

## MAGNETIC PARTICLE TESTING

| Level I | Level II |
|---|---|
| 1. a | 1. d |
| 2. b | 2. b |
| 3. b | 3. b |

## MICROWAVE TECHNOLOGY TESTING

| Level I | Level II |
|---|---|
| 1. c | 1. c |
| 2. b | 2. a |
| 3. a | 3. b |

## NEUTRON RADIOGRAPHIC TESTING

| Level I | Level II |
|---|---|
| 1. c | 1. a |
| 2. b | 2. a |
| 3. d | 3. c |

## RADIOGRAPHIC TESTING

### Radiography

| Level I | Level II |
|---|---|
| 1. a | 1. d |
| 2. c | 2. a |
| 3. b | 3. c |

### Computed Radiography

| Level I | Level II |
|---|---|
| 1. d | 1. a |
| 2. c | 2. b |
| 3. b | 3. b |

### Computed Tomography

| Level I | Level II |
|---|---|
| 1. d | 1. b |
| 2. c | 2. a |
| 3. b | 3. c |

### Digital Radiography

| Level I | Level II |
|---|---|
| 1. d | 1. a |
| 2. c | 2. d |
| 3. b | 3. b |

## THERMAL/INFRARED TESTING

| Level I | Level II |
|---|---|
| 1. d | 1. a |
| 2. c | 2. d |
| 3. d | 3. d |

## ULTRASONIC TESTING

| Level I | Level II |
|---|---|
| 1. c | 1. a |
| 2. b | 2. b |
| 3. c | 3. c |

### Phased Array Ultrasonic Testing

**Level II (only)**
1. d
2. b
3. b

### Time of Flight Diffraction

**Level II (only)**
1. d
2. c
3. c

## VIBRATION ANALYSIS

| Level I | Level II |
|---|---|
| 1. a | 1. b |
| 2. a | 2. c |
| 3. c | 3. b |

## VISUAL TESTING

| Level I | Level II |
|---|---|
| 1. c | 1. b |
| 2. a | 2. c |
| 3. c | 3. b |

## Appendix B. NDT Practical Examination Checklist

NAME: _____ EMPLOYEE #: _____

COMPANY: _____ LOCATION: _____

DATE: _____ NDT METHOD: _____

PROCEDURE DESCRIPTION: _____

SPECIMEN(S) DESCRIPTION: _____

Time Started: _____ Time Completed: _____

| No. | Categories | Points | Score | Remarks |
|---|---|---|---|---|
| 1. | **Knowledge of NDT Procedure**<br>• Familiarity<br>• Utilization<br>• Consideration for limitations<br>• Adherence to procedural details | 10 | | Record the presence or absence of actions that support your score. Was the procedure picked up, thumbed through, read ahead of time, highlighted or marked up. Did the candidate refer to the procedure when questions arose? Did the output comply with the procedure? |
| 2. | **Equipment and Material**<br>• Stated in procedure or user experience<br>• Proficiency in set up, utilization, and calibration<br>• Proficiency in technique and standardization | 5 | | Record the presence or absence of actions that support your score. Note the equipment and materials used. Evaluate the procedure for calibration adequacy, ease of use, and care. |
| 3. | **Test Specimen Care and Custody**<br>• Appropriate pre-cleaning<br>• Maintenance/control<br>• Appropriate post-cleaning | 5 | | Record the presence or absence of actions that support your score. Note preparation adequacy, specimen care, final cleaning, and final specimen condition. |
| 4. | **Operations**<br>• Calibration verification<br>• Adhering to procedures<br>• Adherence to the sequencing requirements<br>• Utilization of appropriate testing media<br>• Inspecting designated areas of interest | 10 | | Record the presence or absence of actions that support your score. State if calibration was verified or not. List steps followed. Note any steps missed. Describe actual test media used, area of interest, and area(s) missed. |
| 5. | **Detection of Indications**(1)<br>• Adherence to procedure requirements<br>• Accuracy (detection of critical indications)<br>• Finding detectable indications | 15 | | Record the presence or absence of actions that support your score. List all procedure requirements not followed. Note number of hits, misses, and false calls. Reference attached report annotated. |
| 6. | **Interpretation of Indications**<br>• Adherence to procedure requirements<br>• Accuracy (interpreting the critical indications)<br>• Interpreting relevant indications | 15 | | Record the presence or absence of actions that support your score. Identify metrics reflecting inspection accuracy or inaccuracy. Refer to attached report and interpretation standards compared to known defect map and characterization. |
| 7. | **Evaluation of Indications**(2)<br>• Following procedure requirements<br>• Accuracy (evaluating the critical indications)<br>• Evaluating relevant indications | 20(3) | | Record the presence or absence of actions that support your score. Quantify discrimination accuracy and margin of error between relevant and nonrelevant indications. |
| 8. | **Documentation and Records**<br>• Accurate documentation<br>• Proper data processing<br>• Appropriate control of records<br>• Compliance with procedural routing | 10 | | Record the presence or absence of actions that support your score. State degree of completeness, legibility, clarity, correctness, and appearance of reports with errors and omissions. |
| 9. | **General Health and Safety**<br>• Familiarity with health and safety of method<br>• Volatile substances<br>• Electrical hazards<br>• Respiratory concerns<br>• Compliance with specific site procedures | 5 | | Record the presence or absence of actions that support your score. State violations of industry standards and practices. General statement of compliance is acceptable if no violations. |
| 10. | **General Observable Conduct**<br>• Proficiency in knowledge of the method<br>• Proficiency in application of the method<br>• Proficiency in the results<br>• Adherence to a professional behavior | 5 | | Record the presence or absence of actions that support your score. List comments or behavior that supports or detracts from examinee performance. |

**(1)** The candidate should detect all discontinuities and conditions specified by the NDT Level III.
**(2)** No more than 10% false calls allowed.
**(3)** 80% of designated defects correctly classified (16 points required to pass).

Print/Signature of NDT Level III: _____ Date: _____

## Appendix C. Example Certification Template

| | |
|---|---|
| Date of Certification | *{Insert}* |
| Date of Certification Expiration | *{Insert}* |

9.5.8

9.5.1

# *{INSERT LEGAL COMPANY NAME}*

9.5.1

## NDT CERTIFICATE

**This is to certify that the individual named below has successfully completed experience, training, and examination requirements in accordance with the provisions of *{INSERT LEGAL COMPANY NAME}* NDT Written Practice for the Qualification and Certification of NDT personnel *{INSERT WRITTEN PRACTICE IDENTIFICATION NUMBER & REVISION}*.**

9.5.3

## *{INSERT FULL LEGAL NAME OF INDIVIDUAL}*

**Is hereby certified to perform the following Nondestructive Testing Method(s)**

9.5.4 & 9.5.5

| NDT Method | NDT Level | NDT Technique (as applicable per written practice) | Limitations (if any) |
|---|---|---|---|
| *{Insert}* | *{Insert}* | *{Insert}* | *{Insert}* |

9.5.4 9.5.4 9.5.4

9.1

**Certified on behalf of the Certifying Authority - *{INSERT LEGAL COMPANY NAME}***

**Sign:** 9.5.6

**Print Name**

***{INSERT LEGAL COMPANY NAME}* designated Level III**

**Sign:** 9.5.6

**Print Name:**

9.5.2

This company written practice intends to meet or exceed the requirements of ASNT published document SNT-TC-1A *{INSERT EDITION YEAR OF ISSUANCE THAT THE COMPANY IS REQUIRED TO COMPLY WITH}* as it applies to NDT performed by this company.

## *SNT-TC-1A* Interpretation Request Form

Each inquiry should address a specific section or paragraph of *SNT-TC-1A*. If submitting multiple inquiries, submit a separate form for each inquiry.

In the top section of the form, provide complete contact information so that you can be reached should clarification be required. List the *SNT-TC-1A* edition (year) being referenced and the specific paragraph or section in question.

In the Inquiry block, state the question in the clearest terms possible and in a manner that will permit a Yes or No answer if possible.

In the Background block, provide any additional information that will explain the need for the clarification or the intent of a paragraph or section. Attach additional pages if necessary.

The **Proposed Response** block is for ASNT use only.

### *SNT-TC-1A* INQUIRY REQUEST FORM

Submit to: Chair, SNT-TC-1A Interpretation Panel
c/o Director of Standards and Accreditation
Email: SNT-TC-1Ainterpretations@asnt.org

Date:

*ASNT USE ONLY*

Inquiry #:

Name: _____ Phone: _____ Email: _____

Address: _____ City: _____ State: _____ Zip: _____

Country: _____ *SNT-TC-1A* Edition: _____ Associated Paragraph(s): _____

Inquiry:

Background (Add any additional information that will clarify the situation, need, etc.):

PROPOSED RESPONSE (ASNT Use Only)

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The American Society for
Nondestructive Testing Inc.