



CERTIFICATION SCHEME FOR WELDING AND INSPECTION PERSONNEL

DOCUMENT NO. CSWIP-DIV-8-96

Requirements for the Certification of Personnel engaged in the ACFM Inspection of Welds – Levels 1, 2 and 3

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Issued under the authority of the Governing Board for Certification

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CSWIP is administered by TWI Certification Ltd

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FOREWORD

The Certification Scheme for Welding and Inspection Personnel (CSWIP) is a comprehensive scheme which provides for the examination and certification of individuals seeking to demonstrate their knowledge and/or competence in their field of operation. The scope of CSWIP includes Welding Inspectors, Welding Supervisors, Welding Instructors and Underwater Inspection personnel.

CSWIP is managed by the Certification Management Board, which acts as the Governing Board for Certification in keeping with the requirements of the industries served by the scheme. The Certification Management Board, in turn, appoints specialist Management Committees to oversee specific parts of the scheme. All CSWIP Boards and Committees comprise member representatives of relevant industrial and other interests.

The CSWIP In-Service Inspection Management Committee is one such Management Committee and is representative of offshore operators, diving contractors and classification societies.

These requirements for examination eligibility, examination format and the rules governing ACFM certificate validity and renewal are, as minimum in compliance with ISO 9712¹ and EN 473².

These requirements cover ACFM equipment capable of manual probe operation, which operate with QFM, Assist and WAMI software packages. These currently include the ACFM Crack Microgauge Models U9, U12, U21, U31 and -AMIGO (U19).

ACCESS TO CERTIFICATION

Access to certification schemes is not improperly restricted. The sole criteria for certification are given in the document (and any subsequent amendments) and no other criteria will be applied. Certification is not conditional on the candidate applying for other services or membership from TWI Certification Ltd, its parent, or any other groups or associations.

1. GENERAL

1.1. SCOPE

Electromagnetic inspection of welds has evolved as a widely used inspection technique. CSWIP recognises that development continues in the light of equipment evaluation and user experience.

1.2. DEFINITIONS AND ABBREVIATIONS

ACFM	Alternating Current Field Measurement
ACFM Equipment	Instruments produced by TSC ¹ capable of providing single probe operation using TSC WAMI, Assist and QFM programmes.
Array Probe	ACFM probe containing more than one pair of Bx/Bz sensors
Standard Probe	ACFM probe containing a single pair of Bx/Bz sensors
Single Handed Operation	Where the ACFM operator also manipulates the probe.
Two Handed Operation	Where the probe is operated remotely under the instruction of the ACFM operator.
NDT Written Instruction	A written description of the precise steps to be followed in testing to an established standard, code, specification or NDT procedure.

¹ Technical Software Consultants Ltd

Experience	Experience in the applicable methods and field of application which leads to the acquisition and maintenance of the required skill and knowledge.
Practical Examination	The examination in which the candidate demonstrates familiarity with and an ability to operate the necessary test equipment to test the prescribed specimens, and to analyse and report the resulting test data to the degree required.
TWI	TWI Ltd, Granta Park, Abington, Cambridge, CB1 6AL, England.

1.2.1 To date the ACFM technique has demonstrated:

- Capability of detecting and identifying some surface breaking cracks, both pre-service and in-service.
- Capability of locating surface breaking cracks and sizing them for length and depth.

This document addresses general certification for ACFM systems including systems that support array probe technology.

1.2.2 Examination is in three parts:

- a) General (theory appropriate to the electromagnetic inspection of welds)
- b) Sector specific (theory and practical for the technique related to a specific application – in the present case this is weldments with in-service crack-like defects).
- c) Practical Examination.

1.2.3 This examination scheme is specific to ACFM equipment types using QFM, Assist and WAMI control programmes.

1.3. CERTIFICATION AVAILABLE

The categories of certification available are ACFM Operator Levels 1, 2 and 3.

1.3.1. ACFM Operator Level 1

An individual certificated to Level 1 is qualified to carry out NDT operations according to a written instruction and under the supervision of Level 2 personnel. CSWIP Level 1 certificated personnel have demonstrated their competence to:

- Set up equipment and complete all necessary quality assurance checks (function checks)
- Carry out the test
- Assess, record and classify the results in terms of written criteria
- Size, for length and depth, simple fatigue cracks or spark eroded slots
- Record the results
- Follow a written procedure and written test instructions
- Brief the remote probe operator.

Level 1 personnel have **not** demonstrated competence in the choice of test probes or parameter settings to be used.

1.3.2. ACFM Operator Level 2

Level 2 personnel are qualified to perform and direct NDT according to established or recognised procedures and have demonstrated their competence to:

- Choose the technique for the test method used
- Set up the equipment, and conduct operation checks
- Create a probe file configuration
- Perform and supervise the test
- Interpret and evaluate results according to applicable standards, codes or specifications
- Define the limitations of application of the testing method for which they are qualified
- Understand and transform NDT standards and specifications into practical testing instructions adapted to the actual working conditions
- Prepare written test instructions
- Carry out and supervise all Level 1 duties – including auditing offline data
- Organise and report the results of non-destructive tests
- Understand fundamental differences between magnetic and non magnetic material effects.

1.3.3. ACFM Operator Level 3

Level 3 personnel are expected to be competent to assume the responsibilities of management of an industrial NDT facility and staff therein. Level 3 personnel have demonstrated their competence to:

- Allocate staff with appropriate certification according to the customer's requirements
- Supervise and manage personnel holding level 1 and level 2 qualifications
- Review reports and current work practices and maintain standards and safe working practices
- Compile records of equipment performance
- Understand and transform NDT standards and specifications into written procedures
- Select NDT methods.

1.4. ELIGIBILITY FOR EXAMINATION

Candidates shall have a combination of education, training and experience adequate to ensure that they have the potential to understand the principles and procedures of the applicable NDT method. All candidates should submit a full CV with their application.

Training

To be eligible for certification in the ACFM method, the candidate shall provide evidence of successful completion of a training course approved by CSWIP for that method.

Details of approved training courses are available on request from TWI Certification Ltd.

1.4.1. Levels 1 and 2

a) Education

All candidates must provide evidence of qualifications that indicate a basic understanding of the scientific and engineering principles appropriate to non-destructive testing.

b) Approved Training

Level 1 and 2 candidates will be required to have satisfactorily completed an approved training course on the ACFM equipment type of not less than 40 hours.

Notes:

- 1 On the job training can account for one third of the total training hours.
- 2 Direct access to level 2 implies the total hours for Level 1 and Level 2 training (80 hours).

Candidates must provide evidence of training. A certificate of successful attendance and a copy of the training syllabus, both authenticated by a senior person in the candidate's employing organisation or by an approved training organisation will suffice.

c) Experience for Levels 1 and 2

Level 1 candidates will be required to show a minimum requirements of 3 months practical experience, Level 2 candidates to show a minimum of 9 months practical experience.

Notes:

- 1 Work experience in months is based on a nominal 40h/week (175h/month). When an individual is working more than 40h/week, he/she may be credited with experience based on the total hours, but he/she shall be required to produce evidence of this experience.
- 2 If the individual is being qualified directly to Level 2, with no time at Level 1, the experience shall consist of the sum of the hours required for Level 1 and Level 2. Credit for work experience may be gained simultaneously in two or more NDT methods listed in EN 473:2000, with the reduction in total required experience as follows:
 - a) two testing methods – reduction of the total required time by 25%
 - b) three testing methods – reduction of the total required time by 33%
 - c) four testing methods – reduction of total required time by 50%

1.4.2. Level 3

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. The table below details the minimum experience related to formal education.

	Degree	Experience (months)
Access to Level 3 by a certified Level 2 operator	Graduate of a four years accredited science or engineering college or university programme	12
	Successful completion of at least 2 years of engineering or science study at an accredited college, university or technical school	24
	No Degree	48
Direct access to Level 3 by a non-certified operator with experience equivalent to Level 2	Graduate of a three years accredited science or engineering college or university programme	24
	No degree	72

Note: If the college or university degree is issued in non-destructive testing the experience required for access to Level 3 may be reduced by 50%.

1.4.3. Health/eyesight

Candidates need to be in satisfactory physical condition and the person completing the application form will be required to signify that the candidate's health and eyesight are adequate to enable him/her to carry out his/her duties. An eyesight test certificate must be submitted with the application form. The evidence must be in the form of a certificate issued by a medically recognised person. The eyesight test should comprise of the following:

Unaided or corrected near visual acuity in at least one eye shall be such that the candidate is capable of reading N4 Times Roman type or Jaeger J-1 standard type at a distance of not less than 30 cm on a standard reading chart.

With all the above eligibility requirements the onus is on the candidate to provide the necessary evidence prior to the examination. An examination appointment will not be confirmed until the evidence has been received.

2. EXAMINATION PROCEDURE

The examination procedure for all levels consists of written oral and practical examinations and candidates must satisfy the examiner in all parts. Details of the examination format follow and the syllabus and specimen examination questions are given in Appendices 1 and 2 respectively.

2.1. ACFM OPERATOR LEVEL 1

The examination will comprise the following:

- a) **General** (theory appropriate to all electromagnetic inspection of welds)
 - 40 multiple-choice questions
 - Time allowed: 60 minutes
 - Pass mark is 70%

- b) **Sector specific** (theory and practical for the technique related to a specific application – in the present case this is weldments with in-service crack-like defects)
- 20 multiple-choice questions
 - Time allowed: 30 minutes
 - Pass mark is 70%

- c) **Practical examination**
Time allowed: 1 hour 15 minutes

Equipment Specific Practical examination appropriate to the ACFM equipment type.

- i) Equipment function and probe sensitivity checks, setting up the equipment.
Single handed operation
- ii) Examination of one block containing surface breaking fatigue type defects.
Two handed operation
- iii) Examination of one variable geometry weld selected from plate, pipe and tee configurations
Two handed operation
Carry out sizing for length and depth on simple spark eroded slots or simple fatigue crack.
Two handed operation
- iv) An oral examination made up of ten questions on briefing the remote probe operator.

2.2. ACFM OPERATOR LEVEL 2

The examination will comprise the following:

- a) **General** (theory appropriate to the electromagnetic inspection of welds)
- 40 multiple-choice questions.
 - Time allowed: 60 minutes
 - Pass mark is 70 %
- b) **Sector specific** (theory and practical for the technique related to a specific application – in the present case this is weldments with in-service crack-like defects).
- 20 multiple-choice questions
 - Time allowed: 30 minutes duration
 - Pass mark is 70%
- c) **Practical examination**
Time allowed: 3 hours
Equipment Specific Practical examination, appropriate to the equipment type comprising:
- i) The preparation of written test instructions
- ii) Function check and set-up of test equipment and probe sensitivity checks
- iii) Examination of at least three welds of which at least two must be variable geometry welds. The welds to be selected from plate, pipe, “T,” “Y,” cruciform and nodal configurations for which test instructions or procedures will be provided
- iv) Reporting the results in a prescribed manner in accordance with the NDT instructions or NDT procedures provided
- v) Setting up probe files for detection only
- surface breaking defects
 - plane and curved surface defects
 - in-service defects, fatigue cracking

- defect characterisation and sizing (length and depth) where applicable.

Candidates will also be expected to audit data supplied on media collected independently from ACFM systems.

2.3. ACFM OPERATOR LEVEL 3

The examination will comprise the following:

Part A (basic examination) – Time allowed: 1 hour

- 1) Technical knowledge in materials science and technology related to the activity of the candidate: 30 multiple-choice questions
- 2) Knowledge of the qualification and certification system defined in EN473: 2000: 10 multiple-choice questions

Part B (basic examination) – Time allowed: 1 hour 30 mins

General knowledge of at least four recognised NDT methods as required for level 2 and chosen by the candidate. These four methods shall comprise the principal method for which the certification will be sought and three others which must include at least one volumetric method (UT or RT): 15 multiple-choice questions for each test method (total 60).

Part C (main method of examination) – Time allowed: 3 hours

- C1 General examination covering Level 3 knowledge relating to the test method applied: 30 multiple choice questions.
- C2 A specific examination relating to the application of the NDT method in the industrial sector concerned, including applicable codes, standards and specifications: 20 multiple choice questions.
- C3 A practical examination concerning the drafting of one or more NDT procedures in the relevant sector.

3. APPLICATION FOR EXAMINATION AND FEES

Applications must be made on the appropriate application form to the examining organisation, details of which are given at the end of this document. Application forms ask for specific details of experience, training and health and must be signed confirming that these details are correct and supported by such other documents as may be necessary to confirm that the candidate is eligible for examination. No applications can be confirmed or exam dates issued until receipt of a correctly completed application form and the full fee. In the event of a false statement being discovered any certificate awarded as a result of the test will be null and void.

4. CATEGORIES OF CERTIFICATION

Candidates may apply for one or more of the following certification categories:

- 3.1 ACFM Inspector Level 1
- 3.2 ACFM Inspector Level 2
- 3.3 ACFM Inspector Level 3.

5. CERTIFICATION

5.1. RESULTS NOTICES

5.1.1. ACFM Operator Level 1 and 2 Certification

All candidates will be sent a results notice. This notice will also be sent to the organisation paying the exam fee, if not paid by the candidate.

The examination is evaluated by multiplying the mark achieved by the weighting factor for each component and then adding the components together to get an overall mark. There are four possible results:

- i) Achieving at least 70% in each part and at least 80% overall – **pass**
- ii) Achieving less than 70% in any part and less than 80% overall - **the candidate must take the full initial examination**
- iii) Achieving at least 80% overall but less than 70% in one or more parts - **the candidate may retest the part(s) which were less than 70%**
- iv) Achieving less than 80% overall but more than 70% in all parts - **the candidate may retest a maximum of two parts.**

For (iii) and (iv) above only **one retest** examination is allowed and it must be taken within 12 months of the initial examination. A candidate who fails the re-test shall apply for and take the examination according to the procedure for new candidates. The re-test (or complete re-examination) may not be taken within 30 days of the previous examination.

5.1.2. Grading

Level 1 and 2

To be certified the candidate shall obtain a grade of at least 70% in each of the four sections of the examination and a composite grade of at least 80%.

The composite grade is obtained firstly multiplying each of the four test marks by the weighting factors shown then adding together the marks obtained.

Weighting Factor			
Level	General Written	Specific Written	Practical
1	0.25	0.25	0.5
2	0.25	0.25	0.5

Level 3

Section A of the general examination shall be graded separately so that the candidates may be examined later for certification in another NDT method.

To be certified the candidate shall obtain a grade of at least 70% in each section of the examination and a composite grade of at least 80%.

The composite grade is obtained by firstly multiplying each of the test marks by weighting factors shown and then adding together the marks obtained.

Part A Basic Examination	Weighting
A1	0.25
A2	0.25
Part B	0.5
Part C	Weighting
C1	0.333
C2	0.333
C3	0.333

5.2. SUCCESSFUL CANDIDATES

Two copies of a certificate of proficiency will be issued to the sponsoring organisation or person, i.e. self employed or self sponsored candidates will receive both copies of the certificate.

Duplicate certificates to replace those lost or destroyed will only be issued after extensive enquiries.

5.3. UNSUCCESSFUL CANDIDATES

Brief details of the reasons for failure will be given in the results notice. The rules regarding re-examination are given in 4.1 above.

5.4. PERIOD OF VALIDITY

Certificates will be valid for five years from the date of completion of the original test. The renewal procedure after five years is described in section 4.5.

Certificates which are issued as a result of previously failed parts of the examination will be valid from the date of completion of the original test as described above.

Certificates are only valid provided:

- a) they are within the certification period
- b) they are on a standard cream CSWIP paper bearing the CSWIP logo, black on gold, signed by an officer of CSWIP and embossed with the CSWIP stamp
- c) they have been signed by the individual to whom the certificate is awarded
- d) they are accompanied by a valid official CSWIP identity card
- e) all fees have been paid
- f) the holder continues to work in the NDT method and sector (i.e. welds) for which the certificate is awarded
- g) *the holder continues to meet the vision requirements

*This is based on the eyesight test (see Clause 1.4.3) being taken at least every second year under the responsibility of the employer or responsible agency.

PHOTOCOPIES ARE UNAUTHORISED BY CSWIP and should only be used for internal administrative purposes.

5.5. RENEWAL

5.5.1. Five Year Renewal

In all cases, the individual applying for renewal must meet the following criteria:

- a) Provide evidence at least every second year of satisfactory vision examination (see Clause 1.4.3)
- b) Provide evidence of continued satisfactory work activity without significant interruption.

A significant interruption means an absence or a change of activity which prevents the certified individual from practising the duties corresponding to his/her level in the technique and equipment type(s) for which he/she is certified, for one or several periods for a total time exceeding one year.

The certificate will not be renewed without further test if an authenticated complaint is received by the Governing Board for Certification during the period of its validity. Further instruction and retest may then be required.

Renewal must take place not later than 21 days after the date of expiry. It is the certificate holder's responsibility to ensure that renewal takes place at the appropriate time. Only under extreme circumstances will certificates be renewed after a lapse of six calendar months from the date of expiry shown on the certificate and late renewal will be subject to a special fee.

5.5.2. Ten Year Renewal Procedure

At the end of a further five years (i.e. 10 years from Initial Certification), a renewal examination will be required prior to the expiry of the certification in addition to the renewal procedures given in Clause 5.5.1. The renewal examination will consist of the practical part of the initial examination.

A candidate unsuccessful in any section of the examination will be allowed one further attempt within four months in the section or sections failed. If the candidate is unsuccessful in this second examination no certificate will be awarded and, to obtain a certificate, the procedure for a new candidate will have to be followed.

5.6. COMPLAINTS AND APPEALS

Any party which considers itself to have reasonable grounds for questioning the competency of a CSWIP qualified person may petition the CSWIP In Service Inspection Management Committee for withdrawal of that person's certificate. Such a petition must be accompanied by all relevant facts and if, in the opinion of the Committee, an adequate prima facie case has been presented, a full investigation of their circumstances under dispute will be initiated. If the petition is substantiated to the satisfaction of the Committee, the persons certificate will be withdrawn and a further test will be required.

6. RECORDS

Records of all successful and unsuccessful candidates are maintained. These records are accessible to the CSWIP In-Service Inspection Management Committee or its nominees at all reasonable times.

At all times the rules of CSWIP current at the time of the examination apply. The CSWIP In-Service Inspection Management Committee will not be responsible for failure of candidates or their sponsors to inform themselves of these rules.

ADDRESSES

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References

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|---|------------------|------------------------------------------------------------------------------------------------------|
| 1 | ISO 9712: 1999: | Non-destructive testing: qualification and certification of personnel. |
| 2 | BS EN 473: 2000: | Non-Destructive Testing – Qualification and certification of personnel – General principles |
| 3 | ASTM E2261-03 | Standard Practice for Examination of Welds using the Alternating Current Field Measurement Technique |
| 4 | CSWIP DIV-8-96 | Requirements for the Certification of Personnel engaged in the ACFM Inspection of Welds |

Requirements for the Certification of Personnel engaged in the ACFM Inspection of Welds

APPENDICES TO DOCUMENT CSWIP-DIV-8-96 4th Edition

Appendix 1:	Examination Syllabus
Appendix 2:	Specimen Examination Questions
Appendix 3:	Specification for practical examination specimens.

APPENDIX 1: EXAMINATION SYLLABUS

Any aspects of the syllabus may be included in the written, oral or practical examination.

The level of knowledge required by the candidates varies according to the topic. To ensure comprehension by all parties the following terms have been selected to demonstrate an increasing level of knowledge.

DEFINITIONS

OUTLINE KNOWLEDGE: The candidate must be familiar with the subject in outline terms. He/She should know that the topic exists and what it is applied to. In the context of **inspection** methods/techniques the candidate would be expected to know "what it is, what it does" but would not be expected to know the finer points of application of the technique.

KNOWLEDGE: The candidate must have a working knowledge of the subject and be able to apply it.

DETAILED KNOWLEDGE: The candidate must have a depth of knowledge sufficient to enable him/her to exercise judgement.

LEVEL 1

1 INTRODUCTION

The candidate will be required to demonstrate **KNOWLEDGE** in the following general areas:

The need for inspection and the requirement in relation to the safety and integrity of welded structures..

Basic terminology of steel structures, risers and pipelines, and weld terminology.

Outline modes of failure and deterioration experienced in steel structures, risers and pipelines.

2 GENERAL OVERVIEW OF NDT TECHNIQUES

Overview of topside and underwater NDT techniques for surface crack detection and sizing.

2.1 Visual Inspection

An Outline Knowledge of:

- General visual inspection
- Close visual inspection

2.2 Magnetic Particle Inspection (MPI)

An Outline Knowledge of:

- Principles of magnetism
- Electrically induced magnetic fields

3 PRINCIPLES

3.1 Electricity

A Knowledge of:

- Direct current
- Amperage and voltage
- Resistance and Ohm's Law
- Alternating current
- Magnetism
- Induction and magnetic fields
- Magnetic permeability
- Induced magnetic flux
- Lines of force and force fields
- Residual magnetism
- Electromagnetism
- Magnetic field produced by a current
- Eddy currents induced by a magnetic field
- Field created by eddy currents

3.2 Eddy Currents

A Knowledge of:

- Eddy current distribution
- Standard depth of penetration
- Defect reaction according to its position

4 EQUIPMENT SPECIFIC: ACFM

4.1 ACFM Technology

A Detailed Knowledge of:

- Uniform fields
- Probe design
- Types of equipment
- Software versions
- ACFM system hardware equipment assembly
- Operation of ACFM software and WINDOWS commands

4.2 Basic Signal Interpretation

A Detailed Knowledge of:

- Relationship between Bz, Bx and butterfly plot
- Typical signals from a spark eroded slot
- Other signal sources
- General strategies for crack identification

4.3 Scanning Procedures

A Detailed Knowledge of:

- Function checks
- Marking up components
- Scanning speed

4.4 Remote Probe Operator Briefing Requirements

A Detailed Knowledge of:

- Preparation of inspection area
- Standard Probes
- Probe use

4.5 Care of Equipment

A Detailed Knowledge of:

- Safety checks
- Equipment maintenance

4.6 **Recording and Processing of Data**

- The principles of report writing
- The ability to generate reports for ACFM inspection data
- File management systems
- Data storage
- Instrument data retrieval
- Report data transfer to PC

LEVEL 2

1 **INTRODUCTION**

The candidate will be required to demonstrate **KNOWLEDGE** in the following general areas.

The importance of documentation, record keeping and good communications, planning and briefing.

The need for appropriate levels of personnel qualification and equipment certification.

The need for written procedures for all activities.

2 **PRINCIPLES**

2.1 **Principles of Eddy Current**

A Detailed Knowledge of:

- Influence of different parameters on measurement
- Influence of permeability
- Influence of frequency
- Influence of structure and geometry
- Influence of probe handling (scanning technique including relative scanning speed)
- Influence of coating (sensitivity and compensation)
- Influence of defect position and orientation
-

3 **EQUIPMENT SPECIFIC: ACFM**

3.1 **Advanced Defect Sizing**

A Detailed Knowledge of:

- Sizing software operation
- Single defect sizing
- Multiple defect sizing
- Theoretical limitations
-

3.2 **Remote Probe Operator Briefing Requirements**

A Detailed Knowledge of:

- Preparation of inspection area
- Standard Probes and principles of Array Probes
- Probe use

3.3 Reporting

A Detailed Knowledge of:

- Backing up and saving data
- Report sheets and title page
- File management and directory names
- The principles of report writing
- The ability to generate report formats for ACFM inspection data
- Data storage
- Instrument data retrieval
- Report data transfer to PC

3.4 Equipment Operation

A Detailed Knowledge of:

- How to set up equipment, and adjust equipment parameters
- Basic interpretation using Array Probes
- Probe selection and the setting up of probe files
- Safety checks
- Equipment maintenance and troubleshooting.

4 PRODUCT TECHNOLOGY

A Knowledge of:

- Surface defects associated with welded joints, both pre-service and in-service.

LEVEL 3

1 GENERAL

Level 3 personnel are expected to be competent to assume the responsibilities of management of an NDT facility. The CSWIP Level 3 examination will evaluate the candidates knowledge of the following:

Allocation of staff with appropriate certification according to the customers requirements. Supervision and maintenance of Level 1 and Level 2 personnel's certification, documentation and records.

The internal audit of all customers records, equipment performance and repairs and maintenance.

Review company procedures and current work practices.

Be responsible for safe working practices

Understanding of this document; product technology and the production of defects.

2 LEVEL 3 GENERAL THEORY

Candidates will be required to be conversant with the syllabi for ACFM theory at Level 1 and Level 2

3 GENERAL THEORY OF NDT METHODS AT LEVEL 2

A knowledge of the Level 2 general theory of ACFM testing and a general familiarity with other NDT methods.

4 **PROCEDURE WRITING**

Candidates will be required to produce a written procedure for the inspection of a specified component. The procedure must include any safety requirements appropriate to the test situation, NDT personnel approvals including any documentation, actions to be taken in the case of non-compliance and reporting instructions.

APPENDIX 2: SPECIMEN EXAMINATION QUESTIONS

For all multiple-choice questions candidates are required to tick or otherwise indicate the correct answer in the space provided. Some examples are included in this Appendix.

LEVEL 1: ELECTROMAGNETIC INSPECTION OF WELDS

The Level 1 theory examination is in two parts: Time allowed 1.5 hrs

- 1A General Theory (Common to all eddy current techniques) 40 multiple-choice questions.
2A Equipment Specific Theory (ACFM) 20 multiple-choice questions.

All parts must be attempted.

LEVEL 1: GENERAL THEORY COVERING THE SCOPE OF ACFM PRACTICE

PART 1A:

- 1 What is an electric current?
- a) The movement of an electric charge typically by way of electrons (negatively charged particles) a) _____
 - b) A periodically charged electron changing tangentially to the conductor b) _____
 - c) The currents caused to flow in an electrical conductor by time or space variation, or both, of an applied magnetic field c) _____
 - d) The measurement of resistance in a cable d) _____
- 2 Which of the following frequencies would produce eddy currents with the shallowest depth penetration?
- a) 500Hz a) _____
 - b) 5kHz b) _____
 - c) 10MHz c) _____
 - d) 20kHz d) _____

LEVEL 1: SECTOR SPECIFIC – ACFM EQUIPMENT

PART 2A:

- 1 Which of the following inspection requirements could you not normally use ACFM for defect detection?
- a) Inspection of surface breaking cracks in welded 50D steel under epoxy paint coating a) _____
 - b) Shallow crazed cracking in a surface b) _____
 - c) Fatigue cracks in welded tubular joints in 50D steel c) _____
 - d) Surface fatigue cracks in stainless steel welds d) _____

2 The spark eroded slot dimensions for equipment and probe sensitivity checks using standard coiled (i.e. NOT micro) probes are:

- a) 20mm in length x 2mm in depth a) _____
- b) 20mm in length x 5mm in depth b) _____
- c) 50mm in length x 5mm in depth c) _____
- d) 50mm in length x 2mm in depth d) _____

3 The keystroke for centralising Bx and Bz plots

- a) R a) _____
- b) S b) _____
- c) F c) _____
- d) V d) _____

LEVEL 2: ELECTROMAGNETIC INSPECTION OF WELDS

The Level 2 Theory examination is in three parts: Time allowed 1.5 hours

1A General Theory (common to all Eddy Current techniques) 40 multiple-choice questions

2A Sector Specific Theory (specific to ACFM) 20 multiple-choice questions.

LEVEL 2: GENERAL THEORY

PART 1A:

1 A B H Plot represents?

- a) Current flow plotted against voltage a) _____
- b) Differences in surface current density b) _____
- c) Conductivity plotted against Resistance c) _____
- d) External magnetising force plotted against Flux density d) _____

2 As permeability increases, what happens to the “Skin Depth”?

- a) It decreases a) _____
- b) It increases b) _____
- c) Nothing c) _____
- d) System failure d) _____

3 What is the effect of increasing a current in a coil?

- a) The resistance decreases a) _____
- b) The frequency increases b) _____
- c) The magnetic field decreases c) _____
- d) The magnetic field increases d) _____

LEVEL 2: SECTOR SPECIFIC – ACFM EQUIPMENT

PART 2A:

- 1 When a semi-elliptical crack is in an applied uniform a.c. magnetic field parallel to its surface length, what is the magnitude of the magnetic field at the crack centre relative to the uniform field away from the cracked area?
- a) Less than the uniform field a)_____
 - b) Greater than the uniform field b)_____
 - c) The same as the uniform field c)_____
 - d) Zero d)_____
- 2 To orientate direction of probe the possible keystrokes are:
- a) A, C, or T a)_____
 - b) Alt-shift and space bar b)_____
 - c) Ctrl-shift and enter c)_____
 - d) Alt-shift and enter d)_____
- 3 The manufacturer's recommended probe scalings say that the Bx signal on a 50mm x 5mm deep slot using a standard coiled probe (i.e. NOT micro) should be:
- a) 75% of full screen height (FSH) a)_____
 - b) 25% of full screen height (FSH) b)_____
 - c) 50% of full screen height (FSH) c)_____
 - d) 100% of full screen height (FSH) d)_____

LEVEL 3: ELECTROMAGNETIC INSPECTION OF WELDS

The Level 3 Theory examination: Time allowed 5½ hours

The qualification examination for Level 3 consists only of a written examination covering a specific test method.

The examination covers:

- a) Basic Knowledge relating to the test method applied for and to materials, processes and discontinuities; questions of a level 2 standard relating to other NDT methods (MT, UT, ET and EC)
- b) Specific knowledge relating to the application of the NDT method in which the candidate is being examined including applicable codes, standards and specifications, plus knowledge of the product being tested.