



**CERTIFICATION SCHEME FOR WELDING AND INSPECTION PERSONNEL**

## **DOCUMENT NO. CSWIP-DIV-7-95 - Part 1**

# **Requirements for the Certification of Underwater (Diver) Inspectors**

Categories of Certification:

- Underwater (Diver) Inspector - Grade 3.1U
- Underwater (Diver) Inspector - Grade 3.2U
- Concrete - Grades 3.1UC and 3.2UC

2<sup>nd</sup> Edition September 2001

For details of 3.4U Underwater Inspection Controller and 3.3U ROV Inspector, please refer to Part 2 of this Document.

Incorporating additions and amendments as approved by the CSWIP In-Service Inspection Management Committee as constituted on 29 March 2001.

Issued under the authority of the Governing Board for Certification

All correspondence should be addressed to:

TWI Certification Ltd

Granta Park, Great Abington, Cambridge CB1 6AL, UK

Telephone: +44 (0) 1223 891162;

Telefax: +44 (0) 1223 894219.

E:mail: [twicertification@twi.co.uk](mailto:twicertification@twi.co.uk)

Web: <http://www.cswip.com>

CSWIP is administered by TWI Certification Ltd

The use of the UKAS Accreditation Mark indicates accreditation in respect of those activities covered by Accreditation Certificate No 25

## **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.

## **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**

This document describes the procedures by which personnel may be examined and if successful, certificated in relation to underwater inspection and non-destructive testing. The scheme is intended to meet the majority of users' requirements to provide industry with an assured minimum standard of proficiency. The specialist user may add specific tests or requirements related to his own needs. The examination procedure is designed to test the candidate's grasp of the methods and techniques, and his/her understanding of the operations he/she performs. The examination procedure involves written, oral and practical tests, where appropriate.

Specimen written examination questions and syllabuses for the guidance of organisations and individuals preparing for certification are included as appendices to this document.

The policy of the CSWIP In-Service Inspection Management Committee is to keep all technical requirements under regular review to ensure that current industrial needs and new technology are adequately covered. It is therefore important for users of the scheme to ensure that they are aware of any amendments to, or re-issue of, this document.

This document covers two grades of activity: these apply to divers who are involved in underwater structural inspection, 3.1U and 3.2U. A concrete endorsement is available for all holders of underwater inspection certification.

Certification categories are also available for topside personnel involved in underwater inspection: 3.3U and 3.4U. A separate document (Reference CSWIP-DIV-7-95 - Part 2) is available on these categories.

## 1.2 **Vision requirements**

All candidates must provide evidence of unaided or corrected near visual acuity in at least one eye, such that the candidate is capable of reading N4 Times Roman type at a distance of not less than 30cm on a standard reading test chart. **That evidence to have been provided within the two years preceding the examination.**

## 1.3 **Health requirements**

The candidate must provide evidence of a valid Diver's Medical Certificate issued under Diving at Work Regulations 1997 or a similar standard.

## 1.4 **Job responsibilities**

Candidates will be expected to be able to apply appropriate inspection methods and techniques underwater. They should be capable of maintaining appropriate job records, of preparing written reports and of producing an adequate oral commentary on their work as and when required.

## 1.5 **Evidence of training/competence - all candidates**

Candidates must hold a valid certificate of diver training or competence to HSE surface supplied air diver or higher. (See below Acceptable Equivalents ).

Evidence of the appropriate underwater inspection methods should be logged in the candidate's red IMCA underwater inspection log book or other official log book giving specific details of inspection work, each entry being signed by the candidate, diving supervisor and client representative. Photocopies of entries may be required as supporting evidence of experience when making application to CSWIP for examination but the original log book should be available for inspection by CSWIP, if required.

## **ACCEPTABLE EQUIVALENTS**

There is a comprehensive list of approved commercial diving qualifications that can be found on the Internet at [www.hse.gov.uk/spd/divequz.htm](http://www.hse.gov.uk/spd/divequz.htm)

However, it is recognised that certain commercial divers operating in some countries have no formal diver certification and the CISIMC has agreed that such divers should not be debarred from applying to take the CSWIP 3.1U or 3.2U examinations so long as they meet appropriate entry criteria. It has been agreed that a diver without a training certificate as shown above may apply to sit 3.1U or 3.2U examinations. **The applicant should provide confirmation of his experience and competence by detailed letter, signed by the General Manager or a Director of his employer and consideration will be given on an individual basis.**

## 2 **GRADE 3.1U**

### **NOTE: Training Courses**

Grade 3.1U candidates will be required to have satisfactorily completed a CSWIP approved training course on the methods in which they are to be examined. Part of this training may be land based but a minimum period of inspection training underwater of 7.5 hours is required.

### 2.1 **Approval Procedure**

Candidates will require to satisfy the examiners in all parts of the examination.

#### 2.1.1 **Written examination**

The test will include a written examination consisting of:

- a) 50 multi-choice questions which will include questions on concrete structures, and
- b) Five questions requiring longer written answers, one from each of five sections:
  - i) Underwater visual inspection, steel
  - ii) Underwater visual inspection, concrete
  - iii) Recording methods
  - iv) Corrosion protection
  - v) NDT methods (general knowledge) and ultrasonic digital thickness measurement.

An oral examination will normally only be required in the case of candidates attempting retests following failure in the written examination. It will be designed to reveal the candidate's background knowledge and experience in the inspection and NDT techniques on which he/she is being examined.

#### 2.1.2 **Practical examination**

All underwater practical examinations will be conducted in either a tank or open water (**with the diver clear of the tank bottom or seabed**). Not more than three hours in water will be allowed for underwater tests. As part of the examination an adequate oral commentary by the candidate during underwater work will be required.

The underwater practical examination will consist of the following parts:

- i) Visual examination of an underwater steel structure
- ii) Cathodic potential measurements
- iii) Ultrasonic digital thickness measurements
- iv) Underwater photography
- v) Use of CCTV with oral commentary.

### 2.1.3

#### **Concrete examination**

For those seeking qualification in the inspection of concrete, the examination may be taken at the same time as the initial examination, an upgrade to 3.2U examination or a five year renewal. The concrete qualification will also be renewable at the five year renewal point of the 3.1U or the 3.2U.

The examination will consist of a 20 multi-choice question paper and assessment and reporting on eight photographs of typical concrete blemishes and reporting the possible cause, type and classification.

Please note there is **no** retest for this examination. Further attempts are all treated as an Initial concrete examination.

### 3 **GRADE 3.2U**

**NOTE:** 3.2U candidates must either:

- a) hold a current 3.1U certificate

or

- b) satisfy the 3.1U and 3.2U training requirements and take the 3.1U examination prior to the 3.2U examination. These combined examinations will require the candidate to spend more than one day at the test centre. 3.2U certificates will only be issued if success in both the 3.1U and 3.2U examination is achieved and the candidate has provided proof of at least one years experience working as a practising commercial diver.
- c) **Training Course:** Grade 3.2U candidates will be required to have satisfactorily completed a CSWIP approved training course on the methods in which they are to be examined. They shall provide written evidence of six hours practical underwater experience in Grade 3.2U techniques. This practical experience may be tank based.

#### 3.1 **Approval Procedure**

Candidates will be required to satisfy the examiners in all parts of the examination.

##### 3.1.1 **Written examination**

- a) 25 multi-choice questions
- b) Six questions requiring longer written answers, one from each of six sections:
  - i) Technique preparation
  - ii) Corrosion protection
  - iii) Magnetic particle inspection
  - iv) Ultrasonic testing
  - v) Visual inspection, photography and CCTV
  - vi) NDT techniques (general knowledge)

##### 3.1.2 **Practical examination**

- i) Magnetic particle assessment of three ferritic steel welds using various magnetisation techniques with fluorescent inks and ultraviolet light.
- ii) Practical weld toe grinding of a 150mm length of weld to a specific requirement.

### 3.1.3 Concrete examination

For those seeking qualification in the inspection of concrete, the examination may be taken at the same time as the initial examination, an upgrade to 3.2U examination or a five year renewal. The concrete qualification will also be renewable at the five year renewal point of the 3.1U or the 3.2U.

The examination will consist of a 20 multi-choice question paper and assessment and reporting on eight photographs of typical concrete blemishes and reporting the possible cause, type and classification.

Please note there is **no** retest for this examination. Further attempts are all treated as an Initial concrete examination.

## GENERAL INFORMATION

### 4.1 Examination equipment, specimens and test centres

4.1.1 **3.1U** For the 3.1U examination, suitable underwater structures are situated at test centres and all necessary CCTV, photographic, CP measurement and ultrasonic digital equipment is provided.

Candidates may bring their own cameras but should confirm their suitability at the time of booking the examination.

4.1.2 **3.2U** For the 3.2U examination suitable magnetic particle and grinding equipment and consumables together with a range of test specimens are provided.

- NOTE:**
- a) Surface demand diving equipment is also provided for all divers, but divers requiring unusually large or small suit sizes are advised to check the availability with the Test Centre when booking their examination.
  - b) Rigging aids are provided but candidates may bring their own if they wish.

### 4.2 Applications for examinations 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.

### 4.3 Certification

#### 4.3.1 Results notices

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

#### 4.3.2 Successful candidates

Two copies of a certificate of proficiency will be issued to the organisation or person that pays the examination fees. Duplicate certificates to replace those lost or destroyed will be issued only after extensive enquiries.

Candidates who take the 3.1U and 3.2U examinations together and who pass the 3.1U but not the 3.2U will be awarded a 3.1U certificate.

#### 4.3.3 Unsuccessful candidates

##### **Initial 3.1U, 3.2U and Concrete examinations:**

Brief details of the reasons for failure will be given in the results notice sent to the candidate and to the organisation paying the fees.

**No certification will be awarded to candidates who pass the 3.2U part if success has not been achieved in the 3.1U part.**

Candidates who fail part(s) of the initial examination may attempt **ONE RETEST** of the failed part(s) provided such retest is completed within **six (6) months**. Candidates who do not complete the retest within the specified time or those who are again unsuccessful will be treated thereafter as initial candidates.

**CANDIDATES ARE STRONGLY ADVISED TO ARRANGE SOME INDIVIDUAL REFRESHER TRAINING THROUGH ONE OF THE CSWIP APPROVED TRAINING ESTABLISHMENTS.**

#### 4.3.4 Validity of certificates

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 4.5.1

Certificates 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 certification period
- b) they are on standard cream CSWIP paper bearing the CSWIP logo black on gold signed by an officer of CSWIP and embossed with the CSWIP stamp
- c) all fees have been paid.

**PHOTOCOPIES ARE UNAUTHORISED BY CSWIP AND SHOULD BE USED ONLY FOR INTERNAL ADMINISTRATION PURPOSES.**

#### 4.3.5 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, a prima facie case has been presented, a full investigation of the circumstances under dispute will be initiated. If the petition is substantiated to the satisfaction of the Committee the person's certificate will be withdrawn and a further test will be required.

Appeals against failure to be certified or against non-renewal of a certificate may be made by the person concerned or the employer upon application in writing to the CSWIP In-Service Inspection Management Committee.

#### 4.4 **Supplementary examination (ie upgrade from 3.1U to 3.2U)**

These examinations may be attempted by existing certificate holders provided the necessary requirements are met. Failure in these examinations will not affect the validity of existing certificates.

Supplementary examinations differ in that supplementary examinations are essentially upgrades of an existing certificate (e.g. 3.1U to 3.2U).

Certificates awarded as a result of successful completion of a **supplementary** test will be valid for five years from the date of the supplementary test.

A supplementary upgrade from 3.1U to 3.2U test may not be attempted during the **16 weeks** before the expiry date of an existing certificate.

**The reason for this is to safeguard the certification status of individuals holding a 3.1U in the event of them failing the supplementary examination.**

##### 4.4.1 **Concrete examination**

Candidates already holding underwater inspection certificates requiring the concrete qualification may attempt the examination (see para 2.1.3 or 3.1.3) and if successful will be awarded a 3.1UC or 3.2UC certificate as appropriate.

##### 4.4.2 **Supplementary examination**

Upgrading from 3.1U to 3.2U is described in Section 3, paragraph 3.1.

#### 4.5 **Five year renewal**

To ensure continuity it is desirable for five year examination to be carried out **up to six months prior to the final expiry date of the original certificate**. If successful the certificate shall be dated five years from the original expiry date.

It is not possible to combine a supplementary up-grade examination with a five year renewal examination.

If for any reason it is not possible for the candidate to complete the renewal test before expiry of the original certificate, then the period during which the renewal test can be taken may be extended. Requests for extra time should be made in the first instance to the CSWIP Secretariat, TWI Certification Ltd. It should be noted that this extra time does not change the expiry date on the certificate and **work carried out beyond the expiry date has no certificate cover**.

#### 4.5.1 Experience

Candidates will be required to provide written evidence of a minimum of 100 hours underwater inspection experience (of which no more than 10 hours per year shall be simulated experience) over the five year validity period of the current certificate, to be accepted for five year renewal examination.

For those candidates who have not achieved the experience as specified in 4.5.1, the following rules apply:

3.1U five year renewal: Complete the full five year examination plus the 3.1U written paper.

3.2U five year renewal: Complete the full five year examination plus 3.2U written supplementary paper.

#### 4.5.2 Five year renewal procedure for 3.1U and 3.2U

The five year renewal test consists of both theoretical and practical examinations. The theory will consist of 3.1U and 3.2U multi-choice papers as appropriate to the renewal sought. The practical element will be as follows:

- General survey with commentary of structure 3.1U and 3.2U
- Magnetic particle inspection of two welds 3.2U only
- Close video inspection of weld and defect area 3.1U and 3.2U
- Photography of weld and defect area 3.1U and 3.2U
- Stand off photography 3.1U and 3.2U
- Digital thickness readings 3.1U and 3.2U
- Remedial grinding 3.2U only

The maximum diving time will not exceed four hours.

#### 4.5.3 Renewal of concrete qualification

Candidates holding a certificate with a concrete examination awarded prior to the introduction of the five year renewal of that endorsement will also have to renew at the five year renewal point of their 3.1UC or 3.2UC.

The five year renewal examination will consist of a 20 multi-choice question paper and assessment and reporting on eight photographs of typical concrete blemishes and reporting the possible cause, type and classification.

#### 4.5.4 Failure of five year renewal examination

**3.2U renewal:** If the 3.2U section is passed but the 3.1U section is failed, this constitutes failure of the renewal, with no certificate issue until **successful resit** of the 3.1U examination part failed. **Failure of the 3.1U retest will require candidate to re-certify in both 3.1U and 3.2U.**

A 3.2UC (Concrete) certificate holder who fails the 3.2UC part of the renewal examination will be awarded a 3.1UC certificate.

Failure of **all** parts of the 3.2U five year renewal, ie both the 3.1U and the 3.2U, requires the candidate to return to Initial 3.1U followed by 3.2U, for which a refresher course is strongly recommended.

**3.1U five year renewal:** One retest is allowed for any failed part. Failure of the retest means a return to Initial status.

All retests must be attempted within six months of the date of the Results Notice – this is not extendable under any circumstances.

## 5 **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.

**Additional information:**

CSWIP Secretariat  
TWI Certification Ltd  
Granta Park  
Great Abington, Cambridge CB1 6AL

Phone 01223 891162  
Fax 01223 894219  
Email: [twicertification@twi.co.uk](mailto:twicertification@twi.co.uk)  
Web: <http://www.twi.co.uk>

For examination enquiries:

TWI North For all examinations  
Aurora Court  
Barton Road  
Riverside Park  
Middlesbrough TS2 1RY

Phone: 01642 210512  
Fax: 01642 252218  
Email: [twinorth@twi.co.uk](mailto:twinorth@twi.co.uk)

TWI Examination Services (For 3.3U, 3.4U and all written retests only)  
Granta Park,  
Great Abington, Cambridge CB1 6AL

Phone 01223 891162  
Fax 01223 891630  
Email: [trainexams@twi.co.uk](mailto:trainexams@twi.co.uk)  
Web: <http://www.twi.co.uk>

3.3U, 3.4U and all written retests can also be taken at Paisley University – for details please contact TWI Examinations.

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**Requirements for the Certification of  
Underwater  
(Diver) Inspectors**

**APPENDICES TO DOCUMENT CSWIP-DIV-7-95 - Part 1**

Appendix 1:	Examination Syllabus
Appendix 2:	Specimen Written Examination Questions

## **APPENDIX 1: EXAMINATION SYLLABUS**

Any aspect of the syllabus may be included in the written and oral examination. Items which will be specifically included in the practical examination have the suffix 'P.'

The level of knowledge required by the candidate varies according to topic. To ensure comprehension by all parties the following terms have been defined 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 the "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.

### **3.1U UNDERWATER INSPECTOR**

#### **INTRODUCTION**

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

The need for inspection.

Basic terminology of steel/concrete structures, risers, pipelines, wellheads and protection frames (igloos).

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

Appreciation of how an operator's inspection programme attempts to detect and assess such failure and deterioration by use of the various inspection techniques covered by the Grade 3.1U syllabus.

The importance of documentation, record keeping and good communication.

The need for written procedures for certain activities.

#### **1 UNDERWATER VISUAL INSPECTION**

##### **A KNOWLEDGE OF:**

Cleaning for the purpose of inspection (LP air, water jet, grit entrainment, wire brush) and safety aspects. Standard of surface finish.

Weld structures plus riser and concrete terminology.

Pipeline features and terminology.

Marine growth species identification, percentage coverage (estimates of each type) growth thickness techniques, the effects of marine growth and reasons for removal.

##### **A DETAILED KNOWLEDGE OF:**

Types of visual defects and their likely location in steel/concrete structures and risers. 'P'

Types of defects and areas of concern on pipelines.

Identification of visual weld defects. 'P'

Appreciation of likely weld defect locations.

Dimensional checking of welds, and measurements underwater, principles employed in engineering practice. 'P'

2 **RECORDING METHODS**

**AN OUTLINE KNOWLEDGE OF:**

Principles of photogrammetry.  
Requirements for care in use and deployment of photographic and video equipment.  
Structural marking methods.  
Methods of setting up identification markers and size references.  
Types of video equipment.  
Still photographic equipment, loading and unloading film, pre-setting cameras, charging batteries and checking charge for cameras and strobes.

**A KNOWLEDGE OF:**

Importance of (size) references and record keeping.  
Photography including meaning and relationships between film speed, aperture, shutter speed, focus, depth of field.

**A DETAILED KNOWLEDGE OF:**

Optimum light placement and intensity in photography and video. 'P'  
The correct use of CCTV and video to give optimum results. 'P'  
Narrative commentary by diver and dialogue with topside inspection supervisor/controller during inspection work. 'P'  
Methods of setting up identification markers and size references during stand-off and close-up (macro) photography. 'P'

3 **CORROSION PROTECTION SYSTEMS**

**AN OUTLINE KNOWLEDGE OF:**

General principles of corrosion and how corrosion protection is effected by protective coatings and cathodic protection.  
Potential measurement methods (contact, proximity) and calibration of instruments.

**A KNOWLEDGE OF:**

Modes of deterioration and typical inspection requirements for sacrificial anodes and impressed current systems.  
The effects of external factors such as debris, seabed material and marine growth on CP systems.  
Typical instances and causes of visual corrosion. 'P'

**A DETAILED KNOWLEDGE OF:**

Typical CP values obtained (protected and unprotected steel) 'P'  
Visual inspection of protective coatings including Monel and other cladding.  
Safety aspects of impressed current systems.

#### 4 **WALL THICKNESS MEASUREMENT USING ULTRASONICS**

##### **AN OUTLINE KNOWLEDGE OF:**

Types of flaws associated with various rolled products e.g. laminations, inclusion clusters and piping.

Internal corrosion and its effect on ultrasonic inspection using digital wall thickness meters.

##### **A DETAILED KNOWLEDGE OF:**

Measurements of wall thickness using digital wall thickness meters, necessary surface preparation, calibration, alignment, appreciation of the shortcomings of these instruments. 'P'

#### 5 **NON-DESTRUCTIVE TESTING (NDT) TECHNIQUES**

##### **AN OUTLINE KNOWLEDGE OF:**

Methods, limitations and capabilities of magnetic particle, ultrasonic A scan, radiographic, and eddy current inspection techniques.

Principles of FMD techniques (ultrasonic, gamma radiation, thermal).

#### 6 **CARE AND CALIBRATION OF EQUIPMENT**

##### **AN OUTLINE KNOWLEDGE OF:**

The care of and need for calibration of photographic equipment and digital wall thickness meters.

The care of and need for calibration of cathodic potential measurement systems.

Care and calibration of other NDT equipment.

##### **A KNOWLEDGE OF:**

Deployment and recovery of equipment.

Care of equipment after recovery.

Care of damaged and flooded equipment.

Safe use of electrical equipment relevant to approved codes of practice.

7 **REPORTING AND REPORT WRITING**

**AN OUTLINE KNOWLEDGE OF:**

Principles of report writing.

The function of data sheets, logs, videos, photographs and recording media.

Importance of standard terminology, need for accuracy, simplicity, consistency, clarity and methodical approach.

**A KNOWLEDGE OF:**

Necessity to produce a fluent verbal description during inspection activities. 'P'

Necessity to produce post inspection written reports. 'P'

Necessity to recognise anomalies and the need to report same.

### **3.2U UNDERWATER INSPECTOR**

A **DETAILED KNOWLEDGE** of the 3.1U syllabus is required **PLUS** the following:

#### **INTRODUCTION**

Non-destructive testing techniques, their principles, range of application and their defect detection capabilities.

The techniques particularly applicable underwater.

#### **1 MAGNETIC PARTICLE INSPECTION**

It is expected that candidates will be capable of applying both underwater and above water techniques, the latter being of specific relevance to habitat based work.

##### **AN OUTLINE KNOWLEDGE OF:**

Principles of magnetism, magnetic poles, magnetic field, lines of force, longitudinal magnetisation, horseshoe magnets, vector field, consequent poles, distorted field, leakage field.

Magnetisable and non-magnetisable materials.  
Simple definitions of permeability and reluctance.

Generation of circumferential flux and longitudinal flux. Flux density, residual magnetism.

Hysteresis loops and their relevance to demagnetisation/magnetisation methods.

Equipment - types available and their use.  
Fixed, transportable and portable installations, D C battery, A C mains, d c rectified full wave.  
Ancillary equipment, inspection lighting (including white and UV-A).  
Viewing aids.  
Marking devices.  
Demagnetisers.  
Contrast aids.

##### **A KNOWLEDGE OF:**

Reasons for demagnetisation, A C and D C methods. `P'  
Testing for demagnetisation.  
Problems associated with MPI of partially completed weldments.  
Magnetisation operation to be used, current or flux values, jigs or fixtures.  
Geometric shape of components.  
Method of assessing sensitivity of techniques.  
Surface preparation, cleaning methods and standards.  
Recording of defect indications, photographic fluorescent and non-fluorescent techniques,  
Micro set replication application, tape transfer.  
Use of portable gauss, white light and UV-A meters for testing site conditions. `P'  
Test pieces and 'portable cracks.'

**A DETAILED KNOWLEDGE OF:**

Calibration equipment and the use of meters.

Performance checks.

Inks and concentrates (fluorescent and non-fluorescent), wetting agents and inhibitors.

Preparation and testing of inks.

Determination of solid content. `P'

Types of discontinuity and their indications, (surface and subsurface indications).

Reporting of non-relevant indications.

Surface grinding to confirm indications.

The use of permanent magnets, electromagnets, coils, parallel conductors, flexible cables, prods and the limitations of each. `P'

Narrative commentary during performance of examination. `P'

2 **ULTRASONIC TESTING**

**AN OUTLINE KNOWLEDGE OF:**

Simple explanation of common terms associated with the use of digital wall thickness meters, for example: ultrasonic, frequency, wavelength, velocity, compression probe (single and twin crystal).

Production of ultrasonic waves and a simple explanation of the effects of attenuation, scattering, acoustic impedance.

Use of calibration and reference blocks.

**A KNOWLEDGE OF:**

Surface condition of materials for scanning, checking of material for thickness and internal corrosion.

Effects of coatings on ultrasonic inspection.

**A DETAILED KNOWLEDGE OF:**

Wall thickness and lamination checking using a digital wall thickness meter. `P'

Report writing, including diagrams where appropriate. `P'

Narrative commentary during ultrasonic examination of material. `P'

3 **RADIOGRAPHY**

**AN OUTLINE KNOWLEDGE OF:**

The principles of the technique.

Safety precautions.

4 **EDDY CURRENT INSPECTION**

**AN OUTLINE KNOWLEDGE OF:**

The principle of the technique as applicable to eddy current systems.

The care and deployment of the systems.

**A KNOWLEDGE OF:**

An understanding of the geometry and design of eddy current systems including their specific application.

The importance of a detailed narrative commentary with the topside inspection controller during examination of welds.

The limitations of the techniques with respect to weld geometry, gussets, ratholes, coatings, marine growth, surface pitting and corrosion.

Cleaning standards and surface finish.

## 5 **WELD TOE PROFILING**

### **A KNOWLEDGE OF:**

The use and application of profile and weld geometry gauges.

**`P'**

### **A DETAILED KNOWLEDGE OF:**

The grinding of weld toes/parent plate to a required profile.

The advantages and disadvantages of pneumatic and hydraulic peanut grinders.

Types of burrs and their application.

**`P'**



- 5 Which of the following may occur at the time of construction of a concrete platform?
- a) Abrasion a \_\_\_\_\_  
 b) Spalling b \_\_\_\_\_  
 c) Honeycombing c \_\_\_\_\_  
 d) Water jetting marks d \_\_\_\_\_
- 6 Sacrificial anodes made from which of the following metals could be used to protect a steel structure?
- a) Magnesium a \_\_\_\_\_  
 b) Zinc b \_\_\_\_\_  
 c) Aluminium c \_\_\_\_\_  
 d) All of the above d \_\_\_\_\_
- 7 Which of the following cannot be found by visual inspection (assuming access to both sides)?
- a) Linear misalignment a \_\_\_\_\_  
 b) Undercut b \_\_\_\_\_  
 c) Lamellar tearing c \_\_\_\_\_  
 d) Pitting corrosion d \_\_\_\_\_
- 8 Which of the following cleaning methods is least detrimental to the surface of a structure?
- a) Needle gun a \_\_\_\_\_  
 b) LP Air grit entrained b \_\_\_\_\_  
 c) Water jet c \_\_\_\_\_  
 d) Hydraulic wire brush d \_\_\_\_\_

**PART B: LONGER WRITTEN NARRATIVE**

Candidates are required to answer one question from two in each of five sections. (Only one example is included in this specimen paper).

- 1 Underwater visual - steel  
 Give reasons why it is essential that debris is located on and around offshore structures.
- 2 Underwater visual - concrete  
 Explain why in some instances the aggregate may be visible on concrete structures which are already in service.
- 3 Recording methods, photography and CCTV  
 Explain the importance of good data recording and diver information.
- 4 Corrosion protection  
 Discuss the different ways in which half-cells can be used for structural and pipeline inspection.

- 5 NDT techniques (general knowledge) and ultrasonic digital thickness measurement  
Discuss the limitations of taking digital wall thickness measurements.

### 3.2U

The examination is in two parts A and C. Both parts must be attempted and the total time allowed is 2 hrs 30 minutes.

#### PART A: MULTI-CHOICE ANSWER PAPER

25 questions have to be answered; 5 examples are included in this specimen paper.

All questions to be answered. Candidates are required to tick the correct answers in the space provided.

- 1 Which of the following methods is not usually applicable to underwater crack detection?
- |                             |         |
|-----------------------------|---------|
| a) Current flow using prods | a _____ |
| b) Permanent magnet         | b _____ |
| c) Threading bar            | c _____ |
| d) Flexible cable           | d _____ |
- 2 Prod testing using current flow is suitable for:
- |                        |         |
|------------------------|---------|
| a) AC                  | a _____ |
| b) DC                  | b _____ |
| c) Full wave rectified | c _____ |
| d) All of the above    | d _____ |
- 3 In A-scan presentation, the X-axis (horizontal) on the CRT represents:
- |                             |         |
|-----------------------------|---------|
| a) Signal amplitude         | a _____ |
| b) Direction of wave travel | b _____ |
| c) Elapsed time or distance | c _____ |
| d) Area of defect           | d _____ |
- 4 The engineer needs to know the colour of a defect in a concrete structure because it:
- |   |         |
|---|---------|
| a) Indicates the standard of cleaning       | a _____ |
| b) Indicates construction quality           | b _____ |
| c) Helps to determine the age of the defect | c _____ |
| d) Indicates the effect of marine fouling   | d _____ |
- 5 Which of the following is used as a substitute for sacrificial anodes?
- |                      |         |
|----------------------|---------|
| a) Depressed current | a _____ |
| b) Repressed current | b _____ |
| c) Impressed current | c _____ |
| d) All of the above  | d _____ |

## **PART C: LONGER WRITTEN NARRATIVE**

Candidates are required to answer one from two questions in each section.

### **Section i: - Technique preparation**

Prepare with the aid of a diagram the detailed technique for the magnetic particle inspection of a circumferential butt weld in a 200mm OD x 14mm wall ferritic steel pipe using A C current flow (prods) equipment.

### **Section ii: - Corrosion protection**

List the relative advantages and disadvantages of sacrificial anodes and impressed current systems and state how you would assess their efficiency.

### **Section iii: - Magnetic particle inspection**

Describe one technique for the assessment of sensitivity of a magnetic particle inspection technique used underwater.

### **Section iv: - Ultrasonics**

Describe how to calibrate an ultrasonic A-scan CRT set to measure thickness of steel pipes of 20-30mm wall thickness.

### **Section v: - Visual inspection, photography and CCTV**

Draw a fillet welded T joint where the included angle between the components is over 50 and less than 45o and identify the following features: leg length, weld face, toes, root. Indicate by shading where you might expect to find the heat affected zone.

### **Section vi: - NDT techniques (general knowledge)**

Discuss the advantages and disadvantages of radiography and ultrasonics for the inspection of underwater pipelines.