CERTIFICATION BOARD FOR INSPECTION PERSONNEL

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Guidelines for Certification
Ultrasonic Testing

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Contents

GUIDELINES FOR CERTIFICATION - ULTRASONIC TESTING

FOREWORD

These Guidelines for Certification - Ultrasonic Testing (GCUT), in conjunction with the Guidelines for Certification – General Requirements (PRO-CER-18), defines the requirements for the issue of Discipline Recognition to NDT personnel performing Ultrasonic Testing in New Zealand.

This GCUT must be read in conjunction with the Guidelines for Certification – General Requirements (PRO-CER-18).

Certification and re-Certification in accordance with PRO-CER-18 and this GCUT confirm the qualifications, training, and examined competence of Ultrasonic Testing personnel.

This GCUT is prepared in accordance with ISO 9712, Qualification and Certification of NDT Personnel.

The qualifications described by this GCUT have been prepared for registration at level 6, on the NZQA framework.

1.0 SCOPE AND GENERAL

1.1 Scope

This Guidelines for Certification - Ultrasonic Testing (GCUT) defines the principles, training, experience and examination for the issue of a Discipline Recognition to Ultrasonic Testing personnel.

Certification can be gained in either thickness testing or weld testing.

1.2 Application

Discipline Recognition granted under this GCUT applies to Ultrasonic Testing:

- During manufacturing of industrial equipment, and during the pre and in-service periods of industrial equipment.
- For all product sectors as described in ISO 9712, Annex A, Clause A2.

Six levels of certification currently defined by this standard are;

UTT1	Ultrasonic thickness testing Level 1
UTT2	Ultrasonic thickness testing Level 2
UTW1	Ultrasonic testing Level 1 for butt welds in plate and pipe
UTW2.P	Ultrasonic testing Level 2 for butt welds in plate and pipe
UTW2.T	Ultrasonic testing Level 2 for full penetration welds in tee
UTW2.N	Ultrasonic testing Level 2 for full penetration welds in nozzle
UT3	Ultrasonic testing for all categories of weld including butt welds in plate and pipe, tee butt welds and nozzle welds.

Notes: UTW of welds and UT3 require training and examination of UT thickness testing. If the candidate already holds a current UTT certification, they may seek a reduction in training and/or experience hours.

For UT Welds Level 2, a candidate shall hold current certification in UTW2.P before being granted certification in either UTW2.T or UTW2.N

1.3 Definitions

ISO 9712	Non-destructive testing - Qualification and certification of NDT personnel
AS 2207	Non-destructive testing - Ultrasonic testing of welded butt joints in metal
ASME	Section V Art 4 Ultrasonic Examination methods for welds
CBIP	Certification Board for Inspection Personnel
Certified	An individual is certified for the purpose of this GCUT when they hold a Discipline Recognition for Ultrasonic testing.
UTT	Ultrasonic testing thickness
UTW	Ultrasonic testing welds

Except as modified below, all definitions used in ISO 9712 apply to this GCUT.

1.4 Discipline Recognition

Discipline Recognitions, which may be granted under this GCUT, and their scope, are:

1.4.1 Ultrasonic Testing Level 1 (UT1)

Ultrasonic Testing Level 1, covering UTT1 & UTW1

A person certified to Level 1 shall have demonstrated competence to carry out ultrasonic testing according to ultrasonic testing method instructions and under the supervision of Level 2 or Level 3 certified personnel who also hold a CBIP Competence Certificate. Within the scope defined on the Discipline Recognition, Level 1 personnel may, if they hold a CBIP Competence Certificate and are authorised by their employer, perform the following in accordance with ultrasonic testing method instructions;

- Set up NDT equipment
- Perform specific ultrasonic testing
- Record and classify the results of the tests
- Report the results

A person certified to Level 1 may not work directly from general procedures or standards such as AS 2207, BS EN 1417 or ASME V as these require some interpretation. The Level 1 shall work under the supervision of, and be guided by, a Level 2 or 3 person.

Level 1 persons shall not be responsible for the choice of test method or technique to be used, nor for the interpretation of test results.

1.4.2 Ultrasonic Testing Level 2 (UTT2, UTW2)

Ultrasonic Testing Level 2, covering UTT2, UTW2.P, UTW2.T and UTW2.N

A person certified to Level 2 shall have demonstrated competence to perform ultrasonic inspections according to established procedures. Within the scope of competence defined on the Discipline Recognition (Testing method/Sector), Level 2 personnel may, if they hold a CBIP Competence Certificate and are authorised by their employer;

- Select the NDT technique for the test method to be used.
- Work directly from UT standards and specifications such as AS 2207, BS EN 1417 or ASME V
- Define the limitations of application of the testing method.
- Translate relevant NDT codes, standards, specifications and procedures into NDT instructions adapted to the actual working conditions.
- Set up and verify equipment settings
- Perform ultrasonic testing
- Interpret and evaluate results according to applicable codes, standards, specifications or procedures
- Prepare and write UT instructions
- Supervise, guide and train Level 1 personnel
- Report the results of ultrasonic tests.

1.4.3 Ultrasonic Testing Level 3 (UT3)

A person certified to Level 3 shall have demonstrated competence to perform ultrasonic inspections at Level 2. Additionally they shall demonstrate competence to:

- Evaluate and interpret results in terms of existing standards, codes, and specifications;
- Have sufficient practical knowledge of applicable materials, fabrication, process, and product technology to select NDT methods, establish NDT techniques, and assist in establishing acceptance criteria where none are otherwise available;
- Have a general familiarity with other NDT methods.

Level 3 personnel may be authorised by their employer to:

- Assume full responsibility for a test facility or examination centre and staff;
- Establish, review for editorial and technical correctness, and validate NDT instructions and procedures;
- Interpret standards, codes, specifications, and procedures;

- Designate the particular test methods, procedures, and NDT instructions to be used;
- Carry out and supervise all tasks at all levels;
- Provide guidance for NDT personnel at all levels.

1.5 Sectors

Sectors are defined by ISO 9712 Annex A, and as modified by this Guideline for Certification, covering Ultrasonic Testing at various stages of types of engineering industry including:

- Manufacturing
- Pre-Service
- In-Service and post service
- Fabrication

The products covered include:

- Welding
- Castings
- Forgings
- Wrought

NDT METHOD	LEVEL	Product Sector				Industry Sector
		WELDS	CASTINGS	WROUGHT	FORGING	MANUFACTURING, PRE, POST & IN-SERVICE TESTNG
ULTRASONIC THICKNESS TESTING	1	X	X	X	X	X
ULTRASONIC THICKNESS TESTING	2	X	X	X	X	X
ULTRASONIC WELD TESTING	1	X				X
ULTRASONIC WELD TESTING	2	X				X

2.0 TRAINING

2.1 Training Evidence

The Guidelines for Certification – General Requirements (PRO-CER-18), specify the requirements for the necessary evidence of training.

2.2 Formal Training

2.2.1 Ultrasonic Testing Level 1 (UTT1 & UTW1)

Applicants for examination for Ultrasonic Thickness Testing Level 1 (UTT1) shall have attended a theory course in Ultrasonic testing. The course shall total at least 40 hours.

Applicants for examination for Ultrasonic Weld Testing Level 1 (UTW1) shall have attended a theory course in Ultrasonic testing. The course shall total at least 40 hours.

Training hours are based upon candidates possessing prior knowledge of materials and processes. If this is not the case, additional training may be required by CBIP.

Training hours include both practical and theory courses.

2.2.2 Ultrasonic Testing Level 2 (UTT2, UTW2)

Applicants for examination for Ultrasonic Thickness Testing Level 2 (UTT2) shall have attended a level two theory course or courses in Ultrasonic testing. The course(s) shall total at least 80 hours, exclusive of any Level 1 training.

Applicants for examination for Ultrasonic Testing Level 2 (UTW2.P, UT2W.T & UTW2.N) shall have attended a level two theory course or courses in Ultrasonic testing. The course(s) shall total at least 80 hours, exclusive of any Level 1 training.

Training hours are based upon candidates possessing prior knowledge of materials and processes. If this is not the case, additional training may be required by CBIP.

Training hours include both practical and theory courses

2.2.3 Ultrasonic Testing Level 3

CBIP does not allow direct access to Level 3, therefore applicants will have satisfied the training requirements for Level 2. In addition a further 40 hours is required, which shall include some of the following:

- Other NDT methods
- Procedure writing
- Code and standard interpretation
- Metallurgy
- Fabrication and welding
- Quality manual writing

2.2.4 Ultrasonic Testing – All Levels

- ISO 9712 does not differentiate the training requirements between Ultrasonic Thickness and Weld Testing. CBIP recognises that the minimum training requirements are too onerous for Level 1 and 2 thickness testing. Therefore candidates may apply for a reduction of up to 50% if they can demonstrate pro-rata hours of practical training acceptable to CBIP.
- A reduction of up to 50% in the total required number of hours may be accredited by CBIP for candidates who have graduated from technical college or university, or have completed at least two years of engineering or science study at college or university.
- For candidates seeking Certification in another NDT method at the same time as UT, or who already hold Discipline Recognition and a CBIP Competence Certificate, the training hours may be reduced proportional to the number of hours that the syllabus duplicates the other.
- The maximum reduction in total training hours is fifty percent (50%).
- Any reduction in training hours requires acceptance by CBIP.

3.0 DISCIPLINE RECOGNITION

3.1 Experience

Experience in months will be based on a nominal forty-hour week, provided the candidate is working full time in the Ultrasonic Testing method.

3.1.1 Experience Pre-requisite for Examination

Five (5) percent of the experience hours required for certification shall be completed prior to examination

CBIP may accept reductions in experience hours prior to examination.

3.1.2 Ultrasonic Testing Level 1 (UTT1) (UTW1)

Applicants for Level 1 shall have at least three months (or 480 hours) experience in the Ultrasonic Testing method, not including any organised theory or practical training courses. For the experience to be valid it should be gained under the direct supervision of a Level 2 or 3 certified person who also holds a CBIP Competence Certificate.

3.1.3 Ultrasonic Testing Level 2 (UTT2) (UTW2.1 & UTW2)

Applicants for Level 2 shall have at least nine months (or 1,440 hours) experience in the Ultrasonic Testing method at Level 1. If qualifying directly to Level 2 experience shall be 1920 hours (twelve months in total), not including any organised theory or practical training courses. For the experience to be valid it should be gained under the control of a Level 2 or 3 certified person who also holds a CBIP Competence Certificate.

If the candidate is not working full time in Ultrasonic Testing, then only hours doing Ultrasonic Testing, preparation, reporting and associated work may be logged.

3.1.4 Ultrasonic Testing Level 3

Applicants for Level 3 shall have at least thirty months (or 4,800 hours) experience in the Ultrasonic Testing method at Level 2.

Level 3 responsibilities require knowledge beyond the technical scope of any specific NDT method. This broad knowledge may be acquired through a variety of combinations of education, training and experience, relevant to:

- UT procedure writing
- Code and standard interpretation
- Training Level 1 and 2 personnel
- Running an ultrasonic test facility
- Writing UT quality systems
- Designing and operating UT calibration systems
- Appraisal of or designing new UT test equipment

3.1.5 Possible reductions in experience

For Level 3 no reduction in the period of experience shall be allowed.

Applicants for Levels 1 and 2 may apply to CBIP for a reduction of up to 50% of the specified hours for experience in 3.1.1 and 3.1.2.

Reductions may be allowed for time spent on training courses (weighted by a factor of 5). Such courses shall consider practical solutions to testing problems and shall involve testing of known defects in specimens or actual fabrications.

Credit is allowed for work experience gained in other NDT methods, covered by ISO 9712, with the reduction for total experience for Ultrasonic Testing as follows:

- UT plus one other method: 25%
- UT plus two other methods: 33%
- UT plus three other method: 50%

The candidate shall show that they have at least fifty (50) percent of the experience time required for Discipline Recognition in each of the other methods.

CBIP must approve individual applications for any reduction in experience time.

Note: The minimum experience hours shall be at least:

- UTT1 - 240 hours
- UTT2 - 720 hours (if L1 held)
  960 hours (if L1 not held)
- UTW1 - 240 hours
- UTW2 - 720 hours (if L1 held)

960 hours (if L1 not held)

3.2 Changing Sectors

CBIP will consider applications for sector changes (See ISO 9712 Annex A);

A certified Level 1 or 2 person changing sectors, or adding another sector in the same NDT method, shall be required to take only the new sector specific and practical examinations for that method.

Application for sector changes shall be made in writing.

4.0 EXAMINATION REQUIREMENTS Level 1 and 2

4.1 Initial Discipline Recognition

A Discipline Recognition for both UTT and UTW for both Level 1 and Level 2, requires three examinations consisting of two written examinations and a practical examination. The written exam papers shall comprise a general paper and a specific paper.

Candidates seeking either UTW1, UTW2 shall be practically tested on UT thickness samples. If the candidate holds a current UTT1 or UTT2, then the requirement for UT thickness practical is waivered. The date of recertification is based on the UTW1 or UTW2 certification date, not the UTT1 or UTT2 date.

4.2 Recertification Level 1 and 2

Recertification shall be by way of a practical examination in Ultrasonic Testing.

The requirements of the Guidelines for Certification – General Requirements (PRO-CER-18), Section 10 shall also be complied with.

4.3 Significant Interruption

Where significant interruption has occurred, a recertification examination is required.

Refer to Guidelines for Certification – General Requirements (PRO-CER-18), Section 3 for a definition of Significant Interruption.

4.4 Examination References

References for open book examinations are listed on the CBIP website at www.cbip.co.nz .

4.5 Ultrasonic Testing Level 1

UT thickness testing requires successful completion of two theory and one practical examinations. UT weld testing requires successful completion of another two theory and one practical examination.

UT1 (Level 1): General Paper (Written)

- 40 multi choice questions covering the general theory of Ultrasonic Testing.
- 90 minutes duration in a closed book format.
- Refer to appendix B for exam topics and sample questions

UT1 (Level 1): Specific Paper (Written)

- 20 multi choice and 10 short answer questions covering specific applications of the Ultrasonic Testing method. The questions may involve knowledge of standards, inspection equipment, and calibration.
- Permitted reference material AS 2207, ISO 9712 and this GCUT
- 2.5 Hour duration
- Refer to Appendix B for exam topics and sample questions

UT1 (Level 1): Practical examination

- The practical examination shall comprise of inspections and reporting on samples and shall be carried out in accordance with a detailed written instruction supplied by the examiner and should comply with AS 2207 and AS 2452.3.
- An examination observer will be present and will allocate marks (15% of the total) in accordance with a check sheet supplied by CBIP.
- Written examination reports, including defect indications and datum, will be required to be presented to the examiner at the end of the examination.
- A report pro-forma will be supplied to the candidate.
- See Appendix C for scope of practical examination

	Practical Exam Level 1	Time Allowed
UTT1	3 x thickness samples	3.5 hours
UTW1	2 x thickness samples 2 x weld samples	1.5 hours 4 hours

4.6 Ultrasonic Testing Level 2

UT thickness testing requires successful completion of one practical and two theory examinations.

UT weld testing requires successful completion of one practical and two theory examinations.

UT2 (Level 2): General Paper (Written)

- 40 multi choice questions at level 2 covering the general theory of Ultrasonic testing.
- 90 minutes duration in a closed book format.
- Refer to Appendix B for exam topics and sample questions

UT2 (Level 2): Specific Paper (Written)

- 20 multi choice and 10 short answer questions covering specific applications of the Ultrasonic Testing method. The questions may involve knowledge of standards, specifications, procedures, inspection equipment, and calibration.
- Permitted reference material AS 2207, ISO 9712 and this GCUT.
- 2.5 Hour duration.

- Refer to Appendix B for exam topics and sample questions.

UT2 (Level 2): Practical examination

- The practical examination shall consist of two (2) parts. Time allowed for both parts will be as per the table below.
- Practical Test
- The practical test shall consist of an inspection and reporting on samples and shall be carried out in accordance with a Standard Practice or General Procedure such as AS 2207. This will require the Level 2 candidate to interpret the document and determine the inspection procedure.
- Permitted reference material – AS 2207 and/or the candidates Company Ultrasonic Testing procedure.
- Written examination reports, including defect indications, datum and interpretation, will be required to be presented to the examiner at the end of the test. No pro-forma worksheet will be supplied, but candidates may use their own company report sheets.
- Written Instruction (Procedure)
- The second part shall consist of producing a written instruction for the inspection of a specific part nominated by CBIP. The instruction shall be such that it complies with the requirements of AS 2207 and can be used by a Level 1 with no interpretation required.
- Permitted reference material – AS 2207
- See Appendix C for scope of practical examination

	Practical Exam Level 2	Time Allowed
UTT2	3 x thickness samples 1 x work instruction	3.5 hours 1 hour
UTW2.P	2 x weld samples (pipe and plate) 2 x thickness samples 1 x work instruction	4 hours 2 hours 1 hour
UTW2.T	1 x weld sample (tee) 2x thickness samples (if not already held) 1 x work instruction (if not already held)	2 hours 2 hours 1 hour
UTW2.N	1 x weld sample (nozzle) 2x thickness samples (if not already held) 1 x work instruction (if not already held)	3 hours 2 hours 1 hour

4.7 Practical Re-examination

Applicants who do not obtain the required pass mark of 70% in the practical examination, are only required to re-sit the failed sections.

The re-examination may take place one month after the first attempt, and no longer than two years after the original examination. The re-examination time may be less than one month if evidence of further training acceptable to the certification body is provided.

5.0 EXAMINATION REQUIREMENTS Level 3

UT3 requires successful completion of one practical and two theory examinations.

UT3 (Level 3): Basic Paper (Written)

- 100 multi choice questions covering basic knowledge, as per the table below

Part	Subject	Number of questions
A	Technical knowledge in materials science and process technology.	25
B	Knowledge of the certification body's qualification and certification system based on this International Standard. This may be an open book examination.	10
C	General knowledge of at least four methods as required for Level 2 and chosen by the candidate from the methods given in Clause 1. These four methods shall include at least one volumetric method (UT or RT).	15 for each NDT method. 60 in total

UT3 (Level 3): Main Paper (Written)

- 100 multi choice questions covering UT knowledge, as per the table below

Part	Subject	Number of questions
D	Level 3 knowledge relating to UT	30
E	Application of UT, including the applicable codes, standards, specifications and procedures. This may be an open book examination in relation to codes, standards, specifications and procedures	20
F	Drafting of one or more UT procedures. The applicable codes, standards, specifications and other procedures shall be available to the candidate. For a candidate who has already drafted a UT procedure in a successfully passed Level 3 examination, the certification body may replace the drafting of a procedure with the critical analysis of an existing UT procedure containing errors and/or omissions.	–

UT3 (Level 3): Practical examination

- The practical examination shall be as per the Level 2, with the exemption of the Level 1 written instruction

5.1 Recertification Level 3

Recertification shall be by way of a practical examination, as per the Level 2, with the exemption of the Level 1 written instruction.

Plus either:

- Written examination 20 questions on the application of UT, which demonstrates an understanding of current NDT techniques, standards codes or specifications, and applied technology and, at the option of the certification body, five additional questions on the requirements of the certification scheme.

Or:

- Meeting the requirements for a structured credit system, as given in 5.2.

5.2 Level 3 Credit System

Credits are gained over a five year period prior to recertification, as per the table below. Note that there are a maximum number of points that can be gained in both a single year and over the five years.

A minimum of 70 points are required for a recertification.

A maximum of 25 points can be earned in a single year.

Item	Activity	Points accorded for each item (or function)	Maximum points per year per item	Maximum points per 5 year period per item
1	Membership of an NDT society, attendance at seminars, symposia, conferences and/or courses covering NDT and related sciences and technologies	1	3	8[a]
2.1	Attendance at international and national standardization committees	1	3	8[a]
2.2	Convenorship of standardization committees	1	3	8[ab]
3.1	Attendance at sessions of other NDT committees	1	3	8[a]
3.2	Convenorship of sessions of other NDT committees	1	3	8[ab]
4.1	Attendance at sessions of NDT related working groups	1	5	15[a]
4.2	Convenorship of NDT related working groups	1	5	15[ab]
5.1	NDT related technical/scientific contributions or publications	3	6	20[cd]
5.2	NDT related research work published	3	6	15[cd]
5.3	NDT research activity	3	6	15[cd]
6	NDT technical instructor (per 2 h) and/or NDT examiner (per examination)	1	10	30[d]
7	Professional activity	—	—	—
7.1	within a NDT facility, NDT training centre or NDT examination facility or for Engineering of NDT (see Annex E) (for each full year)	10	10	40[d]
7.2	Dealing with disputes referring to clients	1	5	15[d]
7.3	Development of NDT applications	1	5	15[d]

[a] Maximum points for items 1 to 4: 20.

[b] Points to be given for both convenorship and attendance.

[c] If there is more than one author, the lead author shall define points for the other authors.

[d] Maximum points for each of items 5 and 6: 30, and 7: 50.

APPENDIX A – Knowledge Requirements

ULTRASONIC INSPECTION

	Item	UTT1	UTW1.1	UTT2	UTW 2.1/2.2
1	**The Behaviour and Properties of Ultrasonic Waves**				
1.1	Wave propagation, waveforms, compressions and shear waves, surface waves, plate waves, frequency, sound beam velocities.	x	x	x	x
1.2	Typical acoustic velocities in common materials.	x	x	x	x
1.3	Reflection and refraction, Snells Law, critical angles, attenuation, acoustic impedance, mode conversion.		x		x
1.4	Beamspread, dead zone, near zone, far zone.	x	x	x	x
1.5	Calculations based on the above phenomena and associated formulae.	x	x	x	x
1.6	Variables affecting test results	x	x	x	x
2	**The Production of Ultrasonic Waves**				
2.1	Piezoelectric effect, piezoelectric materials natural and synthetic, crystal planes, efficiency and crystal thickness.	x	x	x	x
2.2	Damping and resolution	x	x	x	x
2.3	Compression wave probes, single and twin crystal probes, focussed probes and their construction and characteristics.	x	x	x	x
2.4	Shear wave probes, single and twin crystal, their construction and characteristics.		x		x
2.5	Special probes – flat and contoured, fixed and adjustable	x	x	x	x
2.5	Couplants.	x	x	x	x
3	**Ultrasonic Equipment**				
3.1	The flaw detector, block diagrams and component circuits, functions of the controls and equipment performance characteristics.	x	x	x	x
3.2	Gain control and the decibel system.	x	x	x	x
3.3	Linearity and suppression	x	x	x	x
3.4	Sweep, delay and timebase controls	x	x	x	x
3.5	A and B scan, recording devices	x	x	x	x
4	**Testing methods**				
4.1	Contact testing	x	x	x	x
5	**Calibration of Equipment and Probes**				
5.1	Calibration and reference blocks.	x	x	x	x
5.2	Flaw detector performance, linearity of time base, linearity of gain.	x	x	x	x

5.3	Methods of determining probe index, beam angle, beam profiles, dominant frequency, pulse length, dead zone, near zone, signal to noise ratio, overall system gain, beam squint, resolving power.		x	x	x
5.4	DAC curve preparation, reflector sizes for various codes		x		x
5.5	Calibration methods and requirements to AS 2452.3, AS 2083 / 2207, AS 1710, ASME V Article 5, BS EN 1714		x		x
6	**Weld Testing**				
6.1	Specification requirements AS 2207, BSEN 1714, ASME V.				x
6.2	Surface condition and methods for determining attenuation and transfer losses.		x		x
6.3	Factors influencing probe selection and frequency selection.				x
6.4	Setting sensitivity for scanning and evaluation AS 2207, BSEN 1714, ASME V.		x		x
6.5	Scan patterns and coverage, plate and pipe welds		x		x
6.6	Scan patterns and coverage, tee and nozzle welds				x
6.7	Procedures for the location, evaluation and sizing of discontinuities.		x		x
6.8	Identification of discontinuities.		x		x
6.9	Reporting.		x		x
7	**Thickness testing**				
7.1	Specification requirements AS 2452.3	x	x	x	x
7.2	Factors influencing probe selection and frequency selection.	x	x	x	x
7.3	Laminations, corrosion types and characteristics	x	x	x	x
7.4	Calibration, pulse echo and multi echo modes	x	x	x	x
7.5	Reporting	x	x	x	x
8	**Materials and Welding Technology**				
8.1	Production of steel and fabrication processes. Common defects associated with the processing methods.	x	x	x	x
8.2	Welding processes and techniques, heat treatment, joint preparation and types of flaws associated with these welding processes.		x		x
8.3	In service defects, fatigue, stress corrosion.	x	x	x	x

APPENDIX B – Sample Examination Questions

Level 1 General

1 Ultrasonic transducers produce which sound waves in the probe shoe?
A. Surface waves
B. Longitudinal waves
C. Transverse waves
D. All of the above

2 Which of the following modes of vibration has the lowest velocity in a given material?
A. Longitudinal wave
B. Shear wave
C. Surface wave
D. Compression wave

3 Ultrasonic wave velocity in a given material is
A. Constant for a given wave mode
B. Equal to frequency x wavelength
C. Different for different wave modes
D. All of the above

3 Rayleigh waves are influenced most by defects located:
A. One wavelength below the surface
B. Six wavelengths below the surface
C. Close to or on the surface
D. Three wavelengths below the surface

4 Sound wave velocity is not dependent on
A. The material under test
B. The mode of vibration
C. The transducer frequency
D. None of the above

5 Calculate the velocity of a wave with a frequency of 3.0 MHz and a wavelength of 1.2mm
A. 2500 m/s
B. 3230 m/s
C. 3600 m/s
D. 5920 m/s

6 Acoustic velocities are determined by:
A. Density
B. Elasticity
C. Wave mode
D. All of the above

7 The frequency of a transducer is primarily a function of:
A. The amplifier characteristics
B. The thickness of the crystal
C. The pulse repetition frequency
D. All of the above

8 The angle of refraction is:
A. Determined by Snell's Law
B. Dependent on material velocities
C. Different for different wave modes
D. All of the above

9 Which of the following material characteristics may affect the acoustic attenuation in the material:
A. Grain size
B. Couplant
C. Acoustic impedance
D. All of the above

10 The shape of an ultrasonic beam located in the far zone can be considered as:
A. Cylindrical
B. Spherical
C. Pyramidal
D. None of the above

11 In the formula Sin □1 / V1 = Sin q2 / V2, V is used to represent:
A. Angles
B. Velocities
C. Amount of reflected sound energy
D. Acoustic impedances

12 Which of the following are true about beam divergence:
A. It is affected by wavelength
B. It is affected by acoustic impedance
C. It is affected by the coupling
D. All of the above

13 The ability to resolve two discontinuities at different depths would be improved by:
A. Decreasing the frequency
B. Shortening the pulse duration
C. Increasing the amplitude of the initial pulse
D. None of the above

14 The length of the near zone is dependent upon which of the following?
A. The diameter of the transducer
B. The frequency of the transducer
C. Both A and B
D. Neither A nor B

15 A test method in which the ultrasonic sound is emitted by a transmitting search unit, transmitted through the test part and picked up by a second receiving search unit on the opposite boundary is called:
A. Surface wave testing
B. Angle beam testing
C. Through-transmission testing
D. All of the above

16 In immersion testing, focusing of the sound beam is accomplished with:
A. An acoustic lens

B. Two separate probes
C. A shorter than usual stand-off
D. A higher frequency probe

17 The process of adjusting the settings of an instrument to a reference standard is referred to as:
A. Zeroing
B. Metrology
C. Distance-amplitude correction
D. Calibration.

18 A level 1 NDT technician may:
A. Select the test technique
B. Record defects detected
C. Interpret code requirements
D. None of the above

19 In ultrasonic testing, a liquid coupling medium between the crystal surface and the part surface is necessary:
A. To minimise wear on the probe surface
B. Because an air interface would almost completely reflect the acoustic energy
C. Because the crystal will not vibrate if in contact with the part surface
D. To complete the electrical circuit between the part and the crystal

CBIP Examination Paper - UT Thickness Testing

Level 1 Specific

1 Thickness testing is usually accomplished using:
A. Pulse echo method
B. Tip diffraction method
C. Surface waves
D. None of the above

2 Excessive noise and a lack of back wall reflection can be improved by:
A. Improving the coupling
B. Increasing the test probe frequency
C. Normalising the material
D. None of the above

3 When testing a metallic material which transducer would give the best resolution?
A. Large diameter high frequency transducer
B. Large diameter low frequency transducer
C. Small diameter high frequency transducer
D. Small diameter low frequency transducer

4 Using the 6dB drop method to size a lamination, the defect boundary is located:
A. Under the inner edge of the probe
B. Under the centre of the probe
C. Under the outer edge of the probe
D. When the signal has disappeared

5 A lamination is an imperfection which might be found in:
A. Castings
B. Forgings
C. Billets
D. None of the above

6 Which of the following are not service induced defects?
A. Corrosion pitting
B. Stress corrosion cracks
C. Laminations
D. Fatigue cracks

7 When changing to testing a material of different velocity, correct measurements can be obtained by:
A. Using a measureable section of the test material to recalibrate
B. Converting the readings using a formula
C. Recalibrating using a block of the same material as the test material
D. All of the above

8 Necessary properties of ultrasonic couplants are:
A. Good acoustic transmission
B. Non-corrosive on the test material
C. Viscosity to fill the probe to test surface gap
D. All of the above

9 When a plate contains coarse inclusions, what effect do they have on the Ascan signal?
A. Small defect indications only
B. Some loss of back echo only
C. Small defect indications and some loss of back echo
D. A horizontal shift in the back echo

10 As a level 1 technician, you have performed a lamination test to a written instruction and found a lamination. You should:
A. Size the lamination
B. Record the details
C. Refer to a level 2 for assessment
D. All of the above

11 State five factors which influence the signals from coarse inclusions and laminations (2 each)

12 State why a couplant is used during ultrasonic testing.

13 Your work instruction requires you to calibrate (A-scan display) for a range of 20mm. Your test block has steps of 2.5mm, 5mm, 7.5mm and 10mm. You are expecting thickness measurements in the range 3 to 4mm. Indicate which step or steps you would use for calibrating your instrument (2 marks) and show
(using diagrams) where these would appear on your screen display (3 marks).

14 List three surface conditions which can influence the technique used in thickness testing. What effect do these three factors have?

15 In order to improve accuracy your work instruction tells you to measure the thickness using the fourth echo on an unpainted surface. Show how this is done, using screen trace sketches.

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Level 2 General

1 The only significant sound wave mode that will travel through a liquid is:
A. Shear (transverse)
B. Longitudinal (compression)
C. Surface
D. none of the above

2 Which of the following modes of vibration has the highest velocity in a given material?
A. Longitudinal wave
B. Shear wave
C. Surface wave
D. The wave with the highest frequency

3 Ultrasonic wave velocity in a given material is
A. Constant for a given wave mode
B. Equal to frequency x wavelength
C. Different for different wave modes
D. All of the above

4 Rayleigh waves are influenced most by defects located:
A. One wavelength below the surface.
B. Six wavelengths below the surface.
C. Close to or on the surface.
D. Three wavelengths below the surface.

5 The velocity of sound waves is dependent on:
A. The pulse length
B. The frequency
C. The material in which the sound is being transmitted and the mode of vibration
D. None of the above

6 Calculate the velocity of a wave with a frequency of 3.0 MHz and a wavelength of 1.2mm
A. 2500 m/s
B. 3230 m/s
C. 3600 m/s
D. 5920 m/s

7 Acoustic velocities for any given wave mode are determined by:
A. Density
B. Elasticity
C. Both (a) and (b)
D. Acoustic Impedance

8 The frequency of a transducer is primarily a function of:
A. The pulse length
B. The thickness of the crystal
C. The P.R.F of the instrument
D. None of the above

9 The angle of reflection is:
A. Equal to the angle of incidence
B. Dependent on the couplant used
C. Equal to the angle of refraction
D. None of the above

10 Which of the following material characteristics may affect the acoustic attenuation in the material:
A. Grain size
B. Elastic modulus
C. Crystalline structure
D. All of the above

11 The shape of an ultrasonic beam located in the far zone can be considered as:
A. Cylindrical
B. Spherical
C. Pyramidal
D. Conical

12 The formula Sin q1 / V1 = Sin q2 / V2 is used to determine:
A. Refraction angles
B. Phase velocities.
C. Amount of reflected sound energy
D. Acoustic impedance.

13 The formula used to determine the angle of beam divergence of a quartz crystal is:
A. Sin f = (Diameter x 2)/4 x wavelength
B. Sin f = Diameter / (frequency x wavelength)
C. Sin f = frequency x wavelength
D. Sin f = (1.22 x wavelength)/Diameter

14 The ability to resolve two discontinuities at different depths would be improved by:
A. Decreasing the frequency
B. Shortening the pulse duration
C. Increasing the amplitude of the initial pulse
D. None of the above

15 The length of the near zone is dependent upon which of the following?
A. The diameter of the transducer
B. The frequency of the transducer
C. The velocity of sound in the material
D. All of the above

16 A test method in which the ultrasonic sound is emitted by a transmitting search unit, transmitted through the test part and picked up by a second receiving search unit on the opposite boundary is called:
A. Surface wave testing
B. Angle beam testing
C. Through-transmission testing
D. All of the above

17 A device added to the front of a contact transducer to match the curvature of a test specimen is called a:
A. Sloped shoe
B. Frontal lens
C. Curved lens
D. Curved shoe

18 The process of adjusting the settings of an instrument to a reference standard is referred to as :
A. Zeroing
B. Metrology
C. Distance-amplitude correction
D. Calibration.

19 A level 1 NDT technician may not:
A. Select the test technique
B. Decide on compliance of the tested items
C. Supervise other level 1 technicians
D. All of the above

20 In ultrasonic testing, a liquid coupling medium between the crystal surface and the part surface is necessary:
A. To minimise wear on the probe surface
B. Because an air interface would almost completely reflect the acoustic energy
C. Because the crystal will not vibrate if in contact with the part surface
D. To complete the electrical circuit between the part and the crystal

CBIP Examination Paper - UT thickness testing

Level 2 Specific

1 Apart from transfer loss, other signal losses can be caused by:
A. Beam spread
B. Attenuation
C. Test piece geometry
D. All of the above

2 Provided that the orientation of the following discontinuity types is at 90 degrees to the incident ultrasonic beam, and are all of comparable size, which of the following types would be most easily detected?
A. Planar longitudinal
B. Threadlike
C. Spherical
D. Threadlike longitudinal

3 Which of the following test frequencies would generally provide the best penetration in a 300mm thick item of course-grained steel?
A. 1MHz
B. 2.25MHz
C. 5MHz
D. 10MHz

4 In immersion testing, the first echo after the initial pulse is:
A. The water / item interface
B. The item backwall echo
C. The water backwall echo
D. The probe / water interface

5 A base line survey is normally taken:
A. Repeatedly at intervals
B. On plant at manufacture or commissioning
C. At key points determined by performance history
D. At key points of anticipated material loss

6 When using an open grid (OG) method, measurements can be taken:
A. By the single spot single measurement method
B. By the single spot double measurement method
C. By the single spot multiple measurement method
D. All of the above, or as specified by the purchaser

7 To detect corrosion running longitudinally along a pipe, the probe acoustic barrier should be aligned:
A. At 45 degrees to the pipe axis
B. Along the pipe
C. Across the pipe
D. Any of the above

8 When a plate contains coarse inclusions, what effect do they have on the A-scan signal?
A. Large defect indications
B. Total loss of back echo

C. Both A and B
D. None of the above

9 According to AS 2452.3, in the formula CL1=Tm x CL2 / Ti, which value represents the velocity which is known:
A. CL1
B. Tm
C. CL2
D. Ti

10 When performing a lamination test to AS 1710, a lamination 50mm x 100mm is detected. This is acceptable to:
A. Level 1
B. Level 2
C. Level 3
D. No level of AS 1710

11 Sketch neatly and label the various parts of a twin crystal compression wave probe used for wall thickness measurement

12 Discuss factors which influence the amplitude of the signal from a backwall reflector when thickness testing (1 each)

13 You are to perform a thickness test, expecting thickness measurements in the range 10-15mm. Explain which thickness or thicknesses you would typically calibrate on, and why. What would you do if you encountered readings of 6-8mm.

14 You are thickness testing un-corroded plates over a wide range of thicknesses from 4mm to 60mm. Discuss probe selection, calibration and any other changes you would expect to make for the different thicknesses.

15 In order to improve accuracy and "gate out" the paint you are measuring the thickness using the fourth echo on a painted surface. Show how this is done, using screen trace sketches.

APPENDIX C - UT Practical examinations

The marks allocated for the Level 1 and 2 Practical examinations will be in accordance with a set of pre-defined criteria. The following gives general information on how the marks are allocated at each level.

UTT1 & UTT1a

Correct use of the equipment

Correct interpretation of the written instruction

Performance of the inspection

Finding all mandatory indications

Defect datum

Reporting

Note: A candidate failing to report a defect specified on the master report as "mandatory" shall be awarded zero marks in the Recording and Reporting part of the practical examination.

UTT2, UTw2a/b

Selection and correct use of the equipment

Equipment control and checks

Correct interpretation of standard / Code

Performance of the inspection

Finding all mandatory indications

Defect datum

Reporting

Writing Level 1 Instruction 15%

Note: A candidate failing to report a defect specified on the master report as "mandatory" shall be awarded zero marks in the Recording and Reporting part of the practical examination.