

EDUCATION, EXAMINATION AND QUALIFICATION SYSTEM OF WELDING PERSONNEL IN KOREA

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ABSTRACT

The education, examination and qualification systems around the world are now changing rapidly and unifying as one system. The Korean national system should be harmonious with this international tendency, in order to overcome the high degree of international economic competition. In this article, the current state of the international and national systems are critically compared and discussed with the intention of proposing improvements to the Korean national system.

The Korean Welding Society has revamped its system so that its certificates might be recognized by the welding institutions in foreign countries such as the European Welding Federation (EWF) and still be recognized by the Korean Government. Their desire to join the system of International Institute of Welding (IIW) was also a factor in the restructuring.

KEY WORDS

Welding, Personnel, Education, Examination, Qualification

1. Introduction

Welding exerts a profound influence on the cost of fabrication and quality of products. It is important, therefore, to ensure that welding is carried out in the most effective possible way and that appropriate control is exercised over all aspects of the operation. For the quality assurance of weldment the manufacturer should have available sufficient and competent personnel for the planning, performance and supervision of the welding stage of production.

In Korea, there is a large number of welding related industries and, therefore, a great demand for welding personals. Between 1975 and 1999, more than 250,000 welding related certificates were issued, according to the Korean national qualification system but these are accepted neither in Korean industries nor in foreign countries. Nowadays the number of participants in national vocational training schools has significantly decreased. The welders are tending to leave their dirty workshops, at a time when industries need competent welding personnel more. These problems can be solved by introducing an advanced internationally recognized system in Korea. The Korean Welding Society (KWS) has developed its education, examination and qualification system of welding personnel along the lines of the EWF system and issued some certificates since 1991.

KWS is attempting that its system will be recognized internationally and in line with IIW system. At the same time, KWS hopes to be recognized by the Korean Government as a legal, private organization responsible for maintaining the welding education, examination and qualification system. In this report, the Korean governmental and KWS systems are introduced briefly, discussed critically and a better system for the future is proposed.

2. National technical qualification system

The Korean government operates the national technical education, examination and qualification system, and issues certificates for welding engineers, technologists, specialists, masters, welders (electrical, gas and special), and assistant welders (electrical, gas and special). Table 1 shows the number and types of welding certificates issued between 1975 and 1999 by the Korean government. Welding certificates represent approximately 4% of the various certificates issued by the Korean government during this period.

Table 1. The number of welding certificates issued by the Korean government [1]

year certificate	Sum	'75- '88	'89	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99
SubSum	8967	3,363	731	616	561	639	471	504	324	318	322	529	589
Engineer	134	25	4	8	7	13	10	3	17	14	12	9	12

Technologist	333	141	24	33	8	18	26	12	5	7	7	30	22	
Specialist	7,698	31,66	695	562	530	543	364	378	237	221	231	390	381	
Master	802	31	8	13	16	65	71	111	65	76	72	100	174	
Welder	Sub Sum	202,786	95,924	10,024	8,838	8,984	10,366	9,727	9,829	9,769	10,533	10,279	8,860	9,663
	Electrical	168,289	79,579	8,166	7,203	7,207	8,850	8,409	8,432	8,480	9,106	8,336	7,078	7,413
	Gas	22,452	14,067	1,574	1,237	1,240	891	767	765	505	432	376	306	292
	Special	12,045	2,278	284	398	537	625	521	632	784	995	1,567	1,476	1,948
Assistant welder	Sub Sum	52,232	29,982	602	665	1,312	970	2,216	2,393	2,989	2,732	2,511	3,639	2,221
	Electrical	47,194	27,674	556	645	1,288	919	1,740	2,324	2,787	2,633	2,176	2,887	1,565
	Gas	2,690	2,244	41	19	19	51	30	55	109	7	15	77	23
	Special	2,348	64	5	1	5	0	446	14	93	92	320	675	633
Total	263,985	129,269	11,357	10,119	10,857	11,975	12,414	12,726	13,082	13,583	13,112	13,028	12,463	

Table 2 shows guidelines for examination of welding engineer and technologist.

Table 2. Guidelines for examination of welding engineer and technologist

Certificate	Guideline	Method	Subject
Welding Engineer	Ability carrying out technical jobs like research, design, analysis, testing, management, evaluation, audit, education etc., with professional knowledge and experience.	Written Examination	Welding process, - metallurgy, - material, - construction design, - fabrication management, - equipment, safety and health, tests of weldment, welding related law and guidelines, machining and production management.
Welding Technologist	Ability carrying out technical jobs like design, fabrication, analysis etc., with technical knowledge	Oral Examination	Machining, material strength, welding metallurgy, - construction design, - welding generals, - safety and health
		Practical Examination	welding experience

Within this system there is no clear definition on the duty performance for the different kinds of qualification and, therefore, no concrete guidelines for education, examination and qualification can be formed. Because of this lack of concrete guidance: the participants of training courses can not be guided towards the successful accomplishment of their duties; training schools can not assure the quality of education and qualification institutions the quality of qualification and employers can not activate the latent power of their employees.

The Korean government has been operating this system for 30 years. Nowadays, industries in Korea have expanded in scale and are specialized in multifarious fields to such an extent that government officials can not have the required specialized knowledge, and the specialization of the different technical fields can not be achieved.

This situation has led to supplier government oriented education, examination and qualification, through which the ability required by industries has not be achieved and the certificates awarded are not fully accepted by industries and by advanced foreign countries.

3. Private qualification system

The Korean government has also operated the private education, examination and qualification system for several years. According to this system every private institution, company and so on. can have their own qualification system and issue certificates, which may be recognized by the government. If recognized by the

government, these certificates are treated legally in the same rank as that of the national technical qualification system. But, at this time the Korean government has not opened this system to all technical fields. Fields that are closely related to people's health and safety have been excluded. Welding technology belongs to this category of the technical fields.

4. Education, examination and qualification system of welding personnel operated by Korean Welding Society (KWS)

In 1991, KWS introduced the EWF-based system for education, examination and qualification of welding personnel in Korea. KWS operates with Quality manuals (QM) identical to the EWF's QM, which includes management systems, operating procedures, standard forms and data, and guidelines for the education, examination and qualification of different kinds of courses. Table 3 shows the certificates introduced by KWS.

Table 3. Welding certificates in Korean Welding Society (KWS)

	Certificate	Minimum Education Duration
Welding Engineer	Korean Welding Engineer, (KWE)	446 hours
	Korean Welding Technologist, (KWT)	340 "
	Korean Welding Specialist, (KWS)	222 "
	Korean Welding Practitioner, (KWP)	143 "
Welding Inspection Personnel	Korean Welding Inspection Engineer, (KWIE)	263 "
	Korean Welding Inspection Technologist, (KWIT)	246 "
	Korean Welding Inspection Specialist, (KWIS)	188 "
	Korean Welding Inspection Practitioner, (KWIP)	105 "
Welding Instructor	Korean Gas Welding Instructor, (KWIN-Gas)	216 "
	Korean MMA Welding Instructor, (KWIN-MMA)	216 "
	Korean MIG/MAG Welding Instructor, (KWIN-MIG/MAG)	216 "
	Korean TIG Welding Instructor, , (KWIN-TIG)	216 "
Welder	Korean Gas Welder, (KW-Gas)	14 weeks
	Korean MMA Welder, (KW-MMA)	18 "
	Korean MIG/MAG Welder, (KW-MIG/MAG)	10 "
	Korean TIG Welder, (KW-TIG)	12 "
Stud Welder	KSW-1, Korean Stud Welder Level 1, (KSW-1)	1 week
	KSW-2, Korean Stud Welder Level 2, (KSW-2)	1 "
Arc Robot Operator	Korean Arc Robot Operator Level 1, (KARO-1)	1 week
	Korean Arc Robot Operator Level 2, (KARO-2)	1 "

Table 4 shows contents and duration of education courses of various welding engineers and welding inspection personals introduced by the KWS.

Table 4. Contents and duration of various welding engineers and welding inspection personnel of introduced in KWS

(a) Welding Process and equipment

(Unit : hour)

Contents	Certificates							
	KWE	KWT	KWS	KWP	KWIE	KWIT	KWIS	KWIP
1.1 General introduction to welding technology	4	2	1	2	2	2	2	2
1.2 Oxy-gas Welding	5	4	2	2	2	2	1	1
1.3 Special Oxy-gas processes	1	1	1	-	1	1	1	1
1.4 Electrotechnics The arc	2	4	2	2	0	0	0	1
1.5 The arc	4	2	1	1	1	1	1	0
1.6 Power sources for arc welding	4	4	2	2	2	2	1	1
1.7 Introduction to Gas-shielded arc welding	2	2	2	2	2	2	1	1
1.8 Tungsten-inert gas welding	6	6	4	2	2	2	1	1
1.9 MIG/MAG welding	8	8	5	2	4	4	2	2

1.10 Manual Metal arc welding	10	6	4	2	4	4	2	2
1.11 Submerged-arc welding	6	4	2	2	3	3	1	1
1.12 Resistance welding	8	6	2	0	0	0	0	0
1.13 Other welding processes	10	6	3	1	0	0	0	0
1.14 Cutting and other edge preparation processes	4	4	2	2	4	4	2	1
1.15 Surfacing	2	2	1	0	0	0	0	0
1.16 Fully Mechanized processes and robotics	6	4	2	0	0	0	0	0
1.17 Brazing and soldering	4	4	2	0	2	2	1	1
1.18 Joining processes for plastics	4	2	1	0	0	0	0	0
1.19 Joining processes for advanced materials	2	1	0	0	0	0	0	0
1.20 Welding laboratory	10	8	6	0	-	-	-	-
Sum	102	80	45	22	29	29	16	15

(b) Materials

(Unit : hour)

Contents	Certificates							
	KWE	KWT	KWS	KWP	KWIE	KWIT	KWIS	KWIP
2.1 Manufacture and designation of Steels	2	1	1	1.5	1	1	1	1
2.2 Testing materials and the weld joint	8	8	6	2.5	0	0	0	0
2.3 Structure and properties of pure metals	4	2	2	0	4	3	2	1
2.4 Alloy and phase diagrams	6	4	2	1	6	4	1	1
2.5 Iron-Carbon alloys	4	4	2	1	2	2	1	1
2.6 Heat treatments of base materials and welded joints	4	4	3	1	4	4	2	1
2.7 Structure of the welded joint	4	4	2	2	4	4	2	2
2.8 Plain carbon- and Carbon-manganese steels	6	5	2	2	2	2	2	1
2.9 Cracking phenomena in steels	4	4	4	2	5	4	2	2
2.10 Fine-grained steels	4	2	2	1	2	2	1	2
2.11 Thermomechanically treated steels	2	1	1	1	2	1	1	0
2.12 Application of structural and high strength steels	2	2	1	2	0	0	0	0
2.13 Low-alloy steels for very low temperature applications	4	2	1	0.5	2	1	1	0
2.14 Low alloy creep resistant steels	4	2	1	0.5	0	0	0	0
2.15 High-alloyed (stainless) steels	8	6	3	2	4	3	1	0
2.16 Introduction to Corrosion	6	3	1	0	2	2	2	1
2.17 Introduction to Wear	2	1	0	0	0	0	0	0
2.18 Protective layers	4	3	2	0	0	0	0	0
2.19 Creep resistant and heat resistant steels	2	1	0	0	2	2	0	0
2.20 Cast irons and steels	4	2	1	0	0	0	0	0
2.21 Copper and copper alloys	4	2	1	0	0	0	0	0
2.22 Nickel and Nickel alloys	4	2	1	0	2	1	0	0
2.23 Aluminum and Aluminum alloys	6	5	2	2	3	3	2	1
2.24 Other metals and alloys	2	1	0	0	1	1	0	0
2.25 Joining dissimilar materials	4	3	2	0	2	2	0	0
2.26 Metallographic examinations	6	6	2	0	2	2	0	0
Sum	110	80	45	22	52	44	21	14

(c) Construction and Design

(Unit : hour)

Contents	Certificates							
	KWE	KWT	KWS	KWP	KWIE	KWIT	KWIS	KWIP
3.1 Fundamentals of the strength of materials	4	4	2	0	4	4	1	1
3.2 Basics of weld design	6	8	3	0	1	1	1	0
3.3 Design principles of welded structures	4	4	2	0	1	1	1	0
3.4 Joint design	4	4	4	4	4	4	4	4
3.5 Introduction to Fracture mechanics	2	8	0	0	6	2	0	0
3.6 Behaviour of welded structures under different types of loading	2	4	1	0	3	2	1	1
3.7 Design of Welded structures with predominantly static loading	5	8	3	2	1	1	1	0
3.8 Behaviour of welded structures under dynamic loading	2	4	1	1	3	2	1	0
3.9 Design of dynamically loaded welded structures	4	8	2	0	0	0	0	0
3.10 Design of thermodynamically loaded welded structures	2	6	2	1	4	2	1	0
3.11 Design of structure in Aluminum and its Alloys	4	4	1	0	1	1	1	1
3.12 Reinforcing-steel welded joints	1	2	1	0	2	1	1	1
Sum	40	64	22	8	30	21	13	8

(d) Fabrication

(Unit : hour)

Contents	Certificates							
	KWE	KWT	KWS	KWP	KWIE	KWIT	KWIS	KWIP
4.1 Introduction to quality assurance in welded constructions	6	5	2	1	3	3	2	2
4.2 Quality control for manufacture	14	12	10	10	3	3	3	3
4.3 Welding stresses and distortion	6	4	2	2	3	3	3	3
4.4 Plant facilities, welding jigs and fixtures	4	4	4	2	1	1	1	3
4.5 Health and safety	4	4	3	2	3	3	2	1
4.6 Measurement, control and recording in welding	4	4	4	2	3	3	2	2
4.7 Non-destructive testing	20	10	6	10	0	0	0	2
4.8 Economics	8	5	2	1	0	0	0	0
4.9 Repair-welding	2	4	3	2	2	2	2	0
4.10 Fitness for purpose	2	1	0	0	4	4	1	2
4.11 Case studies	40	28	14	0	0	0	0	1
Sum	110	81	50	32	22	22	16	19

(e) Practical training / Inspection

(Unit : hour)

Contents	Certificates							
	KWE	KWT	KWS	KWP	KWIE	KWIT	KWIS	KWIP
- Arc Welding practical training (Gas, MMA, TIG, MIG/MAG)	40	40	40	40	-	-	-	-
- Demonstration of special welding process	20	20	20	20	-	-	-	-
- Material testing					120	120	80	40
Sum	60	60	60	60	120	120	80	40

Table 5 shows the number of courses and participants carried out according to KWS system.

Table 5 Number of courses and participants

Course	Number of courses	Number of participants
Welding engineer	15	300
Welding Specialist	2	50
Welding Inspection Engineer	2	50
Welding Instructor (MMA, MIG/MAG, TIG)	4	70
Welder (MMA, MIG/MAG, TIG)	4	70
Stud welder (Level 1, 2)	3	50
Arc Robot operator (Level 1, 2)	2	50

Some of the KWS certificates have been recognized by the EWF as being identical to those offered by the EWF. These include the Korean Welding Engineer and Specialist, Korean Welding Inspection Personnel (Engineer, Technologist, Specialist, Practitioner), and Korean Welders (Gas, MMA, MIG/MAG, TIG). The recognition of KWE terminated at the end of 2001. The KWS has submitted the recognition of KWS certificates to the government as allowed by the law of the private qualification system.

If the KWS certificates can be recognized internationally by international institutions like the EWF and tied to the international qualification systems like that of the International Institute of Welding (IIW), and also recognized by the Korean government, then it can be a truly competitive system in Korea.

5. International system of education, examination and qualification of welding personnel

The International Standards Organization (ISO) has established some important standards related to welding personnel including welding engineers (ISO 14731) and welders (ISO 9601), which have been introduced already in the Korean standards (KS). Originally the EWF made this system which is adopted by ISO, IIW and KWS. Until now IIW adopted only the system of welding engineers like engineers, specialist and technologists. The KWS can be a member and an authorized national body (ANB) of IIW in the future, and then issue KWS-IIW certificates, instead of just having recognition of KWS certificates by EWF.

6. Summary

It is very important to bring the level of the Korean vocational training system up to the level of advanced industrial countries. To solve the serious problems of national technical education, examination and qualification systems operated by the Korean government, it is necessary to move towards an industry oriented system and to connect it with international networks.

Instead of the Korean government, the Korean Welding Society can play the roll better, because the KWS-Governing Board is mostly composed of industrial members and all policies can be made according to industrial demand. This means that industry can educate, examine and qualify their future employees by themselves.

In the future, the KWS-system will be recognized by the Korean government and at the same time connected with IIW-system. KWS should be a national member of IIW and an Authorized National Body (ANB) of IIW, and be able to issue KWS-IIW certificates which will be recognized by the Korean government. KWS-certificates can then fulfil all requirements from industries, government and international institutions, and be used as a real competitive certificate in Korea.

7. References

[1] Korea Manpower Agency ; *Annual report*, 2000