CERTIFICATION SCHEME FOR PERSONNEL

DOCUMENT No. CSWIP-WTR-1-90

Requirements for the Certification of Welding Technical Representatives

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Issued under the authority of the Governing Board for Certification
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CSWIP is administered by TWI Certification Ltd
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FOREWORD

The Certification Scheme for 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, Plant Inspectors, Underwater Inspection personnel, NDT personnel and thermography.

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. OBJECTIVES

Major changes in the characters of the welding industry have transferred the customer interface from the manufacturers to the distributors. The former were characterised by a substantial technical support effort, whereas many distributors are small companies currently short of technical resources. The Association of Welding Distribution (AWD) has recognised the need to enhance the technical standing of its member companies and this certification scheme benefits members of the association by establishing a minimum standard of technical competence for the welding sales personnel employed by both distributors and manufacturers. A higher level of confidence in the technical status and capability of the companies concerned will thereby result.

Clearly it is of advantage to the fabricator, particularly to the many small companies not having significant resources in welding engineering, if the distributor has technical sales staff in whom he can have confidence. This implies that such staff should have demonstrated their competence in appropriate aspects of welding technology and practice so that the advice given will rest on a solid foundation. For the distributor, certification will provide a mark of technical competence having national status through the established recognition of TWI Certification Ltd within the professional engineering scenario.

2. SCOPE

The Scheme identifies sales personnel who have a background in welding, who have attained a minimum level of knowledge as evidenced by examination, and practical welding ability as demonstrated by a test appropriate to the duties of a welding sales representative. This document provides the procedures by which certification is sought and the requirements for the approval of the related training course.

3. EXAMINATION AND TEST PROCEDURE

The candidate is not required to demonstrate their knowledge of all aspects of welding technology because they are concerned specifically with the use of equipment and consumables. It is therefore appropriate to test their understanding of fabrication related aspects only and certification shall require the successful completion of an approved training course (see Appendix 1). Such a course may be continuous, modular, evening or distance learning, as best suits the needs of the candidate, but must include a minimum of 69.75 guided learning hours and be completed within a period of two years.

4. EXAMINATION

A multiple-choice question and written answer examination set by TWI Certification Ltd is designed to test the candidate's knowledge of the welding technology identified in the training syllabus.

5. REQUIRED EXPERIENCE

Candidates must have a minimum of two years' experience in welding before certification, of which at least one must have been in sales. Experience must include:

- Choice of process
- Selection of equipment
- Weldability of materials and selection of appropriate consumables
- Trouble shooting when problems arise from the application of equipment or consumables supplied
- Safe working practices.

6. ASSESSMENT OF SALES RELATED KNOWLEDGE

The applicant shall have completed a course in salesmanship approved by the Management Committee, and relevant questions will be included in the examination. The minimum requirement is met by an Institute of Sales & Marketing Management (ISMM) Level 3 Certificate in Sales and Marketing or equivalent, or the Association for Welding Distribution Professional Salesmanship Diploma (PSD_AWD).

7. MATURE CANDIDATES

A mature candidate route offering exemption from the formal training is available for candidates who are able to demonstrate:

- Recognised Level 3 qualification in Fabrication & Welding and three years experience in the Welding Sales Sector
  or
- International/European Welding Specialist diploma and one years experience in the Welding Sales Sector
  or
- Seven years experience in Welding Sales in the past 10 years.

8. APPROVAL OF COURSES

Training establishments seeking approval must first submit to the Management Committee written application accompanied by a detailed training programme, course texts and visual aids. If acceptable in principle, the establishment will be visited to examine the facilities in place and to interview the staff who will provide the instruction. Courses will only be approved if presented by Welding Instructors or other appropriately qualified staff.

A fee is charged for this work, and operation of the course is subject to a fee per student at the annual renewal point.

9. APPLICATION FOR EXAMINATION AND FEES

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 the 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.

10. CERTIFICATION

10.1. 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.

10.2. 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.

10.3. 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.

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

10.4. 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 9.5.1. 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; and
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.

10.5. Renewal

10.5.1. 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 welding inspection; and

❖ As a guide, 'reasonable continuity' in any given five year period means that absences from work for which the certificate was granted should not exceed one year in one or several periods.

ii) providing evidence that the holder has kept up to date in welding technology.

One way of satisfying Part (ii) is by Registration (see document CSWIP-WI-1-91). Part (i) 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 sent to TWI Certification Contact details are provided at the end of this document.

The certificate will not be renewed without further test if a substantiated complaint is notified 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.

10.5.2. 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 9.5.1

The 10 year examination will consist of the following:

Multiple choice written paper

One retest, within 6 months of the 10 year renewal examination, will be allowed.

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

11. 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.

12. ADDRESSES

For further general information contact:

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

TWI Training and Examinations
Granta Park
Great Abington
Cambridge CB21 6AL

Phone: +44 (0) 1223 899000
Fax: +44 (0) 1223 891630
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CERTIFICATION SCHEME FOR PERSONNEL

CERTIFICATION OF WELDING TECHNICAL REPRESENTATIVES

APPPENDIX TO DOCUMENT NO CSWIP-WTR-1-90

Appendix 1: Syllabus for the Approved Course

APPENDIX 1: SYLLABUS FOR THE APPROVED COURSE

	SUBJECT	TIME/ ALLOCATION	KEY INSTRUCTION POINTS
1	The arc as a heat source	1½ hrs lecture ½ hr reinforce	Formation of an electric arc – characteristics: simple arcs, (carbon/tungsten) and metal arcs; metal transfer; arc forces, are energy; generation of heat welding Flow of electric current in an arc welding circuit; difference between AC and DC current pointing out the spread of heat in a DC arc; explanation of voltage and amperage and the heating effect of the current flow; the need for the transformation of mains power to achieve a satisfactory welding power; formation of ions within the arc and hence the formation of the arc plasma; the need for a gas shield to protect the molten metal formed in the arc produced either from a flux or supplied directly as a gas.
2	MMA welding	1½ hrs lecture ½ hr reinforce	Terminology – MMA; stick welding; metal arc welding. Types of MMA welding power sources; transformers; explanation of constant current design and associated problems in operation; open circuit voltage and arc voltage; need for a satisfactory open circuit voltage with AC sets; benefit of DC power source for MMA welding; reason for arc blow on DC MMA and how it can be cured: typical ranges of MMA power sources, how material type, thickness and joint preparation determine the electrode, power source and accessory (cable couplings, electrode holder) power rating.
3	MIG/MAG welding	3 hrs lecture 1 hr reinforce	Terminology – semi automatic; CO_2; GMAW. Constant voltage power source; advantages in operation; electron flow in MIG/MAG arc metal transfer – dip, globular, spray, pulse; their relationships on the V/A diagram assuming constant solid wire size and gas composition (eg 1.2mm o/d solid wire, arcon/CO_2 mixture); the effect of different wire diameters on the movement of the transfer modes; duty cycle of MIG/MAG equipment; tuning the MIG/MAG welding arc; the effect of voltage selection and wire feed speed on the flow of current through the arc; the effect of wire stickout; factors that affect arc balance (assuming correct initial arc tuning) giving rise to stubbing or burnback; the use of inductance in the MIG/MAG circuit; the need for inching, purging, latching and burnback controls on the MIG/MAG welding unit; the wire feed unit – typical construction and basic Method of control; types of wire feed systems, ie integrated independent with interconnections push-pull; typical range of push and push-pull MIG/MAG welding torches. Pulse MIG/MAG – simple theory based on mains frequency; programmed MIG/AMG; synergic systems – elementary operation and advantages over other MIG/MAG systems. Typical equipment range.

	SUBJECT	TIME/ ALLOCATION	KEY INSTRUCTION POINTS
4	TIG welding	1½ hrs lecture ½ hr reinforce	Terminology – TIG; (argon arc welding; heli-arc welding). Type of welding power source required (ie drooper); current flow in DC TIG arc, the effects of making the torch positive; the need for welding contractor control and high frequency spark start in DC TIG welding; identification of materials on which DC TIG welding can be used successfully; the need for AC TIG welding for reactive metals; the problems of inherent rectification, how this is solved with capacitance in AC circuits; the need for continuous HF on some TIG units to maintain the welding arc; the advantage of square waves in AC TIG welding; simple explanation of solid state control of inherent rectification; slope in and slope out control and their advantages; pre and post argon flow advantages; remote control of welding current; types of tungsten electrodes for DC and AC welding; pulse TIG and its advantages; programmed TIG and its applications; water and air cooled torches. Typical equipment range.
5	Sub-arc welding	½ hrs lecture	Terminology – description of the process; explanation of a basic sub-arc welding head and power source; welding arc control systems; methods of head mounting eg tractor, column and book, leadscrew, etc; multi wire welding techniques, examples of specialised machines (eg webb fillet welders etc); typical joint geometries; narrow gap sub-arc welding; basic understanding of manipulators and roller beds; sub-arc flux types and wire sizes, some common wire flux combinations. The electroslag process, brief outline.
6	Fluxes and gases in arc welding	3½ hrs lecture 1½ hrs reinforce	Manual metal arc flux coatings – explanation of BS EN ISO 2560 and AWS 5.1M/ A5.1: MIG/MAG bare wire deoxidants; types of shielding gases for carbon steel, copper and aluminium; cored wire flux compositions; TIG wires to BS EN ISO 14341/BS EN 14343/BS EN ISO 24373/ BS EN ISO 18273/BS EN ISO 18274: TIG shielding gas compositions to BS EN 439; cored wire technology outlined; range of common wire composition.
7	Gas welding	2 hrs lecture 1 hr reinforce	Outline of oxygen, acetylene and propane gases and propane gases and cylinders; reactivity of the fuel gas with oxygen showing how acetylene gives a higher flame temperature; neutral, oxidising and carburising flames and their applications; problems associated with heat spread across weld surface causing distortion; welding nozzle sizes, why no flux for carbon steel, fluxes for stainless steel, copper and its alloys and aluminium; problems associated with flux that is allowed to remain on the weldment; flux removal.

	SUBJECT	TIME/ ALLOCATION	KEY INSTRUCTION POINTS
8	Gas welding and cutting equipment	2 hrs lecture 1 hr reinforce	Definition of oxy-fuel gas equipment use; how a regulator works; the importance of correct hose quality, size and length; types of hand welding and cutting blowpipes (equal pressure and injector type); nozzle types for cutting using acetylene and propane; other oxy-fuel gas processes ie gouging, heating and flame cleaning; straight line and pipe cutting, equipment; basic principles of profile cutting equipment using templet magnetic wheel and other line following devices.
9	Welding power source systems	2 hrs lecture 1 hr reinforce	Basic principles of transformation and rectification; single 230V and 440V supplies; three phase supplies; where each type of supply is used in welding power source design; compare and contrast the features of single and three phase supply as they apply to welding power source performance; diesel and petrol generators; methods of power source control eg taped primary, taped reactance, moving iron core, magamp, thyrister; field excitation (generators).
10	Instrumentation	½ hr lecture ½ hr reinforce	Moving coil volt and ammeter; where they are positioned in the welding circuit; need for calibration; calibration methods; variations in voltage between power source and welding arc.
11	Wire feed mechanisms and torches	1½ hrs lecture ½ reinforce	Push type; wire feed unit requirements; purge, inch and latch; types of wire-feed, single pair feed rolls; in tandem feed rolls, feed roll grooving; knurled feed rolls; spool on gun wire feed units; compressed air driven units (pull type); push pull type; mechanical and electronic wire feed control systems; typical torch design, construction and range.
12	Gas shielding systems	1 hr lecture ½ reinforce	Argon regulators and flow meters; back purge requirements; regulators for MIG/MAG control; how static pressure is converted to dynamic flow; CO_2 heater and regulator draw off rates.
13	Principles and characteristics of resistance welding	1 hr lecture	Principles of resistance spot welding and seam welding; power source ratings; key areas of applications; problem areas; quality control.
14	Solid phase welding	¼ hr lecture	Principles of diffusion bonding and friction welding; advantages over other welding systems; typical machine sizes and costs; main areas of industrial application.

	SUBJECT	TIME/ ALLOCATION	KEY INSTRUCTION POINTS
15	Brazing and soldering	½ hr lecture	Oxidising flame setting; capillary action; joint geometries; brazing materials; fluxes; bronze welding; problem areas; high and low temperature soldering; examples of materials and fluxes.
16	Power beam welding	¼ hr lecture	Principles of operation; key advantages over other welding systems; typical machine sizes and costs; main areas of industrial application.
17	Thermal cutting	1 hr lecture ½ hr reinforce	Principles of cutting – iron/oxygen reaction; construction of acetylene and propane nozzles; definitions of kerf width, kerf face, drag lines; principles of plasma cutting; primary and secondary gases; arc divergence and its effect on kerf width; problem areas
18	Standards for welding equipment	1½ hrs lecture ½ reinforce	Define what the British and European Standards try to achieve; outline the following standards: BS EN ISO 9000, BS EN ISO 2503, (regulators); BS EN ISO 3821 (hose); BS EN ISO 5172 (blowpipe); BS 6258 (safety equipment); electrical equipment (BS EN 60974-1/BS 638-4/BS EN 60974-5/BS EN 60974-7/BS EN 60974-9): regulations outlined; protection of eyes, regulations.
19	Health & Safety	1¼ hrs lecture	Define the risks associated with welding from electricity, gases, fume, fire etc. Define the correct PPE, i.e. safety glasses, boots, gloves, helmets
20	Robots	1¼ hrs lecture	History; hardware; axis of rotation; methods of programming: fixtures; working area; joint finding and tracking; auxiliary equipment; torch cleaning; fields of application.
21	Cost of equipment a comparative study	1½ hrs lecture ½ hr reinforce	Categorisation of welding costs – initial capital costs; operation costs (ie training, consumables, maintenance) as applied to oxy-fuel gas, MMA, MIG/MAG, TIG, SAW.
22	Care and maintenance	2 hrs lecture 1 hr reinforce	Definition of first line maintenance for oxy-fuel gas; visual inspection of regulators, hose; blowpipes and safety devices; MMA visual inspection of electrode holder and work return leads, and work return clamp; TIG visual inspection of torch leads, work return, ceramic nozzle, tungsten stickout and condition; MIG/MAG – interconnections (where applicable), torch leads and work return cable, fitting of torch liners and contact tips, gas nozzle, wire reel braking, pressure roll tension; SAW – interconnections and work return cables; flux hopper, feed current contact nozzle; welding head cleanliness.

	SUBJECT	TIME/ ALLOCATION	KEY INSTRUCTION POINTS
23	Types and characteristics of steels	1½ hrs lecture ½ hr reinforce	What constitutes a steel; the problems associated with the phase change from austenite to ferrite and pearlite in non-equilibrium conditions; the effect of increasing carbon on the formation of brittle structures; the effect of other elements of this change and hence carbon equivalent number; the effect of high alloy additions of chromium and nickel to give the common range of stainless steels; standard classification of steels – BS EN 10095/BS EN 10240-4/BS EN 10085/PD 970/BS EN 10087/BS EN 10083-1/BS EN 10084; key stainless steels from BS EN 10090: outline of BS EN 10025-1/BS EN 10025-6: BS 7668: BS EN 10029, Parts 1-3 and BS EN 10025 Pts 1, 3, 4 and 5; BS EN 10210-1 (weldable structural steels).
	Non-ferrous alloys	¾ hr lecture ¼ reinforce	Manganese bronze BS EN 1982; phosphor bronze BS EN 1172/BS EN 1652/BS EN 1653/BS EN 1654 copper BS EN 1976 and BS EN 1978 aluminium BS EN ISO 18273.
24	The welded joint	¾ hr lecture ¼ reinforce	How a macro is obtained; detail of the weld macro zones for both butt and fillet welds; indication of the problems that a macro can show; lack of penetration; lack of fusion; hard zones (hardness survey by DP hardness testing).
25	Effects of welding	1¼ hrs lecture ½ hr reinforce	Explanation of yield strength; tensile strength; ductility; hardness; how welding affects these; explanation of toughness and how this is affected by welding; Charpy and CTOD defined; outline the areas of tensile and compressive stress in a simple weld.
26	Distortion and control	1¼ hrs lecture ¾ hr reinforce	Distortion – longitudinal, angular and lateral distortion defined; reasons for distortion; outline methods of control studies.
27	Heat treatment	¾ hr lecture ¼ hr reinforce	Reinforcement of A1 and A3 change points; meaning of the terms annealing, normalising, tempering, quenching, stress relieving, the effects of preheating.
28	Weldability and its testing	1¾ hrs lecture ½ hr reinforce	Definition of weldability. The weldability of materials; techniques for overcoming poor weldablity in materials (eg low hydrogen welding, preheat levels, joint geometry).
29	Cracking	½ hr lecture ½ hr reinforce	Mechanisms of cracking simply outlined; stress raisers, critical crack length, hot and cold cracking defined likely position in the weld area; examples of brittle and ductile failure.
30	Avoiding production welding problems	1 hr lecture ¼ hr reinforce	Assessment of welding plant operational requirements eg operational amperages, duty cycles, workforce skill, on site maintenance requirements; the pre and post weld work flow and its effect on the output of the welding work station.

	SUBJECT	TIME/ ALLOCATION	KEY INSTRUCTION POINTS
31	Faults in welds causes and corrections	1¼ hrs lecture ¾ hr reinforce	Define common weld faults – porosity, piping, slag inclusions, lack of fusion, cracking (refer to subject 26), shrinkage cavities, lack of penetration, excess penetration, excess weld metal, concavity, indicating their likely causes.
32	Wear and repair electrodes	1½ hrs lecture ½ hr reinforce	Define the types of wear – impact, corrosion, abrasion, gouging, friction, erosion; hard facing alloys, austenitic, martensitic, carbide; areas for application of each type; hard facing techniques outlined; repair techniques, carbon steels, cast irons, dissimilar metals.
33	Welding procedure testing	1½ hrs lecture ½ hr reinforce	Reasons for welding approvals; difference between weld procedure (BS EN ISO 15607/BS EN ISO15609-1.BS EN 15614-1/BS EN ISO 15614-2/BS EN ISO 15610/BS EN 15611/ BS EN ISO15612/ BS EN ISO15613/BS EN 288-9) and welder approval (BS EN 287) tests; types of destructive and non-destructive testing used in each case; the series outlined; ASME Section IX (BS EN 287) outlined; weld joint position outlined.
34	Process selection	3½ hrs lecture 2 hrs reinforce	The factors that affect process selection – welding environment (site and shop); material type; material thickness; flat or curved surfaces; radius of curvature (ie pipe o/d); total welded joint length; weld joint geometry type; weld length as a percentage of weld joint (ie stitch or spot welding); welding position; welding productivity outline (ie deposition rate, effective deposition rate, shop duty cycle).
35	Joint preparation for common welding systems	¾ hr lecture ¼ hr reinforce	Types of butt joints and explanation of the names given to the various parts of the joint geometries; joint backing, permanent, removable (eg tiles, glass, rope).
36	Safety: Oxy-fuel gas	1 hr lecture	Oxy-fuel gas flow and control, BCGA CP7, balanced flames (gas velocity, burning velocity); what affects both (pressure drops, wrong mixing pressures, wrong equipment); regulator theory; hose and blowpipe construction; use of safety devices.
	Electric	1 hr lecture	Electric welding, electric shock, bad earthing, radiation, burns, asphyxiation, fume.