



**CERTIFICATION SCHEME FOR PERSONNEL**

**DOCUMENT No. CSWIP-HT-15-05**

# **Requirements for the Certification of Site and Workshop Heat Treatment Operatives**

**1<sup>st</sup> Edition, November 2012**

Issued under the authority of the Governing Board for Certification  
All correspondence should be addressed to:

TWI Certification Ltd  
Granta Park  
Great Abington  
Cambridge  
CB21 6AL,  
United Kingdom

Telephone: +44 (0) 1223 899000  
Fax: +44 (0) 1223 894219  
Email: [twicertification@twi.co.uk](mailto:twicertification@twi.co.uk)  
Website: [www.cswip.com](http://www.cswip.com)

CSWIP is administered by TWI Certification Ltd

## FOREWORD

The Certification Scheme for Personnel (CSWIP) is a comprehensive scheme that 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, Cathodic Inspection Personnel, Bolting Operators, Plant Inspectors Underwater Inspection personnel, NDT personnel and Heat Treatment operatives.

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.

## ACCESS TO CERTIFICATION

Access to certification 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

This document prescribes procedures by which personnel may be examined and, if successful, certificated for site and workshop heat treatment activities.

### 2. Scope

The certification of personnel under the current document covers the heat treatment of metallic engineering structures or components. Such heat treatment would often be associated with welds and may be used before, during and/or after welding.

Certification is available in a number of different categories and levels. The categories are based on the type of heating that is used, (e.g. resistance, induction, etc).

The Levels are defined as follows:

#### 2.1 LEVEL 1 PERSONNEL - HEAT TREATMENT ASSISTANT OPERATOR

An individual certified to Level 1 is qualified to carry out heat treatment operations using resistance and/or induction techniques on components of simple geometric shape (e.g. butt welds in plate or pipe), in accordance with written instructions, and more complex parts (e.g. nozzles and valves) under the supervision of Level 2 or 3 personnel. The individual shall be able to set up the equipment, carry out the treatment, record and report the results obtained; and to understand and apply safety procedures. He/she shall not be responsible for the choice of the heat treatment method or technique to be used, nor for the assessment of the results.

#### 2.2 LEVEL 2 PERSONNEL – HEAT TREATMENT OPERATOR

An individual certified to Level 2 is qualified to perform and direct heat treatment operations on more complex parts (e.g. nozzles and valves) using resistance and/or induction techniques in accordance with established or recognised instructions or procedures. The individual shall be competent to recognise and apply the treatment techniques to be used; to set up equipment; to interpret and evaluate results in accordance with applicable codes, standards and specifications; to carry out all Level 1 duties (or, if done by others, to check that they are properly executed); to interpret and apply written instructions; to organise and report the results of heat treatment; and to understand and apply safety procedures. The individual shall also be familiar with the scope and limitations of the method for which he/she is qualified, and

be able to exercise assigned responsibility for on-the-job training and guidance of trainees and Level 1 personnel.

### **2.3 LEVEL 3 PERSONNEL – HEAT TREATMENT SENIOR OPERATOR**

An individual certified to Level 3 shall be capable of assuming full responsibility for a heat treatment activity and the supervision of staff. The individual shall be competent to understand techniques and procedures; to establish techniques for simple, larger or more complex geometries (e.g. butt welds in plate or pipe, nozzles, valves and part of, or complete pressure vessels etc); to be aware of and understand codes, standards, specifications and procedures; and to designate the particular heat treatment methods, techniques and procedures to be used. The individual shall formulate the procedures, specifications and technique sheets relevant to the components being heat treated. The individual shall have the competence to interpret and evaluate results in accordance with procedures/specifications and to be able to understand and apply safety procedures. The individual shall also have the ability to train and supervise Level 1 and Level 2 personnel.

## **3. Eligibility for Examination**

Candidates shall have a combination of education, training and experience adequate to ensure that they have the potential to understand the principles and procedures of the applicable heat treatment method.

### **3.1 Training**

#### **3.1.1 Standard Route**

To be eligible for certification in any heat treatment method, the candidate shall provide evidence of successful completion of a training programme recognised by TWI Certification Ltd in that method.

Candidates must provide evidence of training. A certificate of successful attendance of a recognised course, authenticated by a senior responsible person in the candidate's employing organisation or by a major client, will normally suffice.

#### **3.1.2 Mature Candidate Route**

A mature candidate route offers exemptions from formal training for Level 1 and 2 candidates who are able to demonstrate at least five years' recent continuous experience\* in heat treatment duties as identified in Clauses 2.1 and 2.2.

For Level 3 candidates:

- (i) 10 years experience\* is required in heat treatment duties identified in clauses 2.1, 2.2 and 2.3. Independent verification of experience is required

Or

- (ii) Hold a suitable academic qualification (i.e. Degree in Metallurgy, Materials Science etc)

### **3.2 Experience – Standard Route**

#### **3.2.1 Levels 1 and 2**

To be eligible for examination, the candidate shall have the minimum experience indicated below in the method in which he/she is seeking certification:

\* experience means carrying out heat treatment work without significant interruption, not the total elapsed time.

Level 1: Although there is no specific experience requirement, it is recommended that candidates possess a minimum of six months' electrical and/or welding related engineering experience.

Level 2: Level 1 certificate holders with one year's experience\* in conducting Level 1 duties, or, by direct entry, two years experience\*.

### **3.2.2 Level 3**

Level 2 certificate holders with five years' experience\* conducting Level 2 duties.

Candidates must provide evidence of experience comprising information authenticated by a senior responsible person in the candidate's employing organisation or by a major client.

### **3.3 Vision Requirements**

The candidate shall provide documented evidence of satisfactory vision in accordance with the following requirements:

- a) Unaided or corrected near visual acuity in at least one eye shall be such that the candidate is capable of reading N4 Times New Roman type at a distance of not less than 30cm on a standard reading test chart.
- b) Successful completion of the standard Ishihara colour vision test.

The above evidence shall be submitted and approved before the candidate arrives at the test centre to sit the examination.

### **3.4 Responsibility for Demonstrating Eligibility**

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

All candidates are required to comply with any relevant national safety requirement that may apply to site and workshop heat treatment work. For example, in the UK, candidates would be required to hold the Safety Passport of the Client Contractor National Safety Group.

Personnel who satisfy most but not all of the other entry requirements and who may have alternative attributes which they consider should be taken into account may have their individual cases assessed by the appropriate CSWIP Management Committee. Such applications should be directed to TWI Certification Ltd in the first instance.

## **4. Application for Examination and Fees**

When the eligibility for examination has been achieved, the next step is to take the examination.

Candidates will be required to submit an application form and a 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 on 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.

Candidates proved to have cheated, or found to have attempted to remove or found to have removed examination material in a CSWIP examination will not be accepted as a candidate for any CSWIP examination for a minimum period of five years from date of the examination where

cheating, attempt to remove or removal of examination material, was established to have taken place.

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

## **5. Certification Available**

Examination can be of four types: initial examinations (new candidates), supplementary examinations (certificate holders wishing to improve their existing certificates) retests (repeat of failed parts of examinations) and ten year renewal examinations.

Details of the examination format and syllabus can be found in the relevant part of Appendix 1.

### **5.1 Level 1 Heat Treatment Assistant Operator**

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

Resistance heating (low voltage – up to 65V)  
Induction heating  
Convection

### **5.2 Level 2 Heat Treatment Operator**

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

Resistance heating (low voltage – up to 65V)  
Induction heating  
Convection

### **5.3 Level 3 Heat Treatment Senior Operator**

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

Resistance heating (low/medium voltage – up to 240V)  
Induction heating  
Convection

## **6. Examination Content**

The qualification examinations for each level comprise written and practical parts, see Appendix 1.

The examinations are of sufficient duration, complexity and scope to verify adequately the candidate's ability to apply the heat treatment method to real situations at the appropriate level.

## **7. Certification**

### **7.1 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.

- a) The examination is evaluated by multiplying the mark achieved by the weighting factor for each component and then adding the components together to get an overall mark.
- b) Results notices will indicate whether the candidate has achieved success or otherwise in the examination, the marks gained in each part of the examination, whether retests

are allowable and brief reasons for failure of any part of the examination. The personal details recorded shall be those provided by the candidate.

## **7.2 Successful Candidates**

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

## **7.3 Unsuccessful Candidates**

Candidates who fail to pass the initial examination 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 test; 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. Further training is recommended before attempting the examination.

Candidates who are unsuccessful in the retest will be required to re-take the full approved course followed by the full examination.

## **7.4 Period of Validity**

The certificate is valid for five years from the date of completion of the initial examination and may be renewed for a further five years on application, provided evidence is produced in accordance with Clause 7.5.1. 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 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.

Photocopies are unauthorised by CSWIP and should only be used for internal administrative purposes.

## **7.5 Renewal Procedure**

### **7.5.1 Five Year Renewal**

Individuals whose certificates expire at the end of the five year period may renew their certificates for a further five years if they are able to supply evidence of reasonably continuous, satisfactory work activity in the relevant method during the period of validity of the certificate.

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 holders' 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.

In all cases, the individual applying for renewal must provide evidence of continued satisfactory work activity without significant interruption

A significant interruption means an absence or a change of activity which prevents the certified individual from practising the duties corresponding to his/her level in the method and

the industrial sector(s) for which he/she is certified, for one or several periods for a total time exceeding one year.

Applicants who do not satisfy the five year renewal criteria will be required to take the full initial examination.

### **7.5.2 Ten Year Renewal**

Certificates can be renewed beyond ten years from the initial examination (or a previous ten year renewal) by the holder successfully completing a renewal examination prior to the expiry of the certificate. This is in addition to the five year renewal procedure given in Clause 7.5.1.

The ten year renewal examination will consist of written and practical parts covering the same areas as described for the initial examination.

In case of failure in the ten year examination, the candidate is allowed one retest within four months.

Failure in the retest examination will result in the candidate reverting to initial status.

### **7.6 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 be invalidated.

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.

### **7.7 Supplementary Examinations**

Certificated candidates who apply to be examined in additional categories/levels or sectors will be required to pass an additional specific theory examination in addition to the practical examination covering the extra group(s) of categories.

Supplementary examinations may not be attempted 30 days prior to the expiry of an existing certificate.

Any new certificate issued as a result of such examination will incorporate the previous certificate. Success in a supplementary examination does not extend the life of the certificate to which it is added.

## **8. Records**

The CSWIP Chief Executive maintains records of successful and unsuccessful candidates. These records are accessible to the Governing Board or its nominees at all reasonable times.

## **9. References**

- |   |                             |  |
|---|-----------------------------|--|
| 1 | ISO/IEC 17024:2012          | 'General criteria for certification bodies operating certification of personnel.'  |
| 2 | ISO/CD 17663:2009           | 'Welding – quality requirements for heat treatment in connection with welding and allied processes.'                         |
| 3 | API 6A: 2010/ISO 10423:2009 | 'Petroleum and natural gas industries – drilling and production equipment – Wellhead and christmas tree equipment: Annex M'. |

## 10. Addresses

*For information on examinations and tests and to arrange for them to be carried out please contact:*

TWI Certification Ltd  
Granta Park  
Great Abington  
Cambridge  
CB21 6AL  
United Kingdom  
Phone: +44 (0) 1223 899000  
Fax: +44 (0) 1223 894219  
Email: [twicertification@twi.co.uk](mailto:twicertification@twi.co.uk)

## APPENDIX 1 – EXAMINATION SYLLABUS

### GENERAL

For all levels, the written examination covers: Safety, Principles of Electricity, Principles of Metallurgy, and Applications.

#### 1. LEVEL 1 – Heat Treatment Assistant Operator

##### 1.1 EXAMINATION FORMAT

The examination comprises written and practical parts. The written part covers theoretical aspects of site and workshop heat treatment as described in the syllabus below and is in the form of a multiple choice paper, consisting of 20 questions to be completed in 30 minutes. The pass mark is 70%.

In the practical part, the candidate is required to carry out and record a heat treatment exercise on a pipe butt weld in accordance with written instructions. The technique used may be either induction or resistance (or both) depending on the scope for which certification is sought.

##### 1.2 SYLLABUS

Candidates will be expected to have a knowledge of:

- a) **Conventional heat treatment:** (1)
  - uses of conventional heat treatment
  - annealing
  - hardening
  - tempering.
  
- b) **Heat treatment of welded joints:** (2)
  - preheating
  - maintenance of interpass temperature
  - postweld heat treatment
  - welding residual stresses.
  
- c) **Equipment for site/workshop heat treatment:** (3)
  - 
  - Transformer units
  - resistance heaters
  - insulated preheaters
  - induction heaters
  - heating elements (heating mats, inductors,
  - Cable, splitters, thermocouple compensating cable)
  - thermocouple attachment unit,
  - auxiliaries (banding tensioners for steel strips, clips, cutters for strips).
  
- d) **Principles of induction and resistance heating:** (5)
  - types of heating elements
  - principles of selection of heat treatment parameters according to the size of the material to be heat treated
  - effectiveness of heat treatment processes, heating power and power output
  
- e) **Thermal principles:** (6)
  - heat, temperature, temperature scales, heat propagation in metals
  - thermal conductivity

- measurements of temperature.
- f) **Techniques of installation of thermal insulation:** (6)
- types of insulation
  - Health and safety issues using ceramic fibres
  - equipment for fastening of thermal insulation over welded constructions.
- g) **Equipment for measurement of temperature of the objects under heating:** (7)
- Construction and types of thermocouples.
  - principle of operation of temperature recorders
  - principle of operation of temperature controllers and programmers.
- h) **Electrical safety:** (9)
- basic electrical theory
  - safety measures
- i) **Work organisation in servicing of electric equipment:** (10)
- regulations
  - requirements imposed on heat treatment equipment operators
  - operator's responsibility for disregard of safety rules.
- j) **Personal Protective Equipment (PPE).** (9)
- k) **Fire prevention.** (9)
- l) **Risk assessments.** (9)
- m) **Use of equipment:** (10)
- visual assessment of the technical state of heaters and conductors
  - switching on the heaters
  - placing of heaters in relation to the component to be heated
  - sequence of operations during the heat treatment of welded joints
  - general troubleshooting
- n) **Practical aspects:** (11)
- connecting the thermocouples
  - Cable connection and management
  - thermal insulation
  - Housekeeping
  - assessment of the result of the heat treatment operation.

## 2. LEVEL 2 – Heat Treatment Operator

### 2.1 EXAMINATION FORMAT

The examination comprises written and practical parts. The written part covers theoretical aspects of site/workshop heat treatment as described in the syllabus below. Candidates are required to answer multiple choice questions and questions requiring short narrative answers.

Written examination Part 1: 30 multiple choice questions to be completed in 45 minutes with a pass mark of 70%.

Written examination Part 2: 4 from 6 narrative questions, to be completed in 1 hr 15 minutes, with a pass mark of 70%

In the practical part, the candidate is required to carry out and record a heat treatment exercise on a nozzle or valve, in accordance with written instructions. The technique used

may be either induction or resistance (or both) depending on the scope for which certification is sought.

## 2.2 SYLLABUS

Candidates will be expected to have a knowledge of the Level 1 syllabus in greater detail than that required for the Level 1; plus, in addition, a knowledge of:

- a) **Properties of metals and alloys:** (1)<sup>\*</sup>
  - physical, chemical and mechanical properties
  - definition of steel, grades and designations
  - cast steel and cast iron.
  
- b) **Electrical circuits** (5)
  - series
  - parallel
  - series-parallel
  - transformers
  - tappings
  - earthing
  - voltage drop
  - test instrumentation
  - power supplies
  - temporary generators
  
- c) **Electromagnetism (Induction heating only):** (5)
  - magnetic hysteresis
  - electromagnetic induction, inductance
  - laws governing physical phenomena in electrical circuits.
  
- d) **Inspecting for correctness:** (3)
  - heat treatment in temporary furnaces
  - heat treatment *in situ*
  - providing the right temperature profile
  - inspection of correctness of heat treatment temperature recording
  - measurements checking out heat treatment correctness
  - Control of temperature and distortion zones
  
- e) **Usefulness of application and the role of thermal insulation** (6)
  
- f) **Measurements/recording/control:** (7)
  - errors in temperature measurements
  - sources of errors generations in temperature measurements
  - calibration of measuring instruments.
  
- g) **Understand and apply relevant standards and specifications.** (8)
  
- h) **Equipment maintenance** (10)
  
- i) **Engineering** (5)
  - piping isometrics
  - thermal expansion
  - heat transfer – conduction

<sup>\*</sup> The numbers refer to the section number in the EWF Guideline for Heat Treatment Personnel

- conversion Fahrenheit to Centigrade including heating rates
- Post weld heat treatment of complex geometries and/or larger components
  - headers
  - branches
  - tees
  - varying thicknesses
  - flanges and valves

**j) Constructing temporary furnaces**

**3. Level 3 –Heat Treatment Senior Operator**

**3.1 EXAMINATION FORMAT**

The examination comprises written and practical parts. The written part covers the theoretical aspects of site/workshop heat treatment as described in the syllabus below. Candidates are required to answer both multiple choice and narrative questions as for Level 2 but covering the Level 3 syllabus, see below..

In the practical part the candidate is required to produce a heat treatment instruction to be used by Level 1 or Level 2 operator, based on a drawing of a component and a given heat treatment requirement. During this part of the examination, candidates may make use of relevant standards and specifications (e.g. BS 2633, NCB 3011, etc).

Candidates entering Level 3 by the direct route (mature candidate), must also take the Level 2 practical.

**3.2 SYLLABUS**

Candidates will be expected to have a knowledge of the Level 1 and 2 syllabuses in greater detail than that required for Level 1 and 2; plus, in addition, a knowledge of:

- a) Crystal structure of metals and alloys: (1)**
  - solutions, alloys, crystal lattice, metal and alloy crystals
  - the influence of the structure of metals and alloys on their mechanical properties.
- b) Iron-carbon diagram: (1)**
  - allotropic transformations of iron during heating and cooling
  - simplified iron-carbon diagram
  - normalising
  - solution heat treatment
- c) Electrical properties of metals and their alloys: (1)**
  - pure metals
  - non-conductors
  - alloys for heating elements
  - change of properties of metals and alloys according to temperature.
- d) Principles of selection of the kind, number and type of heating pads according to the kind and size of the material to be heat treated. (5)**
- e) Kinds of insulation materials and their thermal characteristics: (6)**
  - insulation materials.
- f) Practical aspects: (11)**
  - complex geometry and their implications
  - taking the decision as to the method of heat treatment

- choice of heat treatment parameters
- g) Mechanical consequences of heat treatment (overview only) (11)**
- reduction of yield strength
  - supports
  - expansion/contraction/constraints
  - mechanical properties
  - stability
  - wind loading on columns.
  - Calculating mass and power requirements
  - Heat transfer – radiation and convection
- h) Advanced electricals (4)**
- working with phases
  - current leakage
- i) Heaters (3)**
- high temperature
  - 240V
  - large ceramic heaters and special consideration for their use
  - channel heating elements
- j) Interpretation of codes, standards and specifications. (8)**