



CERTIFICATION SCHEME FOR WELDING AND INSPECTION PERSONNEL

DOCUMENT No. CSWIP- DIV-7-95 – Part 2

Requirements for the Certification of ROV Inspectors and Underwater Inspection Controllers

Categories of certification

ROV Inspector	-	Grade 3.3U
Underwater Inspection Controller	-	Grade 3.4U
Concrete Examination		

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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 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 topside personnel involved in underwater inspection, 3.3U and 3.4U. A concrete Examination is available for all holders of underwater inspection certification.

Certification categories are also available for divers who are involved in underwater structural inspection: 3.1U and 3.2U. A separate document (Reference CSWIP-DIV-7-95 Part 1) 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 N5 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**

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.

1.4 **Job responsibilities**

GRADE 3.3U

The candidate will be expected to be able to demonstrate his/her ability to carry out inspection by means of ROV or manned submersible, using visual and selected NDT techniques. The candidate must have a knowledge of the inspection and testing methods included in the 3.1U syllabus; the capabilities of other relevant non-destructive testing methods in current use; the modes of failure, cracking and deterioration in steel and concrete structures (including the relevance of various inspection methods); and protection systems. He/She will have a knowledge of QA relevant to underwater inspection and an appreciation of the abilities and limitations of remotely applied inspection systems, ROV's and submersibles. 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.

GRADE 3.4U

The candidate will be expected to have a knowledge of all aspects of the ROV Inspector (3.3U) Grade and of the inspection and testing methods included in the 3.2U examination. The candidate must have a knowledge of the capabilities and limitations of diving, ROV's and submersibles, and an understanding of inspection planning and briefing. He/She must have an appreciation of the roles and responsibilities of other personnel and organisations, including the Offshore Installation Manager, Master, Diving and ROV Supervisors, client's representatives, certifying authorities and government departments.

1.5 **Evidence of experience - all candidates**

Candidates should provide evidence of experience in Grades 3.1U or 3.2U satisfying the entry requirements using appropriate log book entries (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).

Experience offshore, experience of application of NDT methods and subsea engineering related work can be provided by letter from the candidate's employing organisation or suitably endorsed authenticated CV. Photocopies of entries may be required as supporting evidence of experience when making application to CSWIP for examination. Any original log book, etc should be available for inspection by CSWIP if required.

2 **GRADE 3.3U**

NOTE: a) **Experience**

To be eligible to attempt Grade 3.3U the candidate must:

i) be a manned submersible pilot or observer, having completed a minimum of 15 operational dives,

or

ii) be an ROV pilot or observer having completed a minimum of 100 logged hours of underwater inspection work experience as pilot or observer,

or

iii) have a qualification in a relevant engineering or science subject which should not be less than HNC level or equivalent and a minimum of 12 months subsea engineering related work, including a minimum of 60 days spent at an offshore site,

or

iv) be a current or previously approved CSWIP 3.1U or 3.2U Diver Inspector who has held such certification for a minimum of three years, with a minimum of 100 logged hours of underwater inspection work,

or

v) be a surface NDT Practitioner, certified under PCN/CSWIP in ultrasonic testing, magnetic particle or penetrant testing or equivalent approval accepted by the CSWIP In-Service Inspection Management Committee, who has a minimum of three years documented experience in the application of NDT methods related to offshore facilities and to have spent a minimum of 30 days at an offshore work site gaining familiarity with underwater inspection techniques.

b) **Training course**

All candidates will be required to have satisfactorily completed a CSWIP approved training course on the methods in which they are to be examined.

c) **Dispensation of entry requirements**

Personnel who satisfy most but not all of the other entry requirements specified and who may have alternative attributes which they consider should be taken into account, may have their individual cases assessed by the CSWIP In-Service Inspection Management Committee or its nominees. **There is no dispensation from training requirements.**

2.1 **Approval Procedure**

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

2.1.1 **Theory examination** - The written examination will consist of two parts, A and B, in one three hour paper:

Paper A 25 multi-choice questions

Paper B General inspection principles and applications divided into two sections.

Section A: One mandatory detailed written answer from two questions on Underwater Visual Inspection of a riser, pipeline or structure.

Section B: Six short written answer questions, viz one question to be attempted from two given in each of the following six sub-sections:

- i) Underwater visual inspection
- ii) Recording methods
- iii) Corrosion protection systems
- iv) Remotely applied inspection systems
- v) Care and calibration of equipment
- vi) Recording and reporting of data.

2.1.2 **Practical examination** - The test will consist of the following parts:

- i) Data recording
- ii) Commentating on video of an inspection task
- iii) Written reports
- iv) Description (written)

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. The concrete qualification will also be renewable at the five year renewal point of the 3.3U.

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 3.4U**

NOTE: a) **Experience**

To be eligible to attempt Grade 3.4U the candidate must:

i) have a qualification in a relevant engineering or science subject which should not be less than HNC level or equivalent and a minimum of 12 months subsea engineering related work, including a minimum of 60 days spent at an offshore site,

or

ii) be a current or previously approved CSWIP 3.3U ROV Inspector who has held such certification for a minimum of one year, with a minimum of 300 logged hours of underwater inspection work,

or

iii) be a current or previously approved CSWIP 3.1U or 3.2U Diver Inspector who has held such certification for a minimum of three years, with a minimum of 100 logged hours of underwater inspection work,

or

iv) be a surface NDT Practitioner, certified under PCN/CSWIP in ultrasonic testing, magnetic particle or penetrant testing or equivalent approval accepted by the CSWIP In-Service Inspection Management Committee, who has a minimum of three years documented experience in the application of NDT methods related to offshore facilities and to have spent a minimum of 30 days at an offshore work site gaining familiarity with underwater inspection techniques.

b) **Training course**

All candidates must have successfully completed a CSWIP 3.4U approved training course.

c) **Dispensation of entry requirements**

Personnel who satisfy most but not all of the other entry requirements specified and who may have alternative attributes which they consider should be taken into account, may have their individual cases assessed by the CSWIP In-Service Inspection Management Committee or its nominees. **There is no dispensation from training requirements.**

3.1 Approval procedure

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

3.1.1 **Theory examination** - The written examination will consist of three parts, A, B and C. Parts A and B will be one three hour long paper and part C will consist of one paper for which 3 hours will be allowed.

Part A 50 multi-choice questions

Part B General inspection principles and applications - six written answer questions, viz one question to be attempted from the two given in each of the following five sections, plus one question from any section in part B:

- i) Magnetic particle inspection
- ii) Ultrasonic inspection
- iii) Corrosion protection systems
- iv) Underwater visual inspection
- v) Non-destructive testing (general knowledge).

Part C Application aspects - eight written answer questions, viz one question to be attempted from two given in each of the following seven sections, plus one question from any section in part C:

- vi) Remotely applied inspection systems
- vii) Recording and processing of data
- viii) Quality Assurance
- ix) Inspection planning and briefing
- x) Capabilities and limitations of divers
- xi) Capabilities and limitations of ROV's and submersibles
- xii) Care and deployment of equipment.

3.1.2 **Practical examination** - The test will consist of the following parts:

- i) Data recording
- ii) Commentating on video of an inspection task
- iii) *Written reports
- iv) *Description (Written)
- v) Technical drawing evaluation
- vi) Telex précis
- vii) Work scheduling
- viii) *Optional, can be computer generated on a word processing package

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, The concrete qualification will also be renewable at the five year renewal point of the 3.4U.

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.

4 GENERAL INFORMATION

4.1 Examination equipment, specimens and test centres

3.3U and 3.4U examinations do not involve practical underwater examination parts and all necessary video equipment/tapes, audio equipment/tapes and photographs will be provided at the Test Centre.

Examinations may be taken at any one of a number of Test Centres in the UK and overseas. Lists are available on request.

4.2 Application 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 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, and a fee will be charged.

4.3.3 Unsuccessful candidates

Initial 3.3U or 3.4U examination

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

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

CANDIDATES ARE STRONGLY ADVISED TO ARRANGE SOME INDIVIDUAL REFRESHER TRAINING THROUGH ONE OF THE RECOGNISED 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 4.4.

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 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) 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.

PHOTOCOPIES ARE UNAUTHORISED BY CSWIP AND SHOULD ONLY BE USED FOR INTERNAL ADMINISTRATIVE 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 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 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 eligibility to attempt an examination 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 Renewal

4.4.1 Five year renewal

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

Candidates who fail the five year renewal test will be given the opportunity of one retest 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

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. 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.**

4.4.2 **Five year renewal procedure for 3.3U and 3.4U**

The five year renewal examination for **3.3U** will consist of:

25 multiple-choice questions

1 question from Section A of Paper B and a choice of 3 from 6 short written answer questions from Section B of Paper B.

The Data Recording and Commentary elements of the practical examination.

The five year renewal examination for **3.4U** will consist of:

50 multiple-choice questions

3 from a choice of 6 written answer questions from Part B and 4 from a choice of 8 written answer questions from Part C.

The Data Recording and Commentary elements of the practical examination.

Certificate holders must demonstrate that they have maintained their competence by providing evidence of continuous work activity in relevant underwater inspection work within the previous five years by letter from their employers, or for self-employed personnel by letters from those companies they have been contracted to over the previous five years.

4.4.3 **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 3.3UC or 3.4UC.

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.

4.6 Records

Records of all successful and unsuccessful candidates are maintained. These records are accessible to the 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 In-Service Inspection Management Committee will not be responsible for failure of candidates or their sponsors to inform themselves of these rules.

Additional information:

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For examination enquiries:

TWI North
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Middlesbrough TS2 1RY, UK

For all examinations

Phone: 01642 210512
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TWI Examination Services
Granta Park,
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Cambridge CB1 6AL, UK

(For 3.3U, 3.4U and all written retests only)

Phone: 01223 891162
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3.3U, 3.4U and all written retests can also be taken at Paisley University. Initial 3.3U and 3.4U retests are available at Statens Dykkerskole, Bergen, Norway but for details please contact TWI North.

CERTIFICATION SCHEME FOR WELDING AND INSPECTION PERSONNEL

**Requirements for the Certification of ROV
Inspectors and Underwater Inspection Controllers**

APPENDICES TO DOCUMENT CSWIP-DIV-7-95 Part 2

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.

3.3U ROV INSPECTOR

INTRODUCTION

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

The need for inspection in relation to the safety and integrity of offshore structures and pipelines.

Basic terminology of subsea structures (steel and concrete), including jackets, semi-submersible and jack-up drilling rigs, FPSOs (Floating Production and Storage and Offloading units), single point moorings, seabed production manifolds, wellhead and valve protection frames.

Basic terminology of subsea pipelines, including rigid and flexible pipelines and risers, umbilicals and J-tubes.

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

An appreciation of how an Operator's inspection programme attempts to detect and assess such failure and deterioration by the use of various ROV inspection techniques.

The importance of good communications, planning and briefing.

The importance of documentation and record keeping. An appreciation of manual and computer based data recording and reporting.

An appreciation of the abilities and limitations of commonly used vehicles.

The need for written procedures for all activities.

An appreciation of current health, safety and environmental issues as they affect subsea operations. This includes Permit to Work systems, the requirements for hazard identification and Risk Assessments, the use of ROV Dive Plans, current legislation and industry guidelines (e.g. IMCA guidelines)

1 ROV SYSTEMS

A KNOWLEDGE OF:

The capabilities and limitations of ROV's, including:

- Types of vehicles (e.g. IMCA Class I – Pure Observation, Class II – Observation with Payload Option, Class III – Workclass Vehicles.)
- Typical thruster configurations, vehicle power, speed, manoeuvrability and operating limits in current.
- Launch and recovery methods and tether management systems.
- Types of ROV sensors and manipulators.

The capabilities and limitations of miscellaneous vehicles, including:

- Types of common seabed vehicles and towed units (e.g. trenching equipment, towed fish, ROTV and AUVs)

Operational Considerations - General:

- Endurance, hazards to ROVs, manning levels, real-time data acquisition over recorded data, spatial awareness, human contact, dexterity, risk of snagging, umbilical handling, access, operating radius and the simultaneous operation of ROVs and Divers, etc

A KNOWLEDGE OF:

ROV's

:

- The capabilities and limitations of underwater vehicles. Operational considerations when operating ROV's from DP vessels, drill rigs or fixed structures.

2 UNDERWATER VISUAL INSPECTION

AN OUTLINE KNOWLEDGE OF:

- Cleaning for the purpose of inspection by ROV (LP air, water jet, grit entrainment, etc.) and safety aspects. Standards of surface finish.
- General Visual Inspection (GVI), Detailed Visual Inspection (DVI) and Close Visual Inspection (CVI) of components on structures/pipelines by ROV.
- Welds and steel structure terminology: This includes an appreciation of the most common steel structures, methods of installation, and the main types of defects, repairs and maintenance

- Concrete structure terminology: An appreciation of the basic types of concrete structures, methods of installation, and the main types of defects, repairs and maintenance
- Pipeline component terminology: This includes traditional rigid risers, tie-in spoolpieces, tees, valves, flanges and mechanical connectors. Also basic pipeline components/items of interest such as riser clamps/guides, sacrificial anodes, (bracelet and retro-fit) field joints and freespans. Also included are flexible pipelines and risers, (including recent buoyant risers with their associated buoyancy components/arches and gravity bases etc).
- Pipeline technology: A basic appreciation of the main methods of rigid and flexible pipeline and umbilical installation, tie-in and repair. Also the main methods of trenching, burying and stabilizing pipelines/umbilicals, and the construction of pipeline/umbilical crossings. (This includes stabilisation and anti-scour mattresses, grouted supports and rockdumps.) Also flexible risers used with semi submersible production facilities and FPSO's. An awareness of recent developments in diverless pipeline tie-in systems.
- Marine growth species identification, percentage coverage (estimates of each type) growth thickness measurement techniques, the effects of marine growth and reason for removal.

A DETAILED KNOWLEDGE OF:

- Types of visual defects and their likely location in steel/concrete structures and risers. Types of defects and areas of concern for structures/pipelines. Dimensional checking of welds and measurements underwater.

3 CORROSION PROTECTION SYSTEMS:

AN OUTLINE KNOWLEDGE OF:

- The general principles of corrosion and how corrosion protection is effected by protective coatings and cathodic protection systems.

A KNOWLEDGE OF:

- Modes of deterioration, types of corrosion and the typical inspection requirements for sacrificial anode and impressed current systems
- The effects of external factors such as debris and seabed material on CP systems.

A DETAILED KNOWLEDGE OF:

- The visual inspection of protective coatings including Monel and other cladding.
- Potential measurement methods, the typical values obtained, common anomaly criteria applicable to cathodic potential levels, and the calibration procedures of equipment/instruments.
- The constraints in using the contact technique (e.g. problems associated with establishing good contact through paint and/or marine growth), the factors affecting the proximity technique (e.g. problems associated with the positioning of the electrode and establishing good electrical continuity to the structure) and the use of current density and/or field strength measurements (e.g. the influence of positioning and orientation on accuracy).

4 REMOTELY APPLIED INSPECTION SYSTEMS

A KNOWLEDGE OF:

- The methods, capabilities and limitations of, Ultrasonic Inspection (UT), Eddy Current Testing (ET), Alternating Current Field Measurement (ACFM) and Flooded Member Detection (FMD) techniques.

5 CARE AND CALIBRATION OF EQUIPMENT

A DETAILED KNOWLEDGE OF:

- The care and set-up of video and digital imaging systems.
- The care, calibration and set-up of cathodic potential monitoring systems.
- The care, calibration and set-up of digital ultrasonic wall thickness meters.
- The safe use of electrical equipment as required by current codes of practice and legislation.
- The care of equipment after recovery.

6 RECORDING AND REPORTING OF DATA

A DETAILED KNOWLEDGE OF:

Data gathering, including:

- The ability to use, understand and compile workbooks, data sheets, and logs.
- The use of the video and digital for recording inspection data.

- How to recognise typical anomalies, and an understanding of “criteria of non-conformance”.
- Video tape recording: The need for accurate video introductions, (text and verbal), and text headers. The use of pipetracker, cross profiler, sonar and navigation displays overlaid onto the video recording. The appropriate use of lighting and cameras. The set up and correct colour balancing of cameras and VCRs
- Video tape commentaries: Video introductions, (text and verbal). The need to adequately explain the subject of the NDT/inspection. The requirement to explain any changes in orientation or position or component layout that may cause confusion. The need to comment on any NDT or inspection or operational factors that effect the NDT/inspection task. The need to adequately report the findings of the NDT/inspection, and any other points of likely interest.
- Video editing and dubbing skills.
- The usage and methods for setting-up video overlay units.
- The skills and ability necessary to direct inspections by ROV in real time.
- Methods of setting up identification markers and recognition of the need for fixed repeatable reference/datum points.

The principles of detailed report writing, including:

- The ability to develop report formats, manually or with the aid of a computer, including logs and demonstrate an ability to use visual aids such as photographs, graphs, histograms and pie charts etc.
- Typical report types.
- Typical methods of reporting routine data and anomalies.
- The ability to prepare a report from inspection data, manually and with the aid of a computer.
- The importance of using standard terminology and the necessity for good communication.
- The need for accuracy, consistency, simplicity, clarity and a methodical approach in all recording and data processing including report writing, daily report preparation and the completion of logs etc.
- The importance of using the correct component identification and location reference systems when inspecting and reporting on structures and pipelines.

- An understanding and ability to read engineering drawings and produce inspection drawings and sketches manually or with the aid of a computer.

7 **QUALITY ASSURANCE, RELEVANT TO UNDERWATER INSPECTION**

AN OUTLINE KNOWLEDGE OF:

- The application of QA/QC systems.

A KNOWLEDGE OF:

- The need for personnel qualification and the need for sufficient and adequate equipment certification.
- Written inspection procedures and documentation. The importance of adhering to approved procedures. The need for procedures to be simple and unambiguous.
- The need for technical equipment and system audits.
- The effects on quality of human relationships, communications, lines of responsibility, liaison and co-operation.
- The quality requirements of design, fabrication, installation and commissioning through to in-service inspection, repair and maintenance.
- The value of documentation and data control and indexing systems.
- The value of general quality assurance principles as applied to the collection and recording of inspection data (whether in the form of drawings, sketches, photographs, video or other media) Quality assurance and quality control as applied to collection and reporting of anomaly data.

3.4U UNDERWATER INSPECTION CONTROLLER

INTRODUCTION

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

The need for inspection in relation to the safety and integrity of offshore structures and pipelines.

Basic terminology of subsea pipelines (steel and concrete), including jackets, semi-submersible and jack-up drilling rigs, FPSOs (Floating Production and Storage and Offloading units), single point moorings, seabed production manifolds, wellhead and valve protection frames.

Basic terminology of subsea pipelines, including rigid and flexible pipelines and risers, umbilicals and J-tubes.

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

An appreciation of how an Operator's inspection programme attempts to detect and assess such failure and deterioration by the use of various Diver or ROV or AUV inspection techniques, including NDT.

The importance of good communications, planning and briefing.

The importance of documentation and record keeping. An appreciation of manual and computer based data recording and reporting.

An appreciation of the abilities and limitations of commonly used ROVs and divers for the collection of data.

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

The need for written procedures for all activities.

An appreciation of current health, safety and environmental issues as they affect subsea operations. This includes Permit to Work systems, the requirements for hazard identification and Risk Assessments, the use of Dive Plans, current legislation and industry guidelines (e.g. IMCA guidelines)

An appreciation of the roles and responsibilities of others, such as: the Diving Supervisor, the ROV Supervisor, the Superintendent/Offshore Project Manager, the Offshore Installation Manager, or the vessel/barge Master, the Client's Representative, and government departments, or other agencies etc.

1 UNDERWATER VISUAL INSPECTION

A KNOWLEDGE OF:

- Cleaning for the purpose of inspection by Diver and ROV (LP air, water jet, grit entrainment, etc.) and safety aspects. Standards of surface finish.
- General Visual Inspection (GVI), Detailed Visual Inspection (DVI) and Close Visual Inspection (CVI) of components on structures/pipelines by Diver and ROV.
- Welds and steel structure terminology: This includes an appreciation of the most common steel structures, methods of installation, and the main types of defects, repairs and maintenance
- Concrete structure terminology: An appreciation of the basic types of concrete structures, methods of installation, and the main types of defects, repairs and maintenance
- Pipeline component terminology: This includes traditional rigid risers, tie-in spool pieces, tees, valves, flanges and mechanical connectors. Also basic pipeline components/items of interest such as riser clamps/guides, sacrificial anodes, (bracelet and retro-fit) field joints and freespans. Also included are flexible pipelines and risers, (including recent buoyant risers with their associated buoyancy components/arches and gravity bases etc).
- Pipeline technology: A basic appreciation of the main methods of rigid and flexible pipeline and umbilical installation, tie-in and repair. Also the main methods of trenching, burying and stabilizing pipelines/umbilicals, and the construction of pipeline/umbilical crossings. (This includes stabilisation and anti-scour mattresses, grouted supports and rock dumps). Also flexible risers used with semi submersible production facilities and FPSO's. An awareness of recent developments in diverless pipeline tie-in systems.
- Marine growth species identification, percentage coverage (estimates of each type) growth thickness measurement techniques, the effects of marine growth and the reason for removal and various methods of prevention.

A DETAILED KNOWLEDGE OF:

- Types of visual defects and their likely location in steel/concrete structures and risers. Types of defects and areas of concern for structures/pipelines. Dimensional checking of welds and measurements underwater.

2 RECORDING METHODS

AN OUTLINE KNOWLEDGE OF:

- The principles of photogrammetry, the care in use, and the deployment of recording equipment.

A KNOWLEDGE OF:

- The use of CCTV, mono, stereo and colour recording equipment. Both hand held and remote.
- Types of video and digital imaging equipment.
- The operation of various types of video equipment and methods for producing hard copy of video and digital images.
- Terms and definitions used in photography and the relationship between film speed, aperture, shutter speed, focus and depth of field.

A DETAILED KNOWLEDGE OF:

- Optimum light placement and intensity for photography and video recording.
- The correct use of CCTV, video and digital imaging equipment to give optimum results.

3 CORROSION PROTECTION SYSTEMS:

AN OUTLINE KNOWLEDGE OF:

- The general principles of corrosion and how corrosion protection is effected by protective coatings and cathodic protection systems.

A KNOWLEDGE OF:

- Modes of deterioration, types of corrosion and the typical inspection requirements for sacrificial anode and impressed current systems. An awareness of the safety requirements involved in diving adjacent to impressed current systems.
- The effects of external factors such as debris and seabed material on CP systems.

A DETAILED KNOWLEDGE OF:

- Contact and proximity potential measurement methods, the typical values obtained, common anomaly criteria applicable to cathodic potential levels, and the calibration procedures of equipment/instruments.
- The visual inspection of protective coatings including Monel and other cladding.

4 **NON-DESTRUCTIVE TESTING TECHNIQUES**

A KNOWLEDGE OF:

- The methods, capabilities and limitations of Magnetic Particle Inspection (MPI), Ultrasonic Inspection (UT), Radiographic Inspection (RT), Eddy Current Testing (ET), Alternating Current Field Measurement (ACFM), Alternating Current Potential Drop (ACPD) and Flooded Member Detection (FMD) techniques.

A DETAILED KNOWLEDGE OF:

- The NDT techniques particularly applicable underwater.
- The practical application underwater of Magnetic Particle Inspection.
- The practical application underwater of Ultrasonic Wall Thickness measurement.
- The practical application of ACFM

5 **MAGNETIC PARTICLE INSPECTION (MPI):**

AN OUTLINE KNOWLEDGE OF:

- The principles and terms/definitions specific to magnetism such as magnetic poles, magnetic field, lines of force, longitudinal magnetisation, horseshoe magnet, vector field, consequent field, consequent poles, distorted field, permeability, reluctance, flux density, residual magnetism, ferromagnetic materials and leakage field etc.
- The generation of circumferential and longitudinal flux.
- Hysteresis loops and their relevance to demagnetisation/magnetisation methods.
- Inspection equipment including: portable installations; ancillary equipment; lighting such as UV-A illumination; viewing aids; marking devices; demagnetisation equipment; contrast aids and consumables.

A KNOWLEDGE OF:

- The reasons for, and the methods used for demagnetisation.
- Testing for demagnetisation.
- The problems associated with the magnetic particle inspection of partially completed weldments.
- The methods used to assess the sensitivity of an MPI technique.
- Methods for recording defect indications.
- Surface preparation.

- The problems associated with component geometry and shape.
- The correct choice of a magnetic technique.

A DETAILED KNOWLEDGE OF:

- Functional and performance checks, calibration equipment and appropriate test pieces.
- Magnetic ink (fluorescent and non-fluorescent), concentrates, wetting agents, contrast paints, cleaning agents and inhibitors and the preparation and testing of inks and other consumables.
- The types and causes of surface breaking and near-surface discontinuities and their indications.
- The types, causes and visible features of non-relevant and false indications.
- Methods of reporting.
- The advantages and limitations of applying magnetisation using permanent magnets, electromagnets, coils, parallel conductors, flexible cables and prods.

6 ULTRASONIC TESTING

AN OUTLINE KNOWLEDGE OF:

- The physical principles of sound, the relationship between ultrasonic frequency/wavelength velocity, the propagation mode of compressional waves and the nature of sound.
- The types and properties of transducers. The piezoelectric effect, near/far fields, dead zones and their effect on both frequency and sound velocity.
- Compressional wave probes, single/twin crystal probes and their construction.
- A basic outline of A-Scan Ultrasonic Equipment.
- Digital Thickness Meters (DTM).
- A basic outline of ultrasonic wall thickness mapping systems.
- The types and uses of calibration blocks.

A DETAILED KNOWLEDGE OF:

- Surface condition requirements of materials and weldments prior to scanning.
- Methods to determine wall thickness, material quality and determination of the presence of internal corrosion and laminations.
- Application and the limitations/advantages of digital instruments for wall thickness measurements.

7 **RADIOGRAPHY**

AN OUTLINE KNOWLEDGE OF:

- The principles and techniques for industrial radiography, including its advantages and limitations.
- Safety precautions and requirements when using ionizing radiations (GS41) and the roles and responsibilities of RP Supervisors

8 **SURFACE GRINDING, SURFACE STRESS RELIEF**

A KNOWLEDGE OF:

- An appreciation of the reasoning behind, and the limitations of, remedial grinding of MPI indications, and the drilling of “crack arrestor” holes in cracks in steel structures.
- Typical basic procedures for remedial grinding, with particular regard to material removal limits per grinding pass and maximum overall grinding limits, as well as the need for final profiling to reduce stress levels. Typical client’s concerns with regard to remedial grinding or the use of crack arrestor holes.
- The practical application of the grinding of weld toes/parent plate material to a required profile and methods of recording/measuring the process undertaken.

9 **CARE AND CALIBRATION OF EQUIPMENT**

A DETAILED KNOWLEDGE OF:

- Still-photographic equipment, loading and unloading of film, pre-setting cameras, charging batteries and checking the correct charge has been applied to both the camera and strobes.
- The care and set-up of video and digital imaging systems.
- The care and set-up of cathodic potential monitoring systems.
- The care and set-up of digital ultrasonic wall thickness meters.
- The care and set-up of MPI equipment.
- The safe use of electrical equipment as required by current codes of practice and legislation.
- The care of equipment after recovery.
- The safe use of electrical equipment as required by current codes of practice and legislation.

10 RECORDING AND PROCESSING OF DATA

A DETAILED KNOWLEDGE OF:

Data gathering, including:

- The ability to use, understand and compile workbooks, data sheets, and logs.
- The use of the video, digital and photographic media for recording inspection data.
- How to recognise typical anomalies, and an understanding of “criteria of non-conformance”.
- Video tape recording: The need for accurate video introductions, (text and verbal), and text headers. The use of pipe tracker, cross profiler, sonar and navigation displays overlaid onto the video recording. The appropriate use of lighting and cameras. The set up and correct colour balancing of cameras and VCRs
- Video tape commentaries: The need to adequately explain the subject of the NDT/inspection. The requirement to explain any changes in orientation or position or component layout that may cause confusion. The need to comment on any NDT or inspection or operational factors that effect the NDT/inspection task. The need to adequately report the findings of the NDT/inspection, and any other points of likely interest.
- Video editing and dubbing skills.
- The usage and methods for setting-up video overlay units.
- The skills and ability necessary to direct inspections by diver or ROV in real time and elicit information from divers in real time by means of suitable questioning.
- Methods of setting up identification markers and recognition of the need for fixed repeatable reference/datum points.

The principles of detailed report writing, including:

- The ability to develop report formats, manually or with the aid of a computer, including logs, and demonstrate an ability to use visual aids such as photographs, graphs, histograms and pie charts etc.
- Typical report types.
- Typical methods of reporting routine data and anomalies
- The ability to prepare a report from inspection data, manually and with the aid of a computer.

- The importance of using standard terminology and the necessity for good communication.
- The need for accuracy, consistency, simplicity, clarity and a methodical approach in all recording and data processing including report writing, work scheduling, daily report preparation and the completion of logs etc
- The importance of using the correct component identification and location reference systems when inspecting and reporting on structures and pipelines.
- An understanding and ability to read engineering drawings and produce inspection drawings and sketches manually or with the aid of a computer.

11 **COMMUNICATION SKILLS:**

A KNOWLEDGE OF:

- The correct use of simplex and duplex communication systems.
- Communication discipline, standard phrases, the phonetic alphabet

12 **REMOTELY APPLIED INSPECTION SYSTEMS**

AN OUTLINE KNOWLEDGE OF:

- The methods, limitations and capabilities of weld inspection techniques when applied remotely.
- The principles of FMD techniques (ultrasonic, gamma radiation and thermal applications) when applied remotely.
- The principles of ACFM remotely applied techniques

A KNOWLEDGE OF:

- ROV pipeline inspection methods and equipment, e.g. pipe trackers, sonar and cross profilers etc. Sidescan sonar inspection of pipelines by ROTV or non-steerable towed fish.
- The method of application by ROV of ultrasonic, gamma radiation and thermal FMD techniques.

A DETAILED KNOWLEDGE OF:

- The measurement of wall thickness using digital wall thickness meters, the necessity and standard of surface preparation, alignment, calibration and the effects of surface coatings and corrosion.
- The factors effecting performance of video and still-photography systems when remotely deployed. The influence of access, positioning, stand-off and set-up constraints. The importance of selecting systems and settings suitable to the task and the location. Deployment method constraints. Cleaning limitations and location and referencing limitations.

13 DIVING SYSTEMS

AN OUTLINE KNOWLEDGE OF:

The capabilities and limitations of divers, including:

- Human physiology with particular emphasis on the effects of pressure on the lungs and hearts, etc., nitrogen narcosis, air/gas mixtures, etc
- Types of diving, the techniques and equipment for air diving, the techniques and equipment for mixed gas saturation diving, current legislation and guidance for commercial diving.
- The effects on divers of currents, tides, wind, waves and water turbulence.

The capabilities and limitations of ROV's, including:

- Types of vehicles (e.g. IMCA Class I – Pure Observation, Class II – Observation with Payload Option, Class III – Work Class Vehicles.)
- Typical thruster configurations, vehicle power, speed, manoeuvrability and operating limits in current.
- Launch and recovery methods and tether management systems.
- Types of ROV sensors and manipulators.

The capabilities and limitations of AUVs/Manned Submersibles, including:

- Manned and unmanned autonomous vehicles: range, endurance, payloads, Diver lockout systems, limited endurance of Divers.
- Tethered vehicles: flying bells, operating footprints, microsups, humanoid, vertically orientated, horizontally orientated.

The capabilities and limitations of Miscellaneous vehicles, including:

- Types of common seabed vehicles and towed units (e.g. trenching equipment, towed fish and ROTVs)

Operational considerations - General:

- Endurance, hazards to divers and ROVs, manning levels, real-time data acquisition over recorded data, spatial awareness, human contact, dexterity, risk of snagging, umbilical handling, access, operating radius and the simultaneous operation of ROVs and Divers, etc

A KNOWLEDGE OF:

Divers:

- The deployment of Divers, the deployment methods for both surface and bell Divers, the safe length of Diver's umbilicals, the restrictions on diving from DP vessels, the limitations of diving inside a structure or around obstructions and the deployment of equipment to the Diver, etc.

ROV's:

- The capabilities and limitations of underwater vehicles. Operational considerations when operating ROV's from DP vessels, drill rigs or fixed structures.

14 INSPECTION PLANNING AND BRIEFING

A KNOWLEDGE OF:

- Inspection philosophies behind inspection programmes for offshore structures and pipelines.
- Local statutory regulations governing the safety of offshore structures and pipelines, and the professional relationships between the client, inspection contractor and any applicable government or other agency.
- The roles and responsibilities of Client's Representatives, Inspection Controllers, the inspection contractor's Superintendent or Offshore Project Manager, and the inspection contractor's ROV and Diving Supervisors and personnel. The different forms of contract under which the work can be undertaken, i.e. day rate, lump sum, etc. This should include an appreciation of the different constraints faced by the Inspection Controller depending on who they are employed by i.e. client or inspection contractor.

A DETAILED KNOWLEDGE OF:

- The need to maintain equipment and consumable inventories and to determine equipment logistics with regard to changing scopes of work.
- Operational restrictions which may affect the planning of works such as vessel movements, platform priorities, diver and ROV limitations and capabilities etc.

15 QUALITY ASSURANCE, RELEVANT TO UNDERWATER INSPECTION

AN OUTLINE KNOWLEDGE OF:

- The application of QA/QC systems.

A KNOWLEDGE OF:

- The need for personnel qualification and the need for sufficient and adequate equipment certification.

- Written inspection procedures and documentation. The importance of adhering to approved procedures. The need for procedures to be simple and unambiguous.
- The need for technical equipment and system audits.
- The effects on quality of human relationships, communications, lines of responsibility, liaison and co-operation.
- The quality requirements of design, fabrication, installation and commissioning through to in-service inspection, repair and maintenance.
- The value of documentation and data control and indexing systems.
- The value of general quality assurance principles as applied to the collection and recording of inspection data (whether in the form of drawings, sketches, photographs, video or other media) Quality assurance and quality control as applied to collection and reporting of anomaly data.

REFERENCE LITERATURE/RECOMMENDED READING: 3.3U ROV INSPECTOR

- An Introduction to ROV operations
Compiled by George Last and Paul Williams.
Ledbury; Oilfield Publications Ltd, 1991.
ISBN18709545239.
- Handbook for ROV Pilot/Technicians
2nd rev ed.
Chris Bell, Mel Bayliss and Richard Warburton.
Ledbury; Oilfield Publications Ltd., 1994. 359p.
ISBN1870945859.
- An Introduction to Offshore Maintenance
Ledbury: Oilfield Publications Ltd, 1991.
ISBN1870945212
- Assessment of Materials for the repair of
Damaged Concrete Underwater: OTH 90318
Prepared by Imperial College for the Department of
Energy Offshore Technology Report, London; Dept of
Energy, 1990 ISBN 0114133204 S H Perry and J M
Holkyard.
- Appraisal of Marine Growth on Offshore
Installations . Rpt 92-102
The Marine Technology Directorate Ltd: 1992
51p. ISBN1870553128. Also published by HSE as
OTO 92/0125
- Oil and Gas Pipeline Fundamentals
John L Kennedy: Tulsa, OK, Penn Well Books 2nd ed:
1993. 366p. ISBN0878143904.
- On-site Checks for Underwater Video
Picture Quality
The Marine Technology Directorate Ltd: 1992
London; MTD, 1992. 24p. ISBN187055311X.
- Remotely Operated Vehicles of the World
4th ed.
Ledbury; Oilfield Publications, 2000. 458p.
ISBN1902157168.
- A Handbook of Terminology for the use of
Divers and Inspectors on Offshore Structures
Inspection.
London; Dept of Energy, Offshore Technology
Board, 1987. OTH 87-277. ISBN0114128898.
- Classification and Identification of
Typical Blemishes Visible on the Surface
of Concrete Underwater OTM84202
and Supplement
London; Department of Energy Offshore Technology
Report. HMSO: 1985. IOSBN0114190031.
London; DoE, OTR, 1987. ISBN0114128766.
- The Underwater Photographer's Handbook
P Rowlands. London; MacDonald, 1983. 240p. .

REFERENCE LITERATURE/RECOMMENDED READING: 3.4U UNDERWATER INSPECTION CONTROLLER

- Underwater NDT: Underwater Inspection and NDT Manual
Dr Michael Haywood and Dr Nigel Mathers, Published by Prodiver Ltd, 1980.
- An Introduction to ROV Operations
Compiled by George Last and Paul Williams. Ledbury; Oilfield Publications Ltd, 1991. ISBN187609545239
- Handbook for ROV Pilot/Technicians 2nd rev ed.
Chris Bell, Mel Bayliss and Richard Warburton. Ledbury; Oilfield Publications Ltd., 1994. 359p. ISBN1870945859.
- An Introduction to Offshore Maintenance
Ledbury: Oilfield Publications Ltd, 1991. ISBN1870945212
- Assessment of Materials for the repair of Damaged Concrete Underwater: OTH 90318
Prepared by Imperial College for the Department of Energy Offshore Technology Report. London; Dept of Energy, 1990 ISBN 0114133204 S H Perry and J M Holkyard.
- Appraisal of Marine Growth on Offshore Installations. Rpt 92-102
The Marine Technology Directorate Ltd: 1992 51p. ISBN1870553128. Also published by HSE as OTO 92/0125
- On-site Checks for Underwater Video Picture Quality
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- Remotely Operated Vehicles of the World 4th ed.
Ledbury; Oilfield Publications, 2000. 458p. ISBN1902157168.
- A Handbook of Terminology for the use of Divers and Inspectors on Offshore Structures Inspection.
London; Dept of Energy, Offshore Technology Board, 1987. OTH 87-277. ISBN0114128898.
- Classification and Identification of Typical Blemishes Visible on the Surface of Concrete Underwater OTM84202 and Supplement
London; Department of Energy Offshore Technology Report. HMSO: 1985. ISBN0114190031.
London; DoE, OTR, 1987. ISBN0114128766.
- An Introduction to Diving Operations Offshore
Paul Williams. Ledbury; Oilfield Publications, 1992. ISBN 1870945336.
- Thermal Stress on Divers in Oxy-helium Environments
Construction Industry Research & Information Assoc. London
- Total Quality Management for Engineers
Mohamed Zairi
Cambridge: Woodhead Publishing Ltd, 1991. 254p. ISBN1855730243
- Introduction to the Non-Destructive Testing of Welded Joints, 2nd ed.
R Halmshaw, Cambridge; Abington Publishing, 1996. 126p. ISBN1855733145.
- Handbook on the Magnetic Examination of Welds
International Institute of Welding. Woodhead Publishing, 1988. 52p. ISBN0853001952.

Welding Inspection Handbook, 3 rd ed	American Welding Society, Miami. 2000. 244p. ISBN0871715600.
*The Ionizing Radiation Regulations	SI 1999 No 3232. London; HMSO, 1999. ISBN0110856147.
*Also note:	
HSC:	The protection of persons against ionising radiation arising from any work activity. Approved Code of Practice L58 , 1994.
HSC:	Work with ionising radiation L121 Ionising radiation regulations, 1999 Approved Code of Practice and Guidance. London, HSE Books, 2000. 178p. ISBN07176177467.
Collins, R.H.	The Radman Guide to the Ionising Radiation Regulations 1999. HHSC Handbook 26. Pub: H &H Scientific Consultants, 2000. ISBN0948237384.

STANDARDS

BS 4778: Part 2:1991	Quality Vocabulary Part 2: Quality concepts and related definitions
BS EN ISO 9002:1994 still current	Quality Systems; model for quality assurance in production, installations and servicing
Above replaced by 9001:2000	Quality Management Systems requirements
BS 7850: Part 1;1992	Total Quality Management. Part 1: Guide to management principles
BS EN 12223:2000	Non-destructive testing. Ultrasonic examination. Specification for calibration block No. 1 (replaces BS2704:1978).
BS EN 1714:1998	Non-destructive examination of welded joints. Ultrasonic examination of welded joints. (Replaces BS 3923: Pt 1: 1986).
BS EN 12668-1: 2000	Non-destructive testing. Characterisation and verification of ultrasonic examination equipment. Part 1:2000. Instruments (Replaces BS 4331-2: 1972).
BS EN 1330: Part 3: 1997	Non-destructive testing. Terminology. Terms used in industrial radiographic testing. (Replaces BS 3683: Pt 3: 1984).
Part 4:2000	Terms used in ultrasonic testing. (Replaces BS 3683-4: 1985)
ANSI/API RP 2X: 1996, 3 rd ed.	Recommended Practice for Ultrasonic Examination of Offshore Structural Fabrication and Guidelines for Qualification of Ultrasonic Technicians
BS 3683: Part 2: 1985	Glossary of terms used in Non-destructive Testing. Part 2: Magnetic Particle Flaw Detection

BS EN ISO 9934 Part 1:2001:	Non-destructive testing. Magnetic particle testing General principles. (Replaces BS6072:1981 which remains current).
BS 4069: 1982	Specification for Magnetic Flaw Detection Inks and Powders
PD 6513: 1985	Magnetic Particle Flaw Detection - A guide to the principles and practice of applying Magnetic Particle Flaw Detection in accordance with BS 6072
ISO 3059:2001 (Identical to BS EN ISO 3059:2001)	Non-destructive Testing Penetrant testing and magnetic particle testing. Viewing conditions.
BS 5044: 1973	Specification for Contrast Aid Paints used in Magnetic Particle Flaw Detection
EN ISO 3059: 2001	Non-destructive testing. Penetrant testing and magnetic particle testing. Viewing conditions. (Replaces BS 4489:1984).
BS 1134: Part 2: 1990	Assessment of Surface Texture, Part 2: Guidance and general information
BS 4094: Part 1: 1966	Recommendation for Data on Shielding from Ionizing Radiation. Part 1: Shielding from Gamma Radiation
BS 5650: 1978	Specification for Apparatus for Gamma Radiography
ISO 5579: 1998	Non-Destructive Testing - Radiographic Examination of Metallic Materials by X- and Gamma Rays. Basic Rules 2 nd ed.
BS 499: Part 1: 1991	Welding Terms and Symbols, glossary for welding, brazing and thermal, cutting.

APPENDIX 2: SPECIMEN EXAMINATION QUESTIONS

3.3U

Theory examination Part A: 25 Multi-choice questions (there is only one correct answer to each question). Three examples are shown below:

- A1 The reason for the importance of having the correct lighting at an inspection site is in order to:
- a) optimise full screen video data image a
 - b) aid ROV navigation around the inspection site b
 - c) distinguish the colour of any visible marine growth c
 - d) enhance the ROV pilot's inspection experience d
- A2 The highest rate of corrosion on a steel structure is expected to be found:
- a) near the mud line a
 - b) in the splash zone b
 - c) below the tidal zone c
 - d) in the continuously submerged zone d
- A3 How many calomel electrodes will normally be required to calibrate a CP proximity cell?
- a) 1 a
 - b) 2 b
 - c) 3 c
 - d) 5 d

Theory examination Part B, Section A: One mandatory written question from two questions on Underwater Inspection of a riser, pipeline or structure. One example shown below:

- A1 You are instructed to conduct the following tasks:
- 1 A marine growth inspection of a vertical member between the elevations -75 and -90 metres
 - 2 A CP survey of the member and a General Visual Inspection of a node on the member of an elevation of -75 metres.

You are using an "Eye Ball" ROV fitted with a SIT and colour video systems, a TVP camera and a direct contact CP meter. Describe the CP calibration procedures you would employ and detail the information you would include in your pre- and post-dive briefing and the methods you would use to carry out the inspections.

Theory examination Part B, Section B: Six short written answer questions, viz one question to be attempted from two given in each of six sub-sections. One example from each sub-section shown below.

Section 1.0 Underwater Visual Inspection

- B1.1 Discuss the advantage and limitations of Remotely Operated Vehicles (ROVs) as a basic method of intervention to inspect or to deploy inspection equipment on underwater structures.

Section 2.0 Recording Methods

- B2.1 Discuss two permanent recording methods commonly used underwater and list each of their advantages and limitations.

Section 3.0 Corrosion Protection Systems

B3.1 Explain the proximity system deployed by ROVs for cathodic protection monitoring of underwater structures.

Section 5.0 Care and Calibration of Equipment

B5.1 Outline the topside checks which should be carried out to ensure correct CCTV camera operations.

Section 6.0 Recording and Recording of Data

B6.1 Explain the purpose of workscopes and workbooks and list the information that would be contained in them.

3.4U

Theory examination Part A: 50 multi-choice questions (there is only one correct answer to each question). Four examples shown below:

- A1 MPI indications can be recorded in which of the following ways?
- a) Magnetic transfer by rubberised tape a
 - b) Photographic technique b
 - c) Replication casts retaining the defect indication particles c
 - d) All of the above d
- A2 How long could you expect a fully charged Bathycorrometer Mark 5 to function in the water?
- a) 15 hours a
 - b) 30 hours b
 - c) 60 hours c
 - d) 120 hours d
- A3 Which standard is commonly used for cleaning welds for close visual inspection?:
- a) Sa 1 a
 - b) Sa 1½ b
 - c) Sa 2½ c
 - d) Sa 4 d
- A4 Photogrammetry is a technique for the measurement of:
- a) dimensions a
 - b) the spectral distribution of a light source b
 - c) real-time radiography c
 - d) the photographic density of a developed transparency d

Theory examination Part B, General Inspection Principles and Application: Six written answer questions, viz one question to be attempted from the two given in each of five sections plus one question from any section in Part B. One example from each section shown below:

Section 1.0 Magnetic Particle Inspection

- B1 Outline the component parts of a typical subsea MPI system and for each component give a short description of its use and main features.

Section 2.0 Ultrasonic Inspection

- B2 Briefly describe the main application of ultrasonic testing of offshore structures.

Section 3.0 Corrosion Protection Systems

- B3 With the aid of diagrams, explain the corrosion mechanism in relation to two methods of protecting platforms.

Section 4.0 Underwater Visual Inspection

- B4 Note in order of priority the inspection procedure for a concrete inspection and outline what you consider to be the significant requirements for reporting.

Section 5.0 Non-destructive Testing

- B5 Briefly describe the theoretical workings and limitations of three NDT techniques used underwater.

Theory examination Part C, Application Aspects: Eight written answer questions, viz one question to be attempted from two given in each of seven sections plus one question from any section in Part C. One example from each section shown below.

Section 6.0 Remotely Applied Inspection Systems

- C1 Discuss the advantages and limitations of remotely applied inspection systems using current ROV's as a method to inspect underwater structures.

Section 7.0 Recording and Processing of Data

- C2 Explain the significance of the essential data that must be recorded when taking ultrasonic wall thickness measurements, taking cathodic potential measurements and performing a magnetic particle inspection.

Section 8.0 Quality Assurance

- C3 Explain the roles of the Certifying Authority, Inspection Controller and Diver Inspector in the quality assurance of a diving and ROV inspection contract.

Section 9.0 Inspection Planning and Briefing

- C4 Detail the job description for an Underwater Inspection Controller on a 24 Hour saturation contract.

Section 10.0 Capabilities and Limitations of Divers

- C5 As high pressure jetting systems can be extremely dangerous to Divers, detail the precautions you would take during this operation to protect the Diver and those around him/her.

Section 11.0 Capabilities and Limitations of ROV's and Submersibles

- C6 Detail the advantages and limitations of the deployment and recovery of the ROV using each of the following launch systems:
- i) Articulated HIAB type crane
 - ii) A-frame
 - iii) Fixed deployment cursor/guide wire system.

Section 12.0 Care and Deployment of Equipment

- C7 Describe fully the procedure you would use for the pre-dive and post-dive checks on an underwater camera during a normal inspection dive.