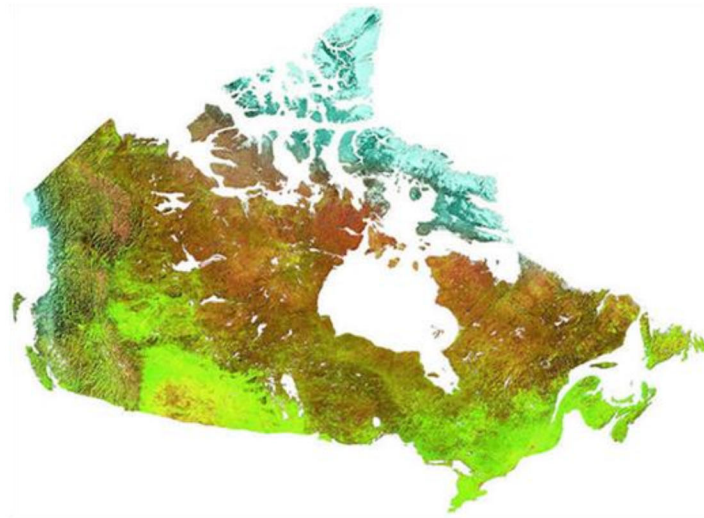




Ultrasonic Testing Phased Array (UT-PA) Level 2

Examination Guide for Initial Certification



Engineering, Materials and Components Sector





Contact Information

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

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CanmetMATÉRIAUX
Ressources naturelles Canada
183 chemin Longwood Sud
Hamilton, Ontario
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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 / (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 form 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.

A valid CGSB Ultrasonic Testing Level 2 EMC Certification is a pre-requisite to the CGSB UT-PA 2 EMC technique certification.

The initial examination package for UT-PA Level 2 contains a specific written paper, and a practical examination.

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.

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Ultrasonic Testing Phased Array Level 2

Ultrasonic Testing Phased Array (UT-PA) Level 2 Technique - Engineering, Materials and Components (EMC) Sector Examination Scheme in Accordance with CAN/CGSB-48.9712

Valid CGSB Ultrasonic Testing Level 2 EMC Certification is a pre-requisite to the CGSB UT-PA Level 2 EMC technique certification.

Examination Part	Pass Grade	Examination Content	Duration
EMC Technique Specific Written Examination	≥70%	<ul style="list-style-type: none"> 30 multiple choice questions on theoretical principles of UT Phased Array technique. 	1 hour & 30 minutes
Practical Examination	≥70% (on each specimen/subpart)	<ul style="list-style-type: none"> Performance and Calibration Checks <ul style="list-style-type: none"> ➤ Make the required settings and operate the test equipment properly to obtain satisfactory results. Includes six (6) calibrations such as element check, Encoder, Velocity, Sensitivity, Wedge Delay, Time Corrected Gain. 	4 hours
		<ul style="list-style-type: none"> Three (3) specimen inspections: locating all reportable indications per designated section and acquire UT-PA Data according to examination written Instructions, including inspection reports for each: <ul style="list-style-type: none"> ➤ Two (2) weld specimens according to the general instructions provided. ➤ One (1) metal formed specimen. 	10 hours
		<ul style="list-style-type: none"> Written Instruction - EMC (Multi-Sector) <ul style="list-style-type: none"> ➤ Complete a written Instruction suitable for a level 1 technician to inspect one (1) of the two Weld specimens, complete with technique development. 	2 hours



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.

In general, training courses are meant to complement your personal efforts, not to substitute them. Furthermore, training courses tend to cover a lot of material over a short period of time. To assimilate the subject material covered, a great deal of personal studying is usually necessary.

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. When you begin your written examination, ensure that you carefully read the examination instructions prior to reading and answering the questions.
3. Before you answer a multiple-choice question, ensure that you carefully read the stem (beginning portion) of the question and each alternative answer to accurately understand the question.
4. Remember, that although more than one multiple-choice alternative answer may appear to be correct or partially correct, only the **best** answer is correct.
5. 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. This will often result in having to choose between two possible options.
6. 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.
7. To test your skills, we recommend the following sample questions that are available on the market:
 - a. Eclipse Scientific Test Maker Questions Data Base
 - b. Supplements to Recommended Practice SNT-TC-1A (Question and Answer Books)



Reference Material for the EMC Technique Written Examination Preparation

EMC Technique Examination

1. Non-destructive Testing Handbook - Ultrasonic Testing, By ASNT – Latest Edition
2. Ultrasonic Testing of Materials, J and H Krautkramer - Latest edition
3. ASM Metals Handbook – Volume 17; by ASM International
4. General Dynamics Classroom Training Handbook CT 4 by PH Diversified
5. Personnel Training Publications, Ultrasonic Testing; by ASNT
6. Handbook of Non-destructive Evaluation, 2nd edition; by Chuck Hellier
7. Ultrasonics: Fundamentals, Technologies, and Applications; by Dale Ensminger & Leonard J. Bond
8. Advances in Phased Array Ultrasonic Technology Applications – Free download from Olympus IMS
9. Phased Array Technology- 2nd edition, by Ed Ginzel

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

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

Reference Material

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

<p>Olympus IMS Resources www.olympus-ims.com</p>	<p>Eclipse Scientific Inc. 1260 2nd Avenue East, Unit 4 Owen Sound, Ontario NK4 2J3 Canada Telephone: (519) 372-1831 Facsimile: (519) 372-2039</p>	<p>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</p>	<p>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</p>
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Sample Questions: UT-PA Level 2 EMC Technique Written Examination

1. Portable UT-PA Instruments typically have _____ pulser channels.
 - a. 14,30,120
 - b. 12,27,140
 - c. 16,32,128
 - d. 18,34,125
2. A _____ is a group of individual array elements that are pulsed to create the desired acoustic aperture.
 - a. non-virtual
 - b. ventricles probe
 - c. daisy array
 - d. virtual probe
3. Delay laws are _____.
 - a. a phased timing pulsed sequence
 - b. an out of phased timing pulsed sequence
 - c. calculated by the operator
 - d. limited to 500 in all UT-PA instruments
4. Phased Array probes make use of _____ to form the sound field.
 - a. Logarithmic and destructive focusing
 - b. constructive and linear focusing
 - c. constructive and logarithmic interference
 - a. constructive and destructive interference
5. When two or more propagating ultrasonic waves interact at a location that is out of phase,
 - a. it's known as "refraction"
 - b. destructive interference occurs
 - c. constructive interference occurs
 - d. reactive radio frequency occurs
6. Near field length is determined by
 - a. total probe aperture, frequency, bandwidth
 - b. virtual probe aperture, frequency, bandwidth
 - c. virtual probe aperture, velocity, element focus
 - d. element size
7. A probe having a long depth of field is generally _____ for industrial inspection.
 - a. less desirable
 - b. more desirable
 - c. not used
 - d. only used
8. Grating lobes are caused by _____ of the individual elements.
 - a. focusing
 - b. periodic spacing
 - c. reducing the number
 - d. using multiple groups

Answer Key:

1. c	2. d	3. a	4. d	5. b	6. b	7. b	8. b
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General Information for the UT-PA Level 2 EMC Technique Practical Examination

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

1. The duration of the UT-PA Level 2 practical examination is a maximum of 16 hours (2 days).
2. The UT-PA 2 practical examination is a closed book examination. Any of the following are strictly forbidden and must be left outside the examination room.
 - personal paper materials,
 - items which could provide answers to examination problems,
 - items capable of recording exam material.

Exceptions to this policy are a scientific calculator, which may be used provided it does not contain information or established programs which may provide solutions to examination problems. The use of a computer with 2D technique development software may be monitored by the invigilator.

3. The candidate is not allowed to bring their own equipment. Equipment, paperwork and the exam specimens cannot be taken out of the laboratory or the examination facility for the whole duration of the exam. All reporting must be completed within the examination room or facility.
4. The candidate will be supplied with all the equipment and accessories required as per “8.4-010 Practical Exam Equipment”. All reporting sheets, any additional examination documents, and additional paper supplies will be provided by the examination centre as needed to complete the exam.
5. The candidate will be shown the operation and placement of equipment and accessories required to complete the examination. Candidates are advised to review the candidate instructions included with the examination documents.
6. The candidate will inspect the exam specimens, all reportable indications shall be measured in millimetres for the length, depth, vertical extent (height) and location from one of the ends of the specimen by completing the report and relevant sketch provided.
7. The candidate is requested not to put permanent mark(s) the equipment, exam specimens and reference samples.
8. The candidate may, at any time, ask any questions concerning the examination procedure. The invigilator may refuse to answer any questions that may lead to the answer to the question(s).
9. Candidates will be given the opportunity to provide feedback concerning the practical exam. After completing the exam, the candidate is urged to complete the comment sheet and place it into the return envelope with the exam paper(s). The comment sheet will then be sent to NRCan NDTCB along with the exam in the sealed return envelope.

NOTE: If the candidate is operating unsafely or improperly while attempting their practical exam, it is the prerogative of the invigilator to discuss this situation with the candidate and, if necessary, terminate the practical exam. 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.



UT-PA Level 2 EMC Practical Examination Program

UT-PA Level 2 EMC Practical Examination Candidates shall complete the following:

1. General Equipment Check:

Perform six (6) calibration tests according to written instructions.

Note: Candidates must include all applicable units of measure when recording the results of the calibration/performance tests.

2. Specimen Inspection (EMC Practical Test):

Inspect two (3) specimens according to written instructions and record results/findings on the applicable reporting sheets (**report measurements in millimetres**):

- Two (2) welded specimens according to the general instructions provided.
- One (1) metal formed specimen according to the general instructions provided.

3. Written Instruction:

Complete a written instruction suitable for a level 1 operator to successfully inspect one (1) of the weld samples provided by the invigilator. The candidate must provide a detailed sketch of the inspection layout and probe to weld placement.

Element headings of a written instruction shall be provided. 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 that they write a specific instruction to inspect the specific specimen.



Suggestions for Success: UT-PA Level 2 EMC Practical Examination

1. Ensure that you have sufficient experience and knowledge in UT-PA 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 the general information and familiarize yourself with the equipment and accessories.
 - 4 hours to perform six (6) calibration tests.
 - 8 hours to inspect, analyze and write reports on 2 welded specimens. 4 hours for each welded specimen.
 - 1.5 hours to inspect a metal formed specimen.
 - 2 hours to complete a written instruction
4. Ensure that you **fully inspect** the specimen and report **all reportable indications**.
5. Fill in the reporting sheets clearly, completely and concisely, ensuring that you show the correct size, shape, length and location of the indications as **accurately** as possible on the illustrations provided in the reporting sheets (or if necessary, draw a sketch of a missing view).
6. Ensure that you write a complete **written instruction as indicated in the candidate instruction document**.
7. Do not hesitate to ask the invigilator questions. The invigilator will not answer a question if they consider it to be an examination requirement.

Common Errors that may Result in Failure of the UT-PA 2 Practical Examinations

1. Candidates not reading the instructions which cost marks.
2. Candidates not having sufficient experience or knowledge of UT-PA inspection.
3. Candidates having poor reporting skills: incorrect length, size, depth, and location of flaws. All reporting must be complete, clear, and concise.
4. Candidates having insufficient understanding of basic engineering drawings (top view, side view, end view). Therefore, incorrectly positioning each discontinuity accurately in two or more views.
5. Candidates not reporting all defects, not fully inspecting the specimen, stopping after finding 1 or 2 signals.