



CERTIFICATION SCHEME FOR WELDING AND INSPECTION PERSONNEL

DOCUMENT No. CSWIP-CP-10-01

Requirements for the Certification of Cathodic Protection Personnel

Categories of Certification:

- Level 1 - Basic
- Level 2 - Intermediate
- Level 3 - Advanced

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CSWIP is administered by TWI Certification Ltd

FOREWORD

The Certification Scheme for Welding and Inspection Personnel (CSWIP) is a comprehensive scheme providing 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, Underwater Inspection personnel, NDT operators, Plant Inspectors and Cathodic Protection Engineers.

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 industries and other interests.

ACCESS TO CERTIFICATION

Access to certification schemes is not improperly restricted. The sole criteria for certification are given in this document 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 Cathodic Protection

Corrosion of a metallic material in an electrolyte is an electrochemical phenomenon in which dissolution of the material is associated with the flow of an electrical current between anodic (corroding) and cathodic (non-corroding or protected) areas.

If the whole surface of the metal can be made sufficiently cathodic by means of an external electrode then corrosion will not occur. This is the basis of cathodic protection (CP), probably the most important of all methods used to protect pipelines buried in the earth, as well as marine structures and ships. Two different approaches may be used:

- a) impressed current protection
- b) sacrificial anode protection.

The latter is by far the older of the two systems. With the impressed current system, corrosion protection results from an external current applied to the buried (or submerged) structure, usually from a transformer-rectifier unit (TRU) supplying low voltage direct current (DC). The positive terminal of the TRU is connected to an inert auxiliary anode (eg high silicon cast iron) buried some distance from the structure to be protected, and the negative terminal to the structure itself. In practice, the current needed to protect an uncoated structure would normally be too great to make the method an economic proposition. The structure is therefore generally coated or wrapped to provide the main corrosion protection barrier, and cathodic protection is used to cope with any breaks or discontinuities in the coating.

In the case of sacrificial anode protection there is no supply of external current and the auxiliary electrode is made of a more active metal than the metal to be protected (e.g. zinc, aluminium, magnesium). It thus becomes the anode in the corrosion cell whilst the structure becomes a cathode which is protected sacrificially by the corroding anode.

The choice of impressed current and/or sacrificial anode systems depends on various factors. Irrespective of the type of CP system applied, however, the long-term effectiveness of the system requires adequate monitoring and surveying of performance.

1.2 Scope

The certification scheme provides qualifications for personnel at three levels: Level 1 (Basic), Level 2 (Intermediate) and Level 3 (Advanced). Their responsibilities are shown below.

1.2.1 Level 1

Level 1 is for personnel with limited experience who require a basic understanding of cathodic protection.

A Level 1 candidate is required:

- to be capable of making basic field measurements of potential for both onshore and offshore CP systems under the control of Level 2 or Level 3 personnel
- to be capable of making basic protective current measurements for onshore CP systems under the control of Level 2 or Level 3 personnel

(Note: a Level 1 is not allowed to interpret CP field test results)

- to recognise the differences between sacrificial anode systems
- to appreciate the use of insulating flanges and joints (monoblocks)
- to understand the anodic and cathodic reactions involved in a CP system
- to appreciate the influence of coating properties and conditions on CP levels
- to understand the function of a transformer rectifier unit (TRU).

1.2.2 Level 2

Level 2 is for personnel who have a basic understanding of cathodic protection but are required to apply more extensive theoretical and practical knowledge.

In addition to meeting the requirements for Level 1 personnel, a Level 2 candidate is required:

- to be capable of making field measurements for onshore, offshore and marine CP systems, including soil resistivities and conductivities, potential and protective current measurements and interference tests
- to be capable of interpreting field test results
- to make stray current tests but only under the control of Level 3 personnel
- to be capable of preparing routine field reports including recommendations for action where appropriate
- to understand the influence of cathodic dimensions (eg pipeline diameter, wall thickness etc) on protective current requirements
- to understand the differences between impressed current anode systems and their application

- to understand the reasons for choice between competing sacrificial and/or impressed current systems
- to be capable of making routine design calculations and/or recommendations where modifications to an existing CP system are required.

1.2.3 Level 3

Level 3 is for more experienced cathodic protection personnel who are required to recognise system operating problems and to solve the more difficult and complex aspects of CP such as interference and stray current effects.

In addition to meeting the requirements for Level 1 and Level 2 personnel, a Level 3 candidate is required:

- to be fully capable of undertaking detailed field measurements of soil resistivities, protective current demand and structure- electrolyte potentials including "Sample and Hold" readings of polarisation potentials
- to implement logical analysis of practical CP operating problems (troubleshooting) including AC and DC stray current tests, loss of current effects, coating failures etc
- to be capable of preparing detailed design reports with recommendations for action.

1.3 Requirements prior to taking a certification test

The job responsibilities and experience criteria for examination eligibility given below shall be followed.

1.3.1 Level 1

Candidates should have a practical background in electricity, corrosion technology or engineering with a minimum of one year of relevant experience and must have successfully completed an approved course of training in cathodic protection at the appropriate level.

1.3.2 Level 2

Candidates should be qualified to Level 1 and subsequently have a minimum of one year of experience in cathodic protection.

or

Candidates should have a practical background in electricity, corrosion technology or engineering with a minimum of two years of experience in cathodic protection.

Candidates from either route must have successfully completed an approved course of training in cathodic protection at the appropriate level.

1.3.3 Level 3

Candidates should be qualified to Level 2 and subsequently have a minimum of two years of experience in cathodic protection

or

Candidates should have a practical background in electricity, corrosion technology or engineering with a minimum of three years of experience in cathodic protection.

Candidates from either route must have successfully completed an approved course of training in cathodic protection at the appropriate level.

A mature candidate route offering exemption from formal training is available for Level 2 and Level 3 candidates who are able to demonstrate at least three and five years respectively of recent continuous experience in cathodic protection.

2 EXAMINATION PROCEDURE

2.1 Level 1

Level 1 candidates are required only to take a theoretical examination with no practical test being given.

The examination paper consists of a total of 20 questions which are made up of a combination of multiple choice or direct questions, simple calculations based on equations used in cathodic protection (eg Ohm's Law) or explanatory sketches of CP situations.

Details of the examination syllabus and specimen questions are given in Appendix 1 and Appendix 2 respectively.

2.2 Level 2

Level 2 candidates are required to take theoretical and practical examinations.

The theoretical examination consists of a total of 35 questions which are made up of a combination of multiple choice and/or direct questions, CP design calculations (eg anode resistance, anode current, etc) or explanatory sketches of CP situations.

For the practical examination candidates will be required to demonstrate their competence in measuring techniques such as structure-electrolyte potentials, current measurements and determination of On and Off potentials.

Details of the examination syllabus and specimen questions are given in Appendix 1 and Appendix 2 respectively.

2.3 **Level 3**

Level 3 candidates are required to take theoretical, practical and oral examinations.

The theoretical examination consists of a total of 15 questions which are made up of a combination of multiple choice and/or direct questions and narrative questions which require explanatory sketches of CP situations. In particular a detailed CP design question is included which accounts for 25% of the total marks available.

For the practical examination candidates will be required to demonstrate their competence in field measuring techniques such as soil resistivities, Pearson tests, pipeline detection, “Sample and Hold” measurements, etc.

The oral examination will normally consist of a discussion with the examiner during the practical tests.

Details of the examination syllabus and specimen questions are given in Appendix 1 and Appendix 2 respectively.

2.4 **Application for examination and fees**

Candidates will be required to submit an application form and CV. All the information requested must be on these forms. No applications can be considered confirmed until receipt of correctly completed documents. Application forms ask for specific details of experience and training and must be signed to the effect that these details are correct.

In the event of a false statement being discovered on forms or CVs any examination undertaken will be declared null and void. A certificate is automatically invalidated if there are any outstanding examination fees in respect of that certificate.

3 **CERTIFICATION**

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.

3.2 **Successful candidates**

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

3.3 **Unsuccessful candidates**

Candidates who fail to obtain a certificate may attempt one retest on those parts of the examination in which success was not achieved. The retest must be completed within one year of the initial examination, otherwise candidates will have to repeat the complete examination.

The retest (or complete re-examination) may not be taken within 30 days of the previous examination.

3.4 **Period of validity**

The certificate is valid for five years from the date of completion of the initial test and may be renewed for a further five years on application, provided evidence is produced in accordance with Clause 3.5.1. Certificates are only valid provided:

- a) they are within date
- b) they are on standard cream CSWIP paper bearing the CSWIP logo in black on gold, signed by an officer of CSWIP and embossed with the CSWIP logo
- 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.

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

3.5 **Renewal**

3.5.1 **Five year renewal**

In order for the certificate to be renewed after five years, the holder has to demonstrate that he/she has maintained his/her competence by:

- i) providing evidence of continuous work activity in cathodic protection
- ii) providing evidence that the holder has kept up to date in cathodic protection technology.

Part a) can be satisfied by submitting a log sheet of relevant work activity covering the period of validity of the certificate. Requests for the appropriate documentation should be made to TWI Certification Ltd. Contact details are given at the end of the document.

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

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

3.5.2 **Ten year renewal**

Certificates are renewed beyond ten years from the initial examination (or from a previous ten year renewal) by the holder successfully completing a renewal examination prior to the expiry of the certificate in addition to the renewal procedure given in Clause 3.5.1. Requests for the appropriate documentation should only be made to TWI Certification Ltd. Contact details are given at the end of the document.

The ten year examination will consist of the following:

a) **Level 1**

A theoretical examination consisting of 30 multiple choice questions.

b) **Level 2**

A theoretical examination consisting of a total of 40 multiple choice questions.

c) **Level 3**

A theoretical examination consisting of a total of 40 multiple choice questions and an oral examination on practical aspects of cathodic protection.

At all levels one retest within 4 months of the 10 year renewal examination will be allowed.

Failure by candidates at any level at the retest point will mean that the candidate must take the full course and initial examination again to regain the qualification.

3.6 **Complaints and appeals**

An aggrieved party in a dispute which considers itself to have reasonable grounds for questioning the competency of a CSWIP qualified person may petition the Governing Board for non-renewal of the certificate. Such a petition must be accompanied by all relevant facts, and if in the opinion of the Board an adequate 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 Board, the certificate will not be renewed without further test.

Appeals against failure to certify or against non-renewal of the certificate may be made by the inspector or the employer upon application in writing to the Governing Board.

4 **RECORDS**

TWI Certification Ltd maintains records of successful and unsuccessful candidates. These records are accessible to the Governing Board or its nominees at all reasonable times.

ADDRESSES

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For specific information on examinations and tests, and arranging for them to be carried out, contact the Examining Body:

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APPENDICES TO DOCUMENT CSWIP-CP-10-01

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

APPENDIX 1: EXAMINATION SYLLABUS

1 Level 1

1.1 Examination format (see 2.1)

The pass mark is 70%.

1.2 Examination syllabus

Candidates will need to demonstrate their knowledge of:

- basic fundamentals of electricity
- basic fundamentals of corrosion
- CP terminology
- reference or half cells
- galvanic effects
- polarisation diagrams
- soil/water (electrolyte) compositions
- principle of coating of buried or immersed structures
- sacrificial and impressed current systems
- basic design of CP systems
- CP materials (anodes, transformer rectifier units, insulating joints, etc)
- criteria for protection (protective potentials)
- safety aspect of CP systems
- pipe (or structure) to soil (or water) potential measurements
- monitoring and maintenance of CP systems
- limitations of CP.

2 Level 2

2.1 Examination format (see 2.2)

The pass mark for each part is 70%.

2.2 Examination syllabus

In addition to the knowledge requirements for Level 1 candidates will need to demonstrate their knowledge of:

- criteria for CP and their limitations
- Pourbaix diagram interpretation
- surface film effects
- CP design considerations for sacrificial anode and impressed current systems
- CP materials, specification and quality control
- safety considerations
- attenuation calculations
- commissioning a CP system
- On and Off instant potentials
- 'IR drop' error
- CP systems for specific installations (tank farms, maritime, process plant, pipelines, jetties and offshore installations)

- CP and protective coatings
- inspection of pipeline coatings.

3 Level 3

3.1 Examination format (see 2.3)

The pass mark for each part is 70%.

3.2 Examination syllabus

In addition to the knowledge requirements for Levels 1 and 2, candidates will need to demonstrate their knowledge of :

- problem areas and troubleshooting of CP systems
- investigation of test posts or stations
- insulating flanges and monoblocks
- low potential readings
- high potential readings
- On and Off potential readings
- interference effects and mitigation
- AC and DC (stray current) effects
- earthing structures
- coatings and CP problems
- holiday detection
- Pearson tests and current attenuation
- auditing of CP systems
- rehabilitation of CP systems
- CP of welded pipelines in sour (aqueous hydrogen sulphide) service.

APPENDIX 2: SPECIMEN WRITTEN QUESTIONS

Level 1

1. What is the minimum required protective potential for steel objects in direct contact with soil?
 - a. -800 mV against copper/copper sulphate
 - b. -950 mV against silver/silver chloride
 - c. -800 mV against silver/silver chloride
 - d. -850 mV against copper/copper sulphate

2. When steel corrodes the electrolyte at the cathode area becomes:
 - a. acidic
 - b. neutral
 - c. alkaline
 - d. all of the above

3. Name two reference electrodes (or half cells) used in practical CP measurements; and for each of them name the typical electrolyte in which they would be used.
 - a. used in.....
 - b. used in

4. If current $I = 5 \text{ A}$ and potential $E = 12 \text{ V}$ then from Ohm's Law what is the resistance R
 $R = \dots\dots\dots\text{Ohm}$

Level 2

1. For a silver/silver chloride reference electrode the potential relative to hydrogen is:
 - a. +242 mV
 - b. -766 mV
 - c. +288 mV
 - d. +316 mV

2. To protect a bare steel storage tank bottom, a protective current of 1.5 mA/sq.m is required.

If a protective current of 20% over capacity is applied, what is the total design current for a 16 metre diameter tank?

3. Give four (4) examples of places where test points would be installed in an onshore CP system.

4. A ship's hull will be cathodically protected by Al anodes and requires a protective current of 50 A.

If the current capacity of an Al anode is 2805 Ah/kg for approximately how long would 5Kg of aluminium protect the ship's hull:

- a. 10 weeks
- b. 5 weeks
- c. 10 days
- d. 10 hours

Level 3

1. Which of the following soil resistivity levels would result in slightly corrosive conditions?
 - a. 1200 Ohm cm
 - b. 1700 Ohm cm
 - c. 2900 Ohm cm
 - d. 3600 Ohm cm
2. Explain what is meant by 'IR drop' and how the problem can be reduced.
3. Using a drawing explain what is meant by AC interference and the solution when serious interference is occurring on a cathodically protected pipeline.
4. Describe the differences between an insulating flange and an insulating monoblock.
5. A Commissioning Report for a completed CP system would contain key information on the CP installation.

Give 5 subjects or sections that should appear in the Commissioning Report.

What are the key contents you would expect to see in each of these?