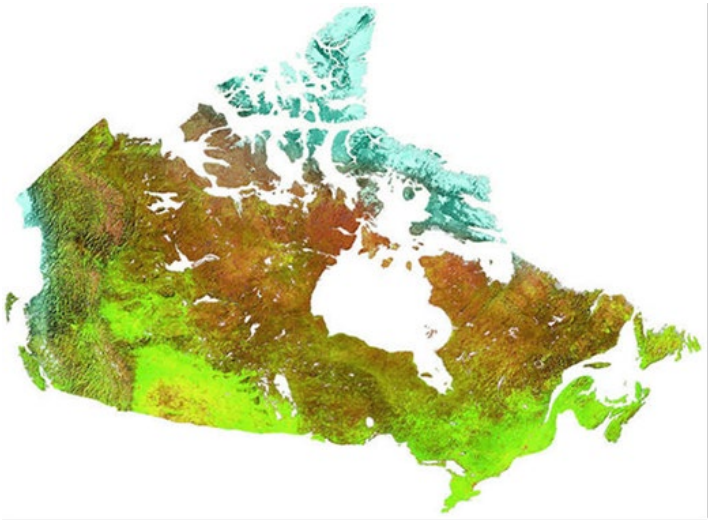
Penetrant Testing

Examination Guide for Initial Certification



Engineering, Materials and Components Sector

Canada

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Ce guide est aussi disponible en français à l'adresse suivante :

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Overview of NRCan National Non-destructive Testing Certification Body Services

The Natural Resources Canada (NRCan) National Non-Destructive Testing Certification Body (NDTCB) manages Canada's nation-wide program for the certification of individuals performing non-destructive testing (NDT). The NRCan NDTCB certifies individuals according to CAN/CGSB-48.9712-2014 / (ISO 9712:2012, IDT) standard.

In performing this function, the NRCan NDTCB carries out the following tasks:

a) Examines the information provided by the applicant to ensure that the applicant has the basic education, recommended NDT training and experience required by the standard;
b) Prepares, administers and evaluates both written and practical examinations;
c) Maintains a network of examination centres across Canada for both written and practical examinations;
d) Renews and recertifies certificates as specified by the standard.

In certifying a candidate, the NRCan NDTCB only attests that the candidate has demonstrated sufficient knowledge, skill, training and experience to meet the requirements of the CAN/CGSB 48.9712 standard. The NRCan NDTCB cannot attest to the certificate holder's competence in any specific situation at the time of original certification, or at any time thereafter.

In undertaking the administration of the program, the NRCan NDTCB attempts to provide the unbiased Canada-wide services required to implement a national program. A group of Scheme, Technical and Advisory Committees composed of stakeholders and individuals knowledgeable about NDT in Canada advises the NRCan NDTCB on the operation of this program.

IMPORTANT NOTICE

The candidate is responsible to ensure that the examination centre has proof of their examination registration approval and/or examination admittance and registration form issued by the NRCan NDTCB prior to the scheduled written or practical examination/re-examination. Failure to do this may delay the start time of the certification examination and may increase cost to the candidate.

In accordance with CAN/CGSB-48.9712-2014 / (ISO 9712:2012, IDT), paragraph 8, the initial certification examination for Levels 1 & 2 consists of the following examination parts: a general written examination, a specific written examination, and a practical examination. A candidate who fails to achieve a grade of at least 70% on each individual examination part and each practical examination specimen/subpart may retake the examination according to the following criteria and schedule:

> A candidate who fails to obtain the pass grade for any examination part may be re-examined twice in the failed part(s), provided that the re-examination takes place not sooner than 1 month, and shall not exceed 2 years after the original examination.

The NDT Certification Body reserves the right of choice for written or practical examination components.

All practical examination times are shown in increments of ½ day or 1 day; ½ day shall be considered a maximum of 4 hours and 1 day shall be considered a maximum of 8 hours. Requests for accommodation (such as additional examination time) can only be granted with authorization from the NRCan NDTCB, following its "8.5-009 - NRCan NDTCB Procedure for Consideration of Candidate Requests for Accommodation". The authorized accommodations shall be noted in the candidate's examination registration approval and/or examination admittance and registration form. It is the candidate's responsibility to notify the examination centre of these accommodations at least 10 working days in advance of the examination.

NOTE: Additional information/instruction may be provided to the candidate at the start of the examination. The NRCan NDTCB may have implementation rules and policies that supersede the information provided within this guide.

Suggestions for Success: Written Examinations

1 The NRCan NDTCB recommends that all candidates for NDT written qualification examinations study extensively on their own time using the suggested reference material, in addition to the material learned during the method/level-specific training course, prior to attempting a written examination. Simply using your knowledge obtained by completing the theoretical portion of the training course will not adequately prepare you to succeed in your written examinations.

Note: You should not use the results of your end-of-course examination from your method/level-specific training course to estimate your level of success on the NRCan NDTCB written qualification examinations.

2 To assess your knowledge/abilities in preparation for a written examination, the NRCan NDTCB recommends completing/reviewing the following sample question resources available for personal purchase:
   a) Ginzel Bros. NDT Testmaker Questions Data Base
   b) Supplements to Recommended Practice SNT-TC-1A (Question and Answer Books)

3 When you begin your written examination, ensure that you carefully read the examination instructions prior to reading and answering the questions.

4 Before you answer a multiple-choice question, ensure that you carefully read the stem (beginning portion) of the question and each alternative answer in order to accurately understand the question.

5 Remember, that although more than one multiple-choice alternative answer may appear to be correct or partially correct, only the **best** answer is correct.

6 If you have difficulty with choosing an answer to a multiple-choice question, proceed by first eliminating the alternative answers that you believe are incorrect, and then choose between the remaining alternative answers.

7 If you find that you cannot answer a question, proceed to the next question(s), and return to any unanswered questions prior to the end of the examination. Do not spend too much time on difficult questions at the expense of completing the remaining questions.

Reference Material

The material identified in this guide as reference study material may be purchased from the following sources:

Canadian Institute for NDE (CINDE) 135 Fennell Avenue W. Hamilton, Ontario L8N 3T2 Canada Telephone: (905) 387-1655 or 1 800-964-9488 Facsimile: (905) 574-6080	ASNT 1711 Arlingate Lane P.O. Box 28518 Columbus, Ohio 43228 - 0518 U.S.A. Telephone: (614) 274-6003 or 1-800-222-2768 Facsimile: (614) 274-6899

Penetrant Testing Level 2

Penetrant Testing Level 2 (PT2) - Engineering, Materials and Components (EMC) Sector Examination Scheme in Accordance with CAN/CGSB-48.9712

Examination Part			
General Written Examination	≥70%	• 40 multiple choice questions on the theoretical principles of PT.	1 hour
EMC (Specific) Written Examination	≥70%	• 50 multiple choice questions (total) ➢ 20 questions on materials & processes and discontinuities. ➢ 10 questions on a code. ➢ 20 questions on PT applications and techniques.	2 hours
Practical Examination	≥70% (on each specimen/subpart)	• Performance/Calibration checks • Four (4) specimen inspections, including inspection reports for each. ➢ One (1) specimen inspected using colour contrast, solvent removable system. ➢ Three (3) specimens inspected using the fluorescent method WW & PE systems. • Detailed written instruction for one (1) of the inspected specimens.	4 hours

Reference Material for PT2 EMC Written Examination Preparation

General and EMC Examinations

1. Nondestructive Testing Handbook - Liquid Penetrant Testing, By ASNT – Latest Edition
2. Betz Handbook on Liquid Penetrant Testing
3. Penetrant Testing: A Practical Guide, By David Lovejoy
4. ASM Metals Handbook – Volume 17; by ASM International
5. Personnel Training Publications, Liquid Penetrant Testing; by ASNT
6. Handbook of Nondestructive Evaluation, 2nd edition; by Chuck Hellier
7. General Dynamics Classroom Training Handbook CT-2 by PH Diversified

Materials and processes

Although Materials & Processes (M&P) training is a prerequisite to all NDT training, method-specific M&P content is still a component of the NDT certification examinations. The following reference material may have been used to prepare examination questions:

1. Basic Metallurgy for Nondestructive Testing by BINDT
2. Materials and Processes for NDT Technology by ASNT
3. Nondestructive Testing Handbook , Introduction (PI-4-1) by General Dynamics
4. Metallurgy for the Non-Metallurgist. Second Edition by ASM International

Codes and Standards

The following six codes/specifications/techniques were utilized to draft the PT2 EMC examination questions on codes (new codes/questions may be added periodically):

1. Article 6 Liquid Penetrant Examination, ASME
2. Standard Practice for Liquid Penetrant , Examination for General Industry, ASTM E 165
3. Standard Practice Liquid Penetrant Testing, ASTM E 1417
4. MIL-STD-6866
5. Standard Practice for Fluorescent Penetrant Examination Using the Water Washable Process, ASTM E 1209
6. Standard Practice for Visible Penetrant Testing Using Solvent Removable Process, ASTM E 1220

Note: Most of the subjects covered by the General and EMC written examinations are found in the above publications; however, additional studying from other reference material may be useful.

Sample Questions: PT2 General Written Examination

1. Aside from increasing the integrity and safety of manufactured pieces, nondestructive testing cuts costs by:

    a) increasing production rates
    b) reducing personnel
    c) eliminating poor stock prior to processing
    d) all of the above

2. The tendency of a liquid penetrant to enter a discontinuity is primarily related to:

    a) the viscosity of the penetrant.
    b) the capillary forces.
    c) the chemical inertness of the penetrant.
    d) the specific gravity of the penetrant.

3. The ability of a liquid to wet a surface is measured by the contact angle, i.e. the angle between the liquid and the surface at the point of contact as the liquid advances. Good penetrants should have:

    a) a very small contact angle.
    b) a very large contact angle.
    c) a contact angle of approximately 45°.
    d) a contact angle greater than 90°.

4. Acids and chromates should not be left on the surface of parts that will be inspected with a water-washable fluorescent penetrant because:

    a) they may prevent the penetrant from entering any discontinuities.
    b) they may reduce the bleed-out.
    c) they may kill the fluorescence of the penetrant.
    d) they may produce non-relevant indications.

5. Which of the following is the best reason why excessive drying of a part is not desired?

    a) The extra time required is wasted.
    b) The developer may lose its blotting ability.
    c) A reduction in resolution may result.
    d) The excess developer may be difficult to remove.

6. Both fluorescent and visible dye penetrants are identified by:

    a) dwell times
    b) viscosity
    c) method of application
    d) method of removal

7. Black light used in penetrant testing has its peak at:

    a) 5550 angstroms (555 nm)
    b) 4850 angstroms (485 nm)
    c) 4250 angstroms (425 nm)
    d) 3650 angstroms (365 nm)

8. Blacklight is considered to be in the range of:

    a) long wavelength ultraviolet
    b) short wavelength ultraviolet
    c) short wavelength infrared
    d) 500 to 800 nm

9. The single most important factor determining the speed penetrant enters a flaw is:

    a) surface finish
    b) viscosity
    c) method of application
    d) depth of defect

10. A good penetrant must be:

    a) inert with respect to the materials being tested.
    b) highly viscous.
    c) highly volatile.
    d) an inorganic base liquid.

11. Nonaqueous suspensible developers are used primarily with:

    a) fluorescent penetrants
    b) oil and whiting
    c) colour contrast penetrants
    d) post emulsified penetrants

12. Which factor does <u>not</u> determine the liquid penetrant technique to be used?

    a) Expected service of part
    b) form and stage of manufacture of the part
    c) expected defect orientation
    d) cost of inspection

13. In order to evaluate a defect an inspector must have:

    a) a knowledge of the test
    b) a knowledge of the material tested
    c) a knowledge of the applicable codes
    d) all of the above

14. Viscosity is used to determine drag out. Units used to measure viscosity are:

    a) poundals
    b) m/sec
    c) centistokes
    d) milligravs per cc

15. The preferred colour for liquid penetrants used in leak detection is:

    a) yellow-green
    b) green-blue
    c) orange
    d) red

Answer Key

1. c)	2. b)	3. a)	4. c)	5. c)
6. d)	7. d)	8. a)	9. b)	10. a)
11. c)	12. c)	13. d)	14. c)	15. d)

Sample Questions: PT2 EMC Written Examination

1. It may be said that specialists in non-destructive testing must:
    a) be aware of the capabilities of materials to sustain deformation without forming defects.
    b) be knowledgeable about the materials they inspect and the defects which can form in them.
    c) have an exhaustive knowledge of metallurgy.
    d) all the above answers are correct.

2. Which of the following statements is correct?
    a) The heat affected zone of a weld is basically a homogeneous structure.
    b) In some areas of the weld heat affected zone, grain size can be smaller than in the unaffected base metal.
    c) The temperature in the heat affected zone can sometimes exceed the temperature in the fusion zone.
    d) Transverse cracks do not occur in the heat affected zone.

3. Metal forming such as rolling results in:
    a) plastic flow of the metal.
    b) elongation of existing defects perpendicular to the rolling direction.
    c) directional properties which are always beneficial for secondary forming operations.
    d) the flattening out of defects which makes them more easily detectable by most NDT methods.

4. What can cause stress raisers?
    a) Punch marks
    b) Corrosion grooves
    c) Corrosion pits
    d) All the above answers

5. When a metal (or alloy) cools from a liquid to a solid state, the lack of molten metal to feed the shrinkage will lead to:
    a) pipes, voids and cavities.
    b) sponge like appearance and hot tears.
    c) none of the above.
    d) both a) and b).

6. Which of the following is not a cause of undercutting?
    a) excessive amperage
    b) excessive travel speed
    c) excessive electrode diameter
    d) excessive restraint during welding

7. An extremely thin discontinuity that is the result of pipes, or inclusions flattened and made directional by working is called:

    a) a stringer.
    b) a lamination.
    c) a seam.
    d) a cold shut

8. In general, where can you find heat treatment cracks?

    a) at the centre of a weld
    b) in areas of sudden change in thickness
    c) on a cast plate
    d) all the above answers

9. Which of the following statements concerning contaminating materials on the surface of a part to be penetrant tested is not true?

    a) The contaminant may be of a composition that attacks the penetrant and reduces the fluorescence or color of the penetrant.
    b) The contaminants may be of such a nature that they reduce or even prevent capillary action by the penetrant.
    c) The contaminant may retain the penetrant and thus increase the sensitivity of the inspection.
    d) The contaminant may completely fill the crack and thus prevent the entry of penetrant.

10. If inspection of parts is delayed:

    a) indication from larger defects loose sharpness
    b) small indications become prevalent
    c) retesting is needed
    d) wet developer can only be removed with vapour degreasing

11. Choosing the correct method of liquid penetrant inspection requires:

    a) knowing the capabilities of the Liquid Penetrant Inspection methods available
    b) history of the part
    c) intended use of the part
    d) all of the above

12. Black light intensity from a standard mercury vapour lamp may vary due to:

    a) the isotope of mercury used
    b) line voltage supplied by utilities
    c) both a and b
    d) none of the above

13. Improper post cleaning of an Aluminum or Magnesium part tested with a penetrant containing an emulsifier may result in:

    a) pitting
    b) cavitation
    c) excessive bleed out
    d) blotching

14. A somewhat linear intermittent penetrant indication would be formed by a:

    a) crater crack
    b) hot tear
    c) forging lap
    d) cold shut

15. Which one of the following statements is true?

    a) If the dryer temperature is too high, the heat may degrade the effectiveness of the penetrant.
    b) It is not necessary to remove a film of oil from a part prior to penetrant testing because the penetrant is basically oil.
    c) Parts should be heated prior to the application of a penetrant.
    d) Development time should be at least twice the penetration time.

16. All indications found by NDT methods are:

    a) rejectable
    b) direct
    c) indirect
    d) dimensionally correct

17. The term defect or flaw indicates:

    a) a minimum or maximum size
    b) suitability of the part for a given purpose
    c) nature of the fault
    d) none of the above

18. Plastic film developers are used:

    a) on plastics only
    b) for maximum sensitivity
    c) if permanent records are wanted
    d) all of the above

Answer Key:

1. b)	2. b)	3. a)	4. d)	5. d)	6. d)
7. b)	8. b)	9. c)	10. a)	11. d)	12. b)
13. a)	14. c)	15. a)	16. c)	17. d)	18. c)

General Information for the PT2 EMC Practical Examination

Prior to the attempting the practical examination, the candidate should be aware of the following:

1. The duration of the PT2 practical examination is a maximum of 4 hours (1/2 day).

2. The PT2 practical examination is a closed book examination. The following items are strictly **forbidden** and must be left outside the laboratory/examination room:
   - Books, notes and papers belonging to the candidate;
   - Electronic devices (cell phones, tablets, cameras, etc.);
   - Other items which could provide answers/information for examination questions/content or are capable of recording examination material.

3. The candidate is **not** allowed to bring his/her own equipment and **not** allowed to take the examination documents, equipment or specimens out of the laboratory/examination room. All reporting must be completed within the laboratory/ examination room.

4. The candidate will be supplied with the necessary examination equipment and accessories as per NRCan NDTCB examination centre requirements, as well as all reporting sheets, any additional examination documents, and additional paper supplies (provided by the examination centre) as needed to complete the examination.

5. The candidate will be shown the operation and placement of equipment and accessories required to complete the examination, including a black light UV meter. Candidates are advised to review the candidate instructions included with the examination documents.

6. Surface preparations are **not** permitted on the examination specimens. The candidate is requested to **not** mark the specimens, equipment and reference samples.

7. The candidate must **not** clean the specimen after testing since the invigilator must also inspect each specimen.

8. The candidate may ask questions concerning the examination. An invigilator may refuse to answer any questions he or she considers to be part of the examination requirements.

9. The candidate has the opportunity to provide feedback concerning the practical examination. After completing the examination, the candidate will complete the comment sheet and place it into the return envelope with the examination paper(s) prior to sealing the envelope. The comment sheet will then be sent to the NRCan NDTCB along with the examination in the sealed return envelope.

NOTE: If the candidate is operating unsafely or improperly while attempting their practical examination, it is the prerogative of the invigilator to discuss this situation with the candidate and, if necessary, terminate the practical examination. All such actions, as well as any special assistance given to the candidate, must be reported to the examiner on the invigilator's assessment sheet.

PT2 EMC Practical Examination Program

PT2 EMC Practical Examination Candidates shall complete the following:

1. Performance/Calibration Check
   Perform four (4) calibration/performance tests:
   - Measure and record the blacklight intensity. Ensure that it meets the minimum required before proceeding with the examination.
   - Compare the relative sensitivity of two samples of water-washable fluorescent penetrants.
   - Measure and record the dryer's maximum temperature.
   - Set and record the wash station's water temperature and pressure.

2. Specimen Inspection
   Inspect four (4) specimens:
   - One (1) specimen shall be inspected using a colour contrast, solvent removable penetrant.
   - Three (3) specimens shall be inspected using fluorescent, water-washable and post emulsifiable penetrants.
     - **Do not** use the same penetrant type and method for all three specimens (i.e. use one penetrant type for two specimens, and the other penetrant type for one specimen).
   - Complete the reporting sheets/illustrations provided with the specimen.

   Note: Draw the appearance of the indications on the illustrations provided as accurately as possible and make a preliminary interpretation and evaluation of your findings. Show the relative size, shape, length and location of the indications and ensure the inspection techniques are clearly shown. When necessary, draw a sketch of a missing view.

3. Written Instruction
   Complete a written instruction for one of the specimens. The instruction must be written in a way that will enable another PT inspector to easily follow the steps and duplicate the results. It should include:
   a) Scope of the inspection—method and field of application.
   b) Personnel qualification requirements.
   c) Description of the specimen.
   d) List of equipment, reference standards and accessories used.
   e) Description of the calibration procedures specific for the equipment.
   f) Description of the inspection procedures specific for the specimen.
   g) The equipment settings at the time of inspection.
   h) Reporting of the results.

   Note: A candidate may use the general information accompanying the exam specimen for writing the instruction; however, the candidate must ensure that he/she writes a specific instruction to inspect the specific specimen.

Suggestions for Success: PT2 EMC Practical Examination

1. Ensure that you have sufficient experience and knowledge in PT inspection prior to booking your practical examination.

2. When you begin your practical examination, ensure that you carefully read the examination instructions prior to proceeding with the examination requirements.

3. Do not spend too much time on one section of the examination at the expense of the other sections. We suggest that you devote:
    - 30 minutes to read instructions and familiarize yourself with the requirements and to conduct the performance/calibration test.
    - 2½ hours to inspect the four (4) examination specimens.
    - 1 hour to write an NDT instruction for one of the examination specimens.

4. Ensure that you fully inspect the specimen and report all defects.

5. Ensure that you use the proper dwell times for both the penetrant and the developer.

6. Accurately identify and interpret the defects for the specific processing/service/material; do not use unclear terms such as “linear” or “rounded”

7. Fill in the reporting sheets clearly, completely and concisely, ensuring that you show the correct length and location of indications.

8. Ensure that you write a complete written instruction as indicated in the candidate instruction document.

9. Do not hesitate to ask the invigilator questions. The invigilator will not answer a question if he/she considers it to be an examination requirement.

Penetrant Testing Level 3

Penetrant Testing Level 3 (PT3) - Engineering, Materials and Components (EMC) Sector Examination Scheme in Accordance with CAN/CGSB-48.9712

Examination Part			
Basic Written Examination: Parts A, B and C (Unless successfully completed during other Level 3 method certification)	≥70% (on each part)	140 multiple choice questions (total) • Part A: ➢ 10 questions on CAN/CGSB-48.9712 standard • Part B: ➢ 30 questions on materials & processes (M&P), general ➢ 40 questions on M&P and discontinuities specific to welds, castings, wrought products, etc. • Part C: ➢ 60 questions (4x15) on NDT methods	3½ hours
General Written Examination	≥70%	• 30 multiple choice questions on the theoretical principles of PT.	¾ hour
EMC – Codes and Applications Written Examination	≥70%	• 40 multiple choice questions (total) ➢ 10 questions on codes (2x5) ➢ 30 questions on PT applications	2 hours
Written Procedure[1] **or** Written Procedure Review[2]	≥70%	• Write one NDT procedure (required for first Level 3 certification). • Option to instead review an NDT procedure (for each additional Level 3 method certification)	4 hours **or** 1½ hours
EMC Practical Examination (If not successfully completed at Level 2)[3]	≥70% (on each specimen/subpart)	• Same as level 2 examination	4 hours

[1] **Written Procedure:**
This four hour examination must be completed by candidates seeking their first Level 3 method certification.

- To complete this examination, the candidate will write a method-specific NDT procedure.
- Writing a comprehensive NDT procedure that meets industrial standards may typically take several days to complete; the NDT Certification Body therefore provides Level 3 candidates (upon application approval) with a pre-examination package that includes all the information and details necessary to prepare for this examination.

[2] **Written Procedure Review:**

Candidates seeking a subsequent Level 3 method certification have the option of completing a 1½ hour procedure review examination, instead of writing another procedure examination.

- To complete this examination, the candidate will review a sample procedure that he/she is to assume comes from their staff for review and approval.
- The candidate (as the responsible Level 3 individual/superviser) must review the procedure and identify the mistakes and deficiencies; the candidate will record the mistakes and defiencies directly in the procedure, adjacent to the problem area. (An example of this will be shown in the procedure review examination document.)
- The candidate must identify and report as many problem areas or deficiencies as they can find within the procedure document. Deficiencies may include, but are not limited to the following:
  - no cover sheets; no provision for approval signatures, approval signatures by unauthorized personnel, missing or incorrect information in headers, missing attachments/references, missing sections, incorrect paragraph numbering, contradicting technical data, technical data contrary to good practice, unclear statements, inconsistent formatting of the document, information placed in wrong sequence, typographical errors, etc.

[3] **Practical Examination:**

Candidates seeking direct access to Level 3 certification must successfully complete the Level 2 method-specific practical examination with a grade of ≥70 %.

- A candidate who is Level 2 in the same NDT method and product sector or who has successfully passed a Level 2 practical examination for the same NDT method and product sector is exempt from the Level 2 practical examination.
- Please refer to the General Information for the PT2 EMC Practical Examination and the PT2 EMC Practical Examination Program.

Reference Material for PT3 EMC Written Examination Preparation

General and EMC Examinations

1. Nondestructive Testing Handbook - Liquid Penetrant Testing, By ASNT – Latest Edition
2. Betz Handbook on Liquid Penetrant Testing
3. Penetrant Testing: A Practical Guide, By David Lovejoy
4. ASM Metals Handbook – Volume 17; by ASM International
5. Personnel Training Publications, Liquid Penetrant Testing; by ASNT
6. Handbook of Nondestructive Evaluation, 2nd edition; by Chuck Hellier
7. General Dynamics Classroom Training Handbook CT-2 by PH Diversified

Materials and Processes

Although Materials & Processes (M&P) training is a prerequisite to all NDT training, method-specific M&P content is still a component of the NDT certification examinations. The following reference material may have been used to prepare examination questions:

1. Materials and Processes for NDT Technology - Latest Edition
2. Nondestructive Testing Handbook - Latest Edition
3. Basic Metallurgy for Nondestructive Testing - Latest Edition
4. General Dynamics Programmed Instruction Handbook (PI-4-1) by PH Diversified
5. Metallurgy for the Non-Metallurgist. Second Edition.by ASM International

EMC - Codes and Applications Examination

The following three (3) codes/specifications/techniques were utilized as inspiration in drafting the PT3 EMC Sector Codes paper. New codes and questions are added periodically:

1. Standard Practice for Liquid Penetrant Examination for General Industry, ASTM E-165
2. Military Specification, MIL-STD-6866B (ASG)
3. Mcdonnell Douglas Standard, DPS 4.7c7 Rev.”AA”

Basic Examination (Parts A, B & C)

1 Materials and Processes for NDT Technology, By ASNT
2 Basic Metallurgy for Nondestructive Testing, By British Institute of NDT
3 Why Metals Fail, chapter 2, By R.D. Barer and B.F. Peters
4 Qualification and Certification of Nondestructive Testing Personnel CAN/CGSB - 48.9712

Note: Candidates should familiarize themselves with the capabilities and limitations of other NDT methods when preparing for the Basic Written Examination.

Written Procedure Examination

As indicated in the PT3 EMC examination scheme (above), the candidate will be provided with (at the time of application) a pre-examination package that includes all the information and details necessary to prepare for the examination.

Note: Most of the subjects covered by the Level 3 written examinations are found in the above publications; however, additional studying from other reference material may be useful.

Sample Questions: PT3 General Written Examination

1. Capillary force is inversely proportional to:
    a) size of surface openings
    b) surface tension
    c) contact angle
    d) all of the above

2. One of the two most important properties of a good penetrant is wetting ability. Wetting ability is:
    a) measured by contact angle and is not related to surface tension.
    b) a function of viscosity and increases as surface tension decreases.
    c) measured by contact angle and decreases as surface tension increases.
    d) measured by surface tension and increases as contact angle decreases.

3. Methylene chloride and dimethyl formamide are used:
    a) in the distillation of penetrants
    b) as traces dyes
    c) to clean crack test samples
    d) for medical LPI

4. Test experience comparing drain dwell and immersion dwell procedures has found drain dwell to be:
    a) inferior
    b) superior
    c) about the same
    d) obsolete

5. The actual cost of colour contrast penetrants may be more than fluorescent penetrants because:
    a) the market is larger and manufacturers can make higher profits
    b) less demand merits higher pricing
    c) more dye must be added to the penetrant
    d) sufficient profit is made on black lights

6. In darkened surroundings, the eye dark adapts. This is called:
    a) myopia
    b) scoptic vision
    c) hypermyopia
    d) photopic vision

7. The width of cracks formed in the chromium plated penetrant test panels is primarily a function of:
    a) chrome alloy
    b) rate of bending to produce fracture
    c) degree of polishing on the brass sub panel

d) thickness of chromium plate

8. Persistence of penetrant indications implies:

a) microshrinkage
b) incomplete cleaning
c) large volume discontinuities
d) all of the above

9. Locating leaks by pressurized fluids can be accomplished by:

a) natural fluorescence in the hydraulic fluid
b) adding fluorescent dye to the hydraulic fluid
c) simple visual inspection
d) any of the above may locate leaks

Answer Key:

1. a)	2. c)	3. c)	4. b)	5. c)
6. b)	7. d)	8. c)	9. d)	

Sample Questions: PT3 EMC Codes and Applications Written Examination

1. The main risk of testing cold parts is:
    a) chilling the penetrant bath
    b) condensed moisture forming on the part blocking penetration
    c) increased drain time
    d) none of the above

2. The most desirable objectives governing the cleaning operations when removing surface penetrant are to:
    a) remove little penetrant from defects and a minimum of residual penetrant remaining on the surface.
    b) remove little penetrant from a defect and no residual penetrant remaining on the surface.
    c) remove no penetrant from defects and leave a minimum of residual on the part surface.
    d) remove no penetrant from defects and leave no penetrant on the part surface.

3. The type of penetrant to be used on an investment casting should be:
    a) water washable fluorescent for adequate sensitivity and water washability.
    b) solvent removable because of size and shape.
    c) post emulsifiable fluorescent for maximum sensitivity and water washability.
    d) solvent removable for greater visibility.

4. Even absolute values of fluorescence measured by photometers are not reliable without a reference standard because of:
    a) variations in metals
    b) variation in black light source intensity
    c) non linear response of photosensors
    d) meter saturation

5. When dipping parts in water suspendible developer, when the parts are slightly warmer than room temperature:
    a) extra safety precautions are needed
    b) shock cooling is a risk
    c) bath concentrations may increase
    d) excessive bleed out is expected

6. Evaluation of liquid penetrant tests for different depth cracks can be determined by:
    a) increasing pre quench temperature on the aluminum block
    b) capillary activity in the glass wedge
    c) varying coating thickness on chrome plated brass panels
    d) none of the above

7. In a situation where several methods of testing are necessary for complete inspection of a part, the preferred sequence would be:

   a) to use penetrant inspection before ultrasonic inspection.
   b) to use magnetic particle inspection before penetrant inspection.
   c) to use ultrasonic inspection before penetrant inspection.
   d) any of the above depending on the existing situation.

8. The inspection of a number of parts from a lot to determine the quality of the lot is called:

   a) lot testing
   b) periodic checks
   c) spot examination
   d) statistical inspection

9. For locating cracks in glass or glazed ceramics the preferred method is:

   a) water washable penetrant
   b) post emulsifiable penetrant
   c) electrified particle
   d) solvent removable

10. What is the method which uses a color contrast penetrant in conjunction with a developer containing a low intensity fluoragent called?

    a) Fluorescent developer method
    b) Reversed fluorescent method
    c) Contrast fluorescent method
    d) Reversed contrast method

Answer Key:

1. b)	2. d)	3. c)	4. b)	5. c)
6. c)	7. a)	8. c)	9. c)	10. b)

Sample Questions: Level 3 Basic Written Examination

1. The Canadian standard for the certification of non-destructive testing personnel is developed and maintained by:

    a) the Canadian General Standards Board (CGSB).
    b) a standard committee composed of representatives from industry working under the auspice of CGSB.
    c) Natural Resources Canada under the auspice of the Canadian General Standards Board.
    d) a cooperative effort between various Canadian regulatory bodies and Natural Resources Canada.

2. The levels of certification covered by the CGSB standard on NDT personnel certification are:

    a) trainee, Level 1, Level 2, Level 3.
    b) apprentice, trainee, Level 1, Level 2, Level 3.
    c) Level 1, Level 2, Level 3.
    d) none of the above.

3. The pickling time will be least for:

    a) low carbon steel.
    b) high carbon steel.
    c) alloy steels.
    d) pickling time is the same for all three materials.

4. Which of the following may be considered an advantage of powder metallurgy as a manufacturing method?

    a) Production of parts of closer tolerances
    b) Mass production of hard to shape parts
    c) Produce parts with a high strength to weight ratio
    d) All of the above

5. Which of the following heat treatments usually follows a hardening treatment in order to make the steel more ductile?

    a) Annealing
    b) Tempering
    c) Spheroidizing
    d) Normalizing

6. Which of the following statements is correct?

   a) Alkaline solutions are never used to clean aluminum alloys.
   b) Acid solutions are never used to clean aluminum alloys.
   c) Acid solutions are usually used to clean aluminum alloys.
   d) Alkaline solutions are usually used to clean aluminum alloys.

7. Suitable combinations of two different materials each with specific properties may result in a composite that:

   a) is better in terms of resistance to heat than either of the two components alone.
   b) is stronger in tension per unit weight than either of the two components alone.
   c) is stiffer per unit weight than either of the two components alone.
   d) any of the above.

8. The practical length standards used by industry for gauging are:

   a) angle slip gauges.
   b) sine bars.
   c) wavelengths of light emitted by different elements.
   d) gauge blocks.

9. Thermal conductivity of a metal is an important factor to consider in making quality weldments because:

   a) some metals, such as aluminum, have a low conductivity which results in weld defects due to localized heat build-up.
   b) some metals, such as stainless steel, have a high conductivity which results in lack of fusion defects as the heat is quickly removed from the weld zone.
   c) in some metals, such as aluminum, very high temperature gradients are produced, causing stresses during cooling.
   d) none of the above.

10. Fracture is a type of material failure. Of the following, which is another type of material failure?

    a) Fracture mechanics
    b) Low frequency dynamic loading
    c) Permanent deformation
    d) Elongation within the elastic range

11. To remove iron from the ore in a blast furnace, the following materials are added to the furnace to generate the desired chemical reactions:

    a) coke, ore and oxygen.
    b) bauxite, ore and air.
    c) coke, ore, limestone and air.
    d) coke, ore, limestone and bauxite.

12. The reason for putting ingots in a soaking pit is:

    a) to control the direction of crystallization.
    b) to homogenize the structure and composition of the ingots.
    c) to permit slow cooling of the ingots.
    d) to bring them to the temperature required for rolling.

13. An advantage of using green sand molds over dry sand molds is:

    a) green sand molds are stronger then dry sand molds and thus are less susceptible to damage in handling.
    b) surface finish of large castings are better when using green sand molds.
    c) over all dimensional accuracy of the mold is better with green sand.
    d) there is less danger of hot tearing of castings when using green sand molds.

14. Shielded metal arc welding is a process of joining metals which is:

    a) fully automated.
    b) semi-automated.
    c) carried out manually.
    d) all of the above.

15. In the resistance spot welding of low carbon steel the heat generated is:

    a) concentrated between the positive electrode and the work.
    b) concentrated at the interface of the two plates to be welded.
    c) concentrated between the negative electrode and the work.
    d) evenly distributed in the work between the electrodes.

16. Which of the following is not a brazing process?

    a) Furnace brazing
    b) Induction brazing
    c) Infrared brazing
    d) Electron beam brazing

17. Completely recrystallized hot rolled steel products have:

    a) exactly the same mechanical properties in the longitudinal and transverse directions.
    b) superior mechanical properties in the direction of rolling.
    c) superior mechanical properties in the transverse direction.
    d) inferior mechanical properties than the original cast structure.

18. Care must be taken not to splash steel on the walls of the mold when pouring to prevent formation of surface defects like:

    a) inclusions.
    b) seams.
    c) cold shots.
    d) bursts.

19. Bursts are caused by:

    a) casting at too low a temperature.
    b) forging metal which is either too hot or too cold.
    c) insufficient reduction in size is attempted in one forging operation.
    d) none of the above.

20. Slag inclusions in welds are caused by:

    a) wide weaving.
    b) incomplete deslagging of a previous pass.
    c) moisture entrapped in the joint.
    d) both a) and b).

21. Cobalt 60 is reported to have a half-life of 5.3 years. By how much should exposure time be increased (over that used initially to produce excellent radiographs when the cobalt 60 source was new) when the source is two years old?

    a) no change in exposure time is needed.
    b) exposure time should be about 11% longer.
    c) exposure time should be about 37% longer.
    d) exposure time should be from 62 to 100% longer.

22. In ultrasonics, increasing the length of the pulse to activate the search unit will:

    a) decrease the resolving power of the instrument.
    b) increase the resolving power of the instrument.
    c) have no effect on the test.
    d) will decrease the penetration of the sound wave.

23. Optimum magnetic particle inspection of a 50 mm inside diameter gear containing a keyway would require:

    a) circular method with magnetic field parallel to keyway.
    b) circular method with magnetic field perpendicular to keyway.
    c) using central conductor.
    d) all of the above.

24. Which of the following physical properties, more than any other, determines what makes a material a good penetrant?

    a) viscosity.
    b) surface tension.
    c) wetting ability.
    d) no one single property determines if a material will or will not be a good penetrant.

25. Direct current saturation coils would most likely be used when testing _____ by the eddy current method.

    a) steel
    b) aluminum
    c) copper
    d) brass

Answer Key

1. b)	2. c)	3. c)	4. d)	5. b)	6. d)	7. d)	8. d)
9. d)	10. c)	11. c)	12. d)	13. d)	14. c)	15. b)	16. c)
17. b)	18. c)	19. b)	20. d)	21. c)	22. a)	23. d)	24. d)
25. a)							