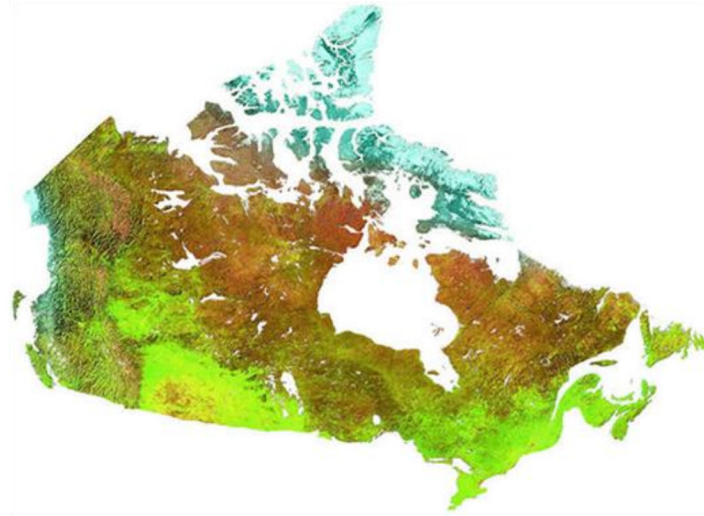




Visual Testing

Examination Guide for Initial Certification



Engineering, Materials and Components Sector

Canada



Contact Information

National Non-Destructive Testing Certification Body
CanmetMATERIALS
Natural Resources Canada
183 Longwood Road South
Hamilton, Ontario
L8P 0A5

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

Organisme de certification national en essais non destructifs
CanmetMATÉRIAUX
Ressources naturelles Canada
183 chemin Longwood Sud
Hamilton, Ontario
L8P 0A5

Courriel : ndt-end@nrcan-rncan.gc.ca
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Site Web : <http://end.nrcan.gc.ca>



Table of Contents

Contact Information 2

Table of Contents 3

Overview of NRCan National Non-destructive Testing Certification Body Services..... 4

IMPORTANT NOTICE 4

Suggestions for Success: Written Examinations..... 5

Visual Testing Level 2..... 6

Visual Testing Level 2 (VT2) - Engineering, Materials and Components (EMC) Sector Examination Scheme in Accordance with CAN/CGSB-48.9712..... 6

Reference Material for VT2 EMC Written Examination Preparation 7

 Sample Questions: VT2 General Written Examination.....8

 Sample Questions: VT2 EMC Written Examination.....10

General Information for the VT2 EMC Practical Examination 12

VT2 EMC Practical Examination Program..... 13

Suggestions for Success: VT2 EMC Practical Examination 14

Visual Testing Level 3..... 15

Visual Testing Level 3 (VT3) - Engineering, Materials and Components (EMC) Sector Examination Scheme in Accordance with CAN/CGSB-48.9712..... 15

Reference Material for VT3 EMC Written Examination Preparation 17

 Sample Questions: VT3 General Written Examination.....18

 Sample Questions: VT3 EMC Codes and Applications Written Examination19

 Sample Questions: Level 3 Basic Written Examination21



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 / (ISO 9712, 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 Admittance and Registration form issued by the NRCan NDTCB prior to the scheduled practical examination/re-examination. For written examination, an Electronic Written Authorization issued by NRCan NDTCB is required prior to purchasing an electronic written 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-48.9712-2022 / (ISO 9712:2021, IDT) section 8.5.2 a candidate who fails to achieve a grade of at least 70% on each individual written examination element (i.e. general, specific), written instruction or 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 element or practical examination specimen/subpart may be re-examined twice, 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) Eclipse Scientific NDT Test maker 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.



Visual Testing Level 2

Visual Testing Level 2 (VT2) - Engineering, Materials and Components (EMC) Sector Examination Scheme in Accordance with CAN/CGSB-48.9712

Examination Part	Pass Grade	Examination Content	Duration
General Written Examination	≥70%	<ul style="list-style-type: none"> 40 multiple choice questions on the theoretical principles of VT method. 	1 hour & 20 minutes
EMC (multi-sector) Written Examination	≥70%	<ul style="list-style-type: none"> 50 multiple choice questions (total) <ul style="list-style-type: none"> ➤ 20 questions on materials & processes and discontinuities. ➤ 10 questions on a code (worth 4 pts each). ➤ 20 questions on VT applications and techniques. 	2 ½ hours
Practical Examination	≥70% (on each specimen/subpart)	<ul style="list-style-type: none"> Performance/Calibration checks Perform four (4) calibration/performance tests: <ul style="list-style-type: none"> ➤ Lighting measurement verification and calibration date check ➤ Measurement and recording of dimensions of two (2) manufactured specimens ➤ Surface comparison of a manufactured specimen. Specimen Inspection following an instruction sheet <ul style="list-style-type: none"> ➤ Direct inspection of two (2) specimens (weld/cast/forged) ➤ Indirect inspection of one (1) inaccessible specimen ➤ Plant surveillance inspection of piping assemblies, hangers, valves, bolted assemblies, gauges, etc. Detailed written instruction for one (1) of the inspected specimens. 	8 hours



Reference Material for VT2 EMC Written Examination Preparation

General and EMC Examinations

1. Non-destructive Testing Handbook, Volume 8, Visual and Optical Testing; by ASNT
2. ASM Handbook (formerly Ninth Edition, Metals Handbook), Volume 11, Failure Analysis and Prevention
3. ASM Handbook (formerly Ninth Edition, Metals Handbook), Volume 17, Non-destructive Evaluation and Quality Control
4. Handbook of Non-destructive Evaluation, 2nd edition, Hellier, Chuck
5. Inspection of Metals: Visual examination, by R Anderson
6. Illuminating Engineering Society – The Lighting Handbook, 10th edition
7. Inspection and Gaging, 6th edition, by Kennedy, Hoffman, Bond
8. ASNT Level II Study Guide: Visual and Optical Testing Method
9. The Tools and Rules of Precision Measuring; by Starret
10. American Welding Society: Welding Inspection

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

Codes, standards and specifications related to Level 2 EMC paper:

The following eight (8) codes/specifications/techniques were utilized to draft the VT2 EMC examination questions on codes:

1. ASME, Section V, Article 9 Visual Examination
2. ASME, Section XI Article IWA-2000 Examination and Inspection, and article IWA-5240 Visual Examination and their related clauses
3. Standard Practice for Investment Casting, Surface Acceptance Standards, Visual Examination, ASTM, A 997-98
4. Standard Practice for Steel Casting, Surface Acceptance Standards, Visual Examination, ASTM, A 802/A 802M-95
5. ISO 3058, Non-destructive testing-Aids to visual inspection – Selection of low-power magnifiers
6. AWS B1.11, American Welding Society, Guide for the Visual Examination of Welds
7. API 577, Welding Inspection and Metallurgy
8. CAN/CGSB-48.9712 / ISO 9712: Non-destructive Testing – Qualification and Certification of Personnel.

Notes: New codes and questions are added periodically. It is **not** recommended that candidates purchase these publications, but rather that they familiarize themselves with the general layout of codes and standards.

Most of the subjects of the General and EMC written examinations are found in the above publications. It should be noted that additional studying from other books might be useful.

References are based on the Recommended Training Course Guidelines of Standard CAN/CGSB 48.9712 for Both General and EMC Papers.

The textbooks 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 Canada L8N 3T2 Telephone: (905) 387-1655 or 1 800-964-9488 Facsimile: (905) 574-6080	ASNT 1201 Dublin Road, Suite #G04 Columbus, Ohio U.S.A. 43215 Telephone: (614) 274-6003 or 1-800-222-2768 Facsimile: (614) 274-6899
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Sample Questions: VT2 General Written Examination

1. What are borescopes used for when performing visual examinations?
 - a) Examination of external parts of welds
 - b) Determination of outside diameter dimensions
 - c) Examination of internal parts of pipes and components
 - d) Determination of inside pipe diameter dimensions

2. It is typically considered a direct visual examination if the individual performing the examination can:
 - a) position the end of a fiberscope to within 24 inches of the object
 - b) use artificial light to illuminate and diffuse the light through the area under examination
 - c) place a mirror within 24 inches of the object being examined
 - d) place the eye within 2 feet of the surface at an angle not less than 30 degrees

3. The measurement of light and its properties is called:
 - a) viscometry
 - b) illuminometry
 - c) photometry
 - d) spectrometry

4. The term used for vision that occurs when the eye is dark-adapted is called:
 - a) myopic vision
 - b) photopic vision
 - c) fovea vision
 - d) scotopic vision

5. The distance a magnifier can be moved toward or away from a subject while keeping it in good focus is called:
 - a) depth of field
 - b) field of view
 - c) focal spot
 - d) magnification distance

6. When the focal spot is deeper into the retina, this condition is called:
 - a) nearsightedness
 - b) astigmatism
 - c) farsightedness
 - d) scotopic vision

7. The roughest surface finish is indicated by a measurement of:
 - a) 64 μin
 - b) 150 μin
 - c) 250 μin
 - d) 380 μin

8. To measure the diameter of a 76 mm (3 in) stud most accurately, use:
 - a) a 51-76 mm (2-3 in.) inside mechanical gauge (micrometer)
 - b) an outside caliper
 - c) a 152 mm (6 in.) dial caliper
 - d) mechanical (micrometer) depth gauge



9. The three physical characteristics of color include:
 - a) saturation, brightness, and glare
 - b) hue, saturation, and brightness
 - c) reflective index, spectral range, and hue
 - d) tone, shade, and hue

10. The visual inspector may encounter compact arc sources, metal vapor, quartz halogen and fluorescent lamps which are sources of:
 - a) infrared hazards
 - b) ultraviolet hazards
 - c) visible hazards
 - d) electromagnetic hazards

11. When measuring plate thickness, the most accurate reading is given by a:
 - a) steel ruler
 - b) steel tape
 - c) mechanical gauge (micrometer)
 - d) feeler gauge

12. A device that provides the means for comparing a test surface to a standard surface finish is called a:
 - a) measuring magnifier
 - b) surface calibrator
 - c) surface comparator
 - d) surface magnifier

13. The use of chemical solutions to attack material surfaces in order to improve the visibility of discontinuities for visual inspection at normal and low power magnification is called:
 - a) micro etching
 - b) macro etching
 - c) replication
 - d) vibro etching

14. The visible portion of the electromagnetic spectrum extends from:
 - a) 100-400 nm
 - b) 210-370 nm
 - c) 360-830 nm
 - d) 570-891 nm

15. The instrument used to measure radiation power over a wide range of wavelengths including the ultraviolet, visible or infrared spectral regions is called a:
 - a) photometer
 - b) radiometer
 - c) spectrophotometer
 - d) raster

Answer Key:

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



Sample Questions: VT2 EMC Written Examination

1. Bursts and laps are typically found in which of the following forming processes?
 - a) Forging
 - b) Rolling
 - c) Drawing
 - d) Extruding

2. A casting discontinuity that appears as a fold of metal or a smooth, crack-like indication is typically called:
 - a) a hot tear
 - b) unfused porosity
 - c) an inclusion
 - d) a cold shut

3. During a visual examination, a welding discontinuity that could not be detected would be:
 - a) undercut
 - b) underfill
 - c) cracks
 - d) side wall lack of fusion

4. An inherent discontinuity in forgings that cannot be detected using visual testing is:
 - a) bursts
 - b) cracks
 - c) seams
 - d) laps

5. A welding discontinuity typically referred to as distortion is caused by:
 - a) the use of a tungsten electrode in the GTAW welding process
 - b) the uncontrolled heating and cooling of the weld metal
 - c) exposure to radiation and other NDE techniques
 - d) the excess amount of porosity in the weld metal

6. The ability of metal to return to its original size and shape after being loaded and unloaded is called:
 - a) plastic deformation
 - b) elastic deformation
 - c) tensile strength
 - d) stress-strain deformation

7. A mechanical device that controls flow into, inside of, or out of a piping system is called a:
 - a) blind flange
 - b) pump
 - c) valve
 - d) flow controller

8. The deterioration of a metal resulting from electrochemical reactions with environment is referred to as:
 - a) erosion
 - b) corrosion
 - c) wear
 - d) fatigue



9. In welding, weld metal protrusion beyond the fusion line at the weld toe is called:
 - a) overlap
 - b) undercut
 - c) reinforcement
 - d) incomplete fusion

10. The maximum diameter of a borescope that can be used for the test is determined by:
 - a) object depth
 - b) entry port size
 - c) objective distance
 - d) direction of view

11. Porosity is:
 - a) material used during the welding process
 - b) gas entrapped below the surface of a material
 - c) gas entrapped below or at the surface of a material
 - d) foreign crystallized material entrapped below the surface of a material

12. Service-induced discontinuities can be the result of:
 - a) vibration
 - b) stress risers
 - c) corrosion
 - d) all of the above

13. A mechanical device that raises, transfers, or pressurizes fluids is:
 - a) a valve
 - b) a snubber
 - c) an electric motor
 - d) a pump

14. An attachment to a component that is welded, cast, or forged is called:
 - a) a non-integral attachment
 - b) an integral attachment
 - c) a restraint
 - d) a clamp

15. A discontinuity associated with metal overflow during forging is called a:
 - a) seam
 - b) flake
 - c) lap
 - d) lamination

Answer Key:

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



General Information for the VT2 EMC Practical Examination

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

1. The duration of the VT2 practical examination is a maximum of 8 hours (1 day).
2. The VT2 practical examination is a closed book examination. No books or notes other than those provided will be permitted during the exam. 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 their 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 white light meter and borescope. 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 **not** to mark the specimens, equipment and reference samples.
7. The candidate may ask questions concerning the examination. An invigilator may refuse to answer any questions that may be considered part of the examination requirements.
8. 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.

NDT Certification Body
Natural Resources Canada
183 Longwood Road South
Hamilton, Ontario
L8P 0A5

Email: ndt-end@nrcan-rncan.gc.ca
Phone: 1-866-858-0473
Fax: 1-905-645-0836

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.



VT2 EMC Practical Examination Program

VT2 EMC Practical Examination Candidates shall complete the following:

1. Performance/Calibration Check

Perform four (4) calibration/performance tests:

- Lighting measurement verification and calibration date check.
- Measurement and recording of dimensions of two (2) manufactured specimens according to an instruction sheet using appropriate measuring devices.
- Surface comparison of a manufactured specimen.

2. Specimen Inspection

Inspect four (4) specimens:

- Direct inspection of two (2) specimens (a combination of welded components, castings or forgings either manufactured or in-service) for flaws using appropriate devices and gauges.
- Indirect inspection of one (1) inaccessible specimen following an instruction sheet using remote viewing equipment.
- Plant surveillance inspection of piping assemblies, hangers, valves, bolted assemblies, gauges, etc. as per instruction sheet followed by reporting of the overall condition of inspected areas.

Note: As accurately as possible, draw on the illustrations provided the appearance of the indications and make a preliminary interpretation of your findings. Show their relative size, shape, length and location. Whenever necessary draw a sketch of a missing view.

3. Written Instruction

Complete a written detailed instruction for one of the inspected specimens. The instruction must be written in a way that will enable another VT inspector to easily follow the steps and duplicate the results. It should include:

- a) Foreword – Scope of the inspection (method used and limitations of the method), reference documents;
- b) Personnel qualification requirements;
- c) List of equipment reference standards and accessories used;
- d) Product - Description or drawing of the examination specimen, including area of interest and purpose of the test;
- e) Test conditions, including preparation for testing and equipment calibration procedures;
- f) Detailed instructions for the application of the test, including settings;
- g) Recording and classifying of test results.
- h) Reporting the results.

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



Suggestions for Success: VT2 EMC Practical Examination

1. Ensure that you have sufficient experience and knowledge in VT 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. Budget your time. Don't spend too much time on one part of the exam at the expense of the other specimens. You have 8 hours to complete the practical portion. We suggest you devote:
 - 1 hour to read the instructions, familiarize yourself with the requirements and conduct the performance/calibration test.
 - 2 hours to conduct the two (2) direct specimen inspections
 - 1.5 hour to conduct the one (1) indirect inaccessible specimen inspection
 - 2.5 hours to conduct the plant surveillance inspection
 - 1 hour to write the detailed instruction for one of the inspected specimens
4. Ensure that you fully inspect the specimen and report all relevant indications.
5. Fill in the reporting sheets clearly, completely and concisely, ensuring that you show the correct length and location of indications. Mark these indications on the reporting sheet using red pen.
6. Ensure photograph submissions are clearly identified and in focus.
7. Ensure that you write a complete written instruction as indicated in the candidate instruction document.
8. Do not hesitate to ask the invigilator questions. However, the invigilator will not answer a question if it is an examination requirement.



Visual Testing Level 3

Visual Testing Level 3 (VT3) - Engineering, Materials and Components (EMC) Sector Examination Scheme in Accordance with CAN/CGSB-48.9712

Examination Part	Pass Grade	Content	Duration
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) <ul style="list-style-type: none"> • Part A: <ul style="list-style-type: none"> ➤ 70 questions on general Materials & Processes (M&P) and discontinuities specific to welds, castings, wrought products, etc. • Part B: <ul style="list-style-type: none"> ➤ 10 questions on CAN/CGSB48.9712 standard • Part C: <ul style="list-style-type: none"> ➤ 60 questions (15 questions per method) on 4 NDT methods selected by candidate. 	4 hours
General Written Examination	≥70%	<ul style="list-style-type: none"> • 30 multiple choice questions on the theoretical principles of VT method. 	1 hour
EMC – Codes and Applications Written Examination	≥70%	<ul style="list-style-type: none"> • 40 multiple choice questions (total) <ul style="list-style-type: none"> ➤ 10 questions on a code (worth 5pts each) ➤ 30 questions on VT applications and techniques 	2 hours
Written Procedure ¹ or Written Procedure Review ²	≥70%	<ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • 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 is assumed to come from their staff for review and approval.
- The candidate (as the responsible Level 3 individual/supervisor) must review the procedure and identify the mistakes and deficiencies; the candidate will record the mistakes and deficiencies 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 VT2 EMC Practical Examination](#) and the [VT2 EMC Practical Examination Program](#).

GENERAL INFORMATION FOR VT 3 EMC PRACTICAL EXAMINATIONS

As indicated in Can/CGSB-489712, candidates seeking direct access to Level 3 certification shall successfully complete with a grade of ≥70 % the Level 2 practical examination. 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 NDT method and product sector, as defined in Annex A is exempt from passing again the Level 2 practical examination.

NOTE: Please refer to the General Information for the VT 2 Practical Examinations.



Reference Material for VT3 EMC Written Examination Preparation

General and EMC Examinations

1. Non-destructive Testing Handbook, Volume 8, Visual and Optical Testing; by ASNT
2. ASM Handbook (formerly Ninth Edition, Metals Handbook), Volume 11, Failure Analysis and Prevention
3. ASM Handbook (formerly Ninth Edition, Metals Handbook), Volume 17, Non-destructive Evaluation and Quality Control
4. Handbook of Non-destructive Evaluation, 2nd edition, Hellier, Chuck
5. Inspection of Metals: Visual examination, by R Anderson
6. Illuminating Engineering Society – The Lighting Handbook, 10th edition
7. Inspection and Gaging, 6th edition, by Kennedy, Hoffman, Bond
8. ASNT Level II Study Guide: Visual and Optical Testing Method
9. The Tools and Rules of Precision Measuring; by Starret
10. American Welding Society: Welding Inspection

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. Non-destructive Testing Handbook - Latest Edition
3. Basic Metallurgy for Non-destructive 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

Codes, standards and specifications related to Level 3 EMC paper

The following eight (8) codes/specifications/techniques were utilized to draft the VT2 EMC examination questions on codes:

1. ASME, Section V, Article 9 Visual Examination
2. ASME, Section XI Article IWA-2000 Examination and Inspection, and article IWA-5240 Visual Examination and their related clauses
3. Standard Practice for Investment Casting, Surface Acceptance Standards, Visual Examination, ASTM, A 997-98
4. Standard Practice for Steel Casting, Surface Acceptance Standards, Visual Examination, ASTM, A 802/A 802M-95
5. ISO 3058, Non-destructive testing-Aids to visual inspection – Selection of low-power magnifiers
6. AWS B1.11, American Welding Society, Guide for the Visual Examination of Welds
7. API 577, Welding Inspection and Metallurgy
8. CAN/CGSB-48.9712 / ISO 9712: Non-destructive Testing – Qualification and Certification of Personnel.

Basic Examination (Parts A, B & C)

1. Materials and Processes for NDT Technology, By ASNT
2. Basic Metallurgy for Non-destructive 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 Non-destructive 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 VT3 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.

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Sample Questions: VT3 General Written Examination

1. The electromagnetic theory describes light as:
 - a) being a continuous stream of vibrating electrons
 - b) having a uniform energy distribution
 - c) traveling at different velocities due to the wavelength
 - d) radiant energy propagated in the form of electromagnetic waves that excite the retina of the eye

2. Visible light is generally considered to be electromagnetic radiation with a wavelength of:
 - a) 10^{-6} to 10^5 m
 - b) 380-770 Å
 - c) 380×10^{-9} to 770×10^{-9} m
 - d) 3,800-7,700 nm

3. A convex lens is used to:
 - a) cause light rays to diverge
 - b) correct for Chromatic Aberration
 - c) cause light rays to converge
 - d) bring an image into sharper focus

4. In order to accurately measure the wall thickness of a small diameter pipe using a standard micrometer, which of the following should be used as an attachment to accommodate the inside radius of the pipe?
 - a) A telescoping gage
 - b) A 0.200 thick shim stock; ½ inch by ½ inch
 - c) A 0.200-inch diameter metal ball
 - d) A fillet weld gage

5. The resolution of a measuring device is the term used to describe the:
 - a) ability of a measuring instrument to produce a measurement that conforms to a known standard
 - b) ability of an instrument to repeatedly give the same reading
 - c) minimum amount of variation to which an instrument is sensitive
 - d) parallax error

6. In developing a procedure for visual examination, which of the following best describes the scope of the procedure?
 - a) List of materials and equipment
 - b) Purpose and applicable codes
 - c) Requirements for calibration
 - d) Personnel certification requirements

7. Variable(s) other than lighting and target size that affect vision acuity include:
 - a) brightness and target angle
 - b) target movement and target angle
 - c) target angle
 - d) target movement and brightness



8. A single lens magnification (in mm) is determined by:
 - a) multiplying the focal distance of the lens by 250
 - b) the focal distance of the lens
 - c) multiplying the magnification power by the focal length
 - d) dividing 250 by the focal length of the lens

9. The most common colour deficiencies are hereditary and occur in:
 - a) the blue-yellow range
 - b) the blue-green range
 - c) the brown-green range
 - d) the red-green range

10. When recording the results of a visual examination, decreasing the aperture opening on a photographic lens results in:
 - a) expanded depth of field
 - b) reduced depth of field
 - c) unchanged depth of field
 - d) reduced field resolution

Answer Key:

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

Sample Questions: VT3 EMC Codes and Applications Written Examination

1. The bearing surface of a component such as a pump is often coated with a soft alloy of lead or tin. When the component is disassembled, this metal is VT inspected for smoothness and wear. This metal coating is formally referred to as:
 - a) hard facing
 - b) weld deposited buttering
 - c) galvanizing
 - d) babbiting

2. The use of chemical solutions to attack material surfaces in order to improve the visibility of discontinuities for visual inspection at normal and low power magnification is called:
 - a) micro etching
 - b) macro etching
 - c) replication
 - d) vibro etching

3. Surface roughness of cold rolled steels is important in quality control because it determines:
 - a) plating, weldability, and workability
 - b) glossiness, weldability, and coating properties
 - c) glossiness, coating, plating properties, and workability
 - d) coating, weldability, and plating



4. Visually apparent primary processing discontinuities include:
 - a) gas, shrink, and pipe
 - b) segregations
 - c) laminations and seams
 - d) bursts

5. On a pump that has not been disassembled, the only visual tests that can be performed are for:
 - a) leakage and hydrostatic pressure
 - b) bearing surface wear
 - c) erosion and corrosion of the moving parts
 - d) the fit and function of the moving parts

6. The most common metallic cell types include:
 - a) body-centered cubic, face-centered cubic, and close-packed hexagonal
 - b) tetragonal, cubic, and orthorhombic
 - c) dendritic, interstitial, and nucleation
 - d) polycrystalline and interstitial

7. Discontinuities found in welds may be divided as:
 - a) mechanical, dimensional, and process
 - b) process, mechanical, and base metal
 - c) dimensional, process, and mechanical
 - d) dimensional, process, mechanical or chemical, and base metal

8. Surface roughness of cold rolled steels is important in quality control because it determines:
 - a) plating, weldability, and workability
 - b) glossiness, weldability, and coating properties
 - c) glossiness, coating, plating properties, and workability
 - d) coating, weldability, and plating

9. The most likely place for erosion and wear in a gate valve are:
 - a) downstream seat of wedge and upstream body seat
 - b) downstream seat of wedge and downstream body seat
 - c) upstream seat of wedge and upstream body seat
 - d) upstream seat of wedge and downstream body seat

10. When carrying out a visual inspection of impeller vanes, it was observed that the vanes are exhibiting abnormal wear and are porous. This condition is most likely due to:
 - a) erosion
 - b) corrosion
 - c) carburization
 - d) cavitation

Answer Key:

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



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 than dry sand molds and thus are less susceptible to damage in handling
 - b) surface finishes of large castings are better when using green sand molds
 - c) overall 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 de-slagging 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)							