THE IMPORTANCE OF TRAINING AND CERTIFICATION IN QUALITY FABRICATION

by

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SYNOPSIS

The increasing importance of quality managment systems to the success of business and industry in general is recognised and the development of welding quality systems specifically for the fabrication industry is discussed.

It is shown how quality requirements in welding have developed from the basic concept of certified welders and welding inspectors to that of welding coordinators.
The importance to quality fabrication of a five tier training and certification route for welding personnel in Europe is reviewed and reference is made to the implications of probable future developments in training and certification of welding personnel on an international scale.

INTRODUCTION

In increasingly competitive markets both on national and international scales, the delivery of quality services or products is of paramount importance to the success of industry and commerce. Many examples could be quoted of companies which have built a worldwide reputation on the bases of the enduring quality of their products, and all of us are familiar with household names in, for example, the automobile or electronics sectors whose success is based on quality.

The continuing aim for improved quality - often customer led - has become increasingly important in recent years and has resulted in the development of quality management systems embodied in the international standards within the ISO 9000/BS5750 series [1-5]. This series of quality system standards is designed to be implemented in both contractual and non contractual situations [1]. The supplier aims to maintain a quality system that improves his product and hence business opportunities, whilst the purchaser seeking to ensure satisfaction requires specified quality system elements to be part of the supplier's system. The precise requirements of the quality system will depend on both the number and detail of quality system elements specified [3-5]. Typical elements specified within a quality system, for example, may cover the requirements of design control, process control, product identification, inspection and testing, document control and training of personnel.

Whilst ISO 9000 standards are undoubtedly important to the welding industry they are general in nature and do not address specific quality requirements of welded fabrications. To meet this need therefore the European Standards Organisation (CEN - Comite Europeen de Normalization) has developed welding specific quality standards based upon the ISO 9000 series. Like the ISO 9000 Series, the European Welding quality standards - the EN 729 series have been produced in a number of parts, reflecting the level of quality requirement applicable [6-9].

In this paper, the development of quality systems in welded fabrication will be considered and the importance of training and qualifications in meeting the specified quality levels emphasized. Brief mention will be made of the likely implications of these factors on future international developments in training and certification in the welding field.

Table I :
Some of the factors affecting the quality of welded joints

* Materials of construct n
* Welding consumables
* Operator skill
* Welding equipment
* Health & safety
* Inspection and testing
* Woking environment
* Welding procedures
* Joint design
* Control of welding operations

BASIC QUALITY REQUIREMENTS IN WELDING

The production of quality joints in welded fabrications depends on a wide range of factors some of which are listed in **Table I**. Depending on the level of quality aimed at these factors will play a greater or lesser part in the successful completion of the joint.

The need for control in welding operations has of course been recognised for many years and long before the concept of the current quality management systems arose, fabricators have taken various precautions to ensure satisfactory production of welded joints.

Probably the most useful aids to the welding fabricator in his achievement of quality are the various standards specifying approval testing of welders and procedures. In this respect the most widely recognised internationally is ASME Code Section IX [10]. In the UK, the approval testing has been covered by separate standards BS4870 "Approval Testing of Welding Procedures" and the complementary BS4871 "Approval Testing of Welders Working to Approved Welding Procedures".

The above standards are key factors in the assurance of quality fabrication and are important mechanisms for certifying both procedures and operator skill. Moreover prior to welder approval testing a period of welder training may frequently be required - perhaps the most widely recognised and common example of training and certification as an aid to quality fabrication. In some instances, where quality requirements may be relaxed, procedure approval may not be required although welder approval is still essential [11]. Here again, prior to certification, welder training will in most cases be required to a greater or lesser extent.

In an effort to ensure equivalent standards throughout Europe, which is seen as a crucial factor in the development of welding quality systems in the European Community, CEN has recently developed new standards EN287 and EN 288 for approval testing of welders and procedures respectively [12,13]. Within the UK, these have superseded the former standards BS4871 and BS4870, respectively. Like the former standards, however, certification of welders to the new European standards will often require prior welder training.

CONTROL OF WELDING OPERATIONS

Whilst conformance to both welder and procedure approvals is a significant step in the search for quality in welding, this provides only part of the answer and many other aspects of control of welding operation must be considered.

The person exercising control of welding may have a number of designations eg welding engineer, welding supervisor, welding foreman and as in the new European concept discussed below, welding coordinator. Perhaps the key job Function with regards to quality control, however, is that of welding inspector, who must perform critical tasks throughout the fabrication process, that is before, during and after welding. As an example, the requirements for welding related inspection and testing specified in EN729 Part 2 and ? Comprehensive quality requirements and Standard quality requirements, respectively [7,8] are listed in **Table II**.

Clearly these tasks must be carried out by a competent person and it is essential that appropriate welding inspection personnel are well qualified to meet this demand. One route to ensuring competence of inspection staff is through CSWIP, the Certification Scheme for Welding and Inspection Personnel. This UK scheme for training, examining and certifying welding inspection personnel is administered by Qualifica-

Table II : Welding related inspection & testing [7,8]

Before welding, check :
- suitability and validity of welders approval crtificates
- suitability of welding prócedure specification
- identity of parent metal
- joint preparation
- fit-up, jigging and tacking
- any special requirements in welding procedure specification eg prevention of distortion
- arrangement for any production test
- suitability of welding conditions for welding, including environment

During welding, check :
- essential welding parameters eg current, voltage, travel speed
- preheating/interpass temperature
- cleaning and shape of runs and layers of weld metal
- back gouging
- welding sequence
- correct use and handling of consumables
- control oi distortion
- any intermediate examination eg dimension check

After welding, check compliance with acceptance criteria
- by visual inspection to relevant CEN standards
- by non-destructive testing to relevant CEN stndards
- form, shape and dimensions of the welded construction
- results and records of post weld operations eg grinding, post weld heat treatment

tion Services of the welding Institute, UK. The CSWIP scheme was started in 1969 (it celebrated its 25th Anniversary in October 1994) and is now well recognised internationally. A key feature of the CSWIP scheme is that it is audited and approved by the UK Government through the national Accreditation Council for Certification bodies (NACCB).

In keeping with the requirements of NACCB, the CSWIP scheme maintains separation of training and examination personnel, ensuring the client may have the highest confidence in his certified staff. At the same time the welding inspector or senior welding inspector is required to follow a CSWIP approved training course prior to examination which is seen as further guarantee of the competence of certified inspectors. Relevant information on the mechanisms and requirements of the CSWIP scheme are available [14-15].

WELDING COORDINATION

Whilst the welding inspection tasks discussed above are of key importance in ensuring quality of welded fabrications, other important requirements are also present, such as equipment, facilities, design, maintenance procedures calibration etc. [7,8]. Thus EN729, quality requirements for welding specifies that "the manufacturer shall have at his disposal sufficient and competent personnel for the planning, performing, supervising and examining of the welding production according to specified requirements". The fulfilling of these tasks is described in terms of "Welding coordination" with a "Welding coordinator" being a person carrying out one or more coordination tasks and having responsibility for quality activities.

The importance of welding coordination personnel, or welding coordinators, is emphasized by the fact that CEN has developed a specific standard EN719 welding coordination, which identifies the quality related responsibilities and tasks associated with the coordination of welding related activities [17].

All welding coordination personnel must be able to demonstrate adequate technical knowledge related to the coordination tasks to be performed, and this knowledge may be attained by a combination of theoretical knowledge, training and or experience. One route available to ensure ad-

equate technical know how is through the training and certification programmes of the European welding federation (EWF).

EWF TRAINING AND CERTIFICATION PROGRAMMES

The European Welding Federation (EWF) is an association of the welding institutes and societies of the European Community (EC) and European Free Trade Association (EFTA). In the late 1980s the EWF formed a working group to develop training and certification routes for welding personnel in Europe. Although not directly associated with the development of welding quality systems within CEN (the EN729 series of standards), the work of EWF was carried out in parallel to that of the CEN working group.

The EWF group has established a five tier qualification system for welding personnel in Europe.

European Welding Engineer (EWE)
European Welding Technologist (EWT)
European welding specialist (EWS)
European Welding Practitioner (EWP)
European Welder

with the European Welding Engineer being at the highest level. Work has been completed on the three higher levels of qualification (EWE, EWT, EWS) and is continuing on the other guidelines. Additional guidelines such as for European Inspection Personnel are in preparation.

The basis of the qualification route is that the candidate must first hold a recognised engineering or practical qualification prior to following an appropriate EWF approved training and examination programme **Table III**.

The EWF training programmes contain both a theoretical and practical content, totalling 446 hours, and subject matter is defined in four main areas.

Within each of the main theory areas the subject matter is again broken down into specific topics.

EWF Qualifications and Welding Quality Systems

Because the welding subject matter of EWF programmes is so comprehensive, welding personnel qualified by training and examination under the EWF guidelines have a knowledge base which is very appropriate for the function of welding coordinator [16]. This has been recognised by CEN such that, technical knowledge requirements of welding coordinators responsible for comprehensive, standard or elementary quality requirements within EN729 are

Theory :		
Welding Processes and equipment	.....	102 h
Materials and their behaviour during welding	.....	110 h
Construction and deign	.....	64 h
Fabrication, applications enginering	.....	110 h
Total theoretical content	.....	**386** h
Practical		
Skill training	.....	40 H
Process demonstrations	.....	20 h
Total practical content	.....	**60** h
TOTAL	.....	**446 h**

Table III : EWF Training and Certification Programmes [17-19]

EWF Qualifications	Prerequisite experience	EWF Training Course Duration (hours)
EWE	Engineering degree	446
EWT	higher level certificate in engineering	340
EWS	engineering certificate	222
EWP	proven practical skill	100

[7-9] considered to be met by personnel qualified to EWE, EWT and EWS level respectively.

Because the recognised complementarity of the CEN welding quality systems and the EWF training and certification qualifications, there is no doubt that increasingly there will be a need for these qualifications amongst welding coordination staff of fabrication companies seeking to meet EN729 welding quality requirements.

Moreover EN729 is to be adopted as an international standard (ISO 3834) which has implications for the development of welding quality systems on a work wide basis.

International Welding Qualifications and Welding Quality Systems

The importance of EWF training and examination programmes has been recognised by the International Institute of Welding (IIW) at its recent Annual Assembly in Beijing (September 1994). The IIW Governing Council has proposed to set up an Authorization and Qualifications Committee (equivalent to EWF) with a view to adopting the EWF programmes [20]. In the future, therefore, the development of international qualifications, such as international welding engineer (IWE), International Welding (Technologist IWT) etc. will have major implications on welding quality systems worldwide.

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