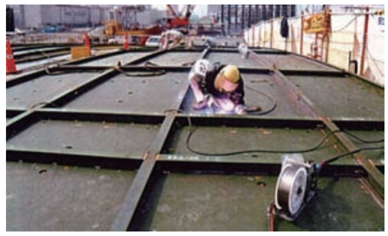
KOBELCO WELDING TODAY

Vol.13 No.1 2010

Faster, Cleaner and Greener Welding: the Excellence of the KOBELCO Arc

PREMIARC™ DW-N709SP

A Hastelloy-type flux cored wire for welding 9% Ni steel in all positions, reducing hot crack susceptibility



Liquefied Natural Gas (LNG), reputed as a source of clean energy, is stored at temperatures as low as –162°C. Such low temperature typically require above-ground storage tanks to be made of 9% Ni steel which provides high strength and high notch toughness.

The most important requirements for 9% Ni steel welding consumables are to obtain the balance between strength and notch toughness, and to minimize susceptibility to solidification cracks and reheat cracks — a recognized weakness of Ni-based alloy.

Regarding strength and notch toughness, the consumables must meet a minimum strength of 690 MPa (the same as 9% Ni steel) and minimum notch toughness of 45 or 55 J, the international standard.

Hot crack susceptibility is closely related to weld metal chemistry. According to the recently proposed BTR (Brittle Temperature Range) prediction formula of weld metal chemistries, high levels of C, P and S can cause the most harm, while Si and Nb are problematic as well.

DW-N709SP flux cored wire with shielding gas 80%Ar-20%CO_2 has been developed by adopting the BTR to reduce crack susceptibility. When combined with the weld metal chemistry of AWS A5.11 ENiMo-8, excellent balance of strength and notch toughness is achieved. It will be classified under the new classification AWS A5.34 in the future.

Table 1: Typical chemical and mechanical properties of DW-N709SP weld metal

Chemical composition of weld metal (%)					
C	Si	Mn	P	S	Ni
0.02	0.2	2.7	0.010	0.003	Bal
Cr	Mo	Fe	Nb	W	
7.0	17.6	7.7	< 0.01	2.4	
Mechanical properties of weld metal					
0.2% YS (MPa)	TS (MPa)	El (%)	RA (%)	IV at –196°C (J)	
459	718	46	46	89	

Table 2: Results of impact test of butt joint at –196°C

Specimen location	Absorbed energy (J)	Lateral expansion (mm)
Face side	92, 90, 99 (Avg 94)	1.28, 1.25, 1.35 (Avg 1.29)
Center	85, 91, 89 (Avg 88)	1.37, 1.44, 1.38 (Avg 1.40)
Back side	95, 86, 88 (Avg 89)	1.54, 1.51, 1.53 (Avg 1.53)

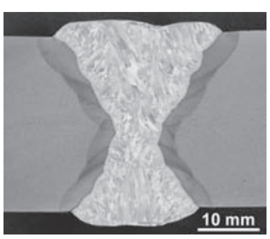


Figure 1: Macro section of butt joint shows consistent penetration and smooth fusion.

Table 1 shows the typical chemistry and mechanical properties of DW-N709SP weld metal. Such harmful elements as C, P, S, Si, Nb are minimized or not intentionally added. In addition, tensile strength is more than 690 MPa and the notch toughness at –196°C is over 55 J min.

The butt joint welding on a 28 mm thick plate in 3G position was conducted, and Table 2 shows the impact test result at –196° C and Figure 1, its macro section.

According to FISCO crack test results, shown in Figure 2, the crack-free zone has become much wider, even at faster welding speeds, when susceptibility to hot cracking becomes critical.

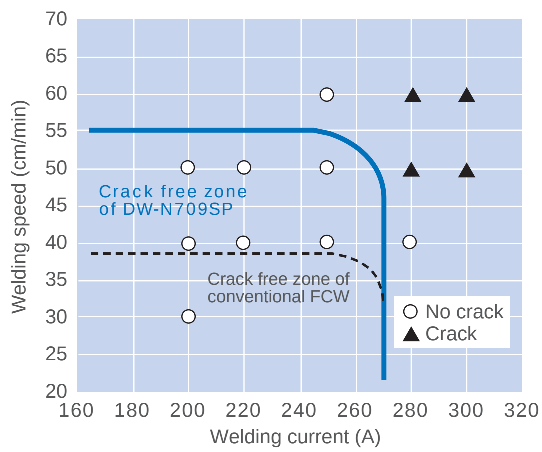


Figure 2: Results of FISCO crack test illustrate superior crack resistibility of DW-N709SP weld metal.

DW-S709SP is a rutile-type flux cored wire and is designed to achieve all position welding except 4G. Figure 3 shows a cross section of 4F position welding. And Figure 4 shows an example of slag removal.

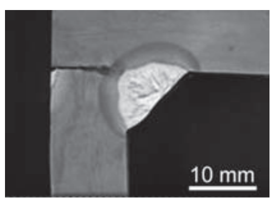


Figure 3: Cross section of fillet weld in 4F position shows smooth weld toes. (Wire diameter: 1.0 mmØ; Welding parameters: 180A-27V-14cm/min.)

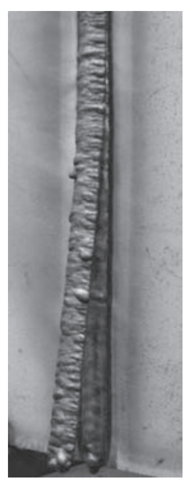


Figure 4: Self-peeling slag removal can save postweld cleaning time (Welding position: vertical)

[Note: Hastelloy is a trademark of Haynes International.]

With a Strong Managerial Foothold,
We can Overcome Economic Difficulties

Toshiyuki Okuzumi
General Manager
ISMD
Welding Business
Kobe Steel, Ltd.

To our dearest readers! Around the end of March this year, all of Tokyo was covered with the full bloom of cherry blossoms. On a weekend while the cherry trees were in full bloom, I fully enjoyed walking through Asakusa and along the Sumida River, well-known sight-seeing spots in Tokyo, and also enjoyed watching lots of flower viewers. On another day, many people were impressed when the new tower called "Tokyo Sky Tree" was lit up with beautiful cherry blossoms. This TV tower has just surpassed the 333m Tokyo Tower in height, and become a hot topic of conversation. When it is completed in 2012, it will stand an incredible 634 m high. When I see the new tower growing taller each day, I feel as if it is giving me a dream and a hope that our business may expand like the tower. We have every reason to believe the new tower will become a new center of attraction in Tokyo; and we'll be glad to welcome you to Japan for sight-seeing in the very near future.

Despite last year's economic slump and the resulting difficulties for our company, I am convinced that a slow and steady business recovery has started, (except in some emerging markets whose economies have remained in full gear). On the other hand, because raw material costs for iron ore or coking coal are now sky-high and we must do our best to cut costs or increase our prices. On the other hand, the future is not clear and unpredictable. We sincerely hope that everybody will understand these circumstances, work together to overcome the hard situation and steadily grow like "Tokyo Sky Tree" supported by a strong managerial foothold.

In the meantime, we have divided the old International Operations Department (IOD) into two new departments in order to be able to respond swiftly to overseas business inquiries that are expanding every moment. One is the International Sales & Marketing Department (ISMD), which is entirely devoted to sales and marketing, and the other is the new International Operations Department (IOD) which is engaged in managerial supports of overseas manufacturing plants or sales offices, and the planning of new businesses. It is our promise that we will respond to your requests in a timely manner. We ask you to give us your full support and cooperation to our new organization.

Heartfelt greetings to our dear readers! My name is Tsunehiro Ishihara, in charge of the China market as well as overseas advertising and publicity in the International Sales & Marketing Department. One of my duties is to publish the magazine "Kobelco Welding Today (KWT)." In the current issue, with news related to the China market, we introduce our two new subsidiaries for manufacturing and sales, KWQ and KWSH. And in the next KWT, we will report on Kobe Steel's participation in the Beijing Essen Welding & Cutting Fair, to be held from 27 May till 30 May 2010. It is my promise to prepare articles full of variety and information useful to our readers' businesses. We will do our best to meet your expectations and hope you could extend us your support.

Tsunehiro Ishihara
ISMD
Welding Business
Kobe Steel, Ltd.

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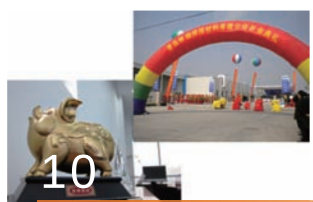

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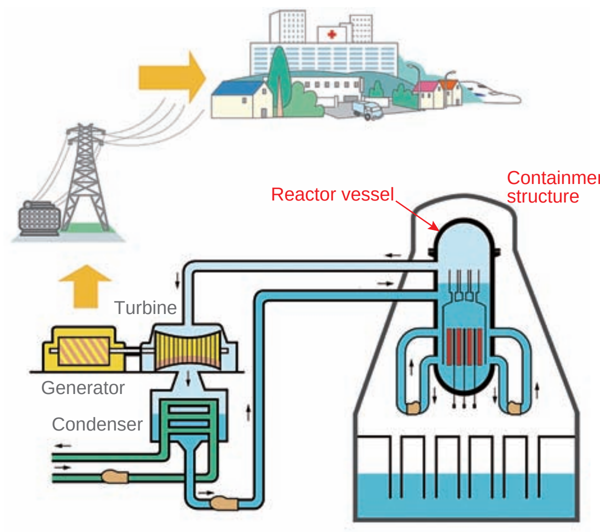
DESIGNING HIGH QUALITY WELDING CONSUMABLES FOR NUCLEAR POWER REACTORS



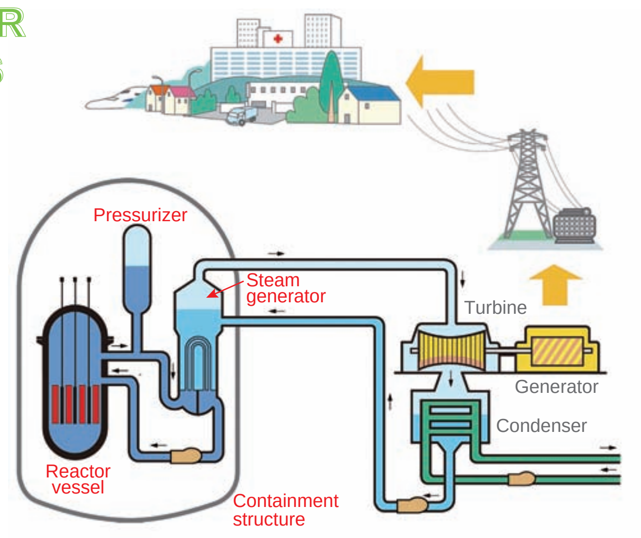


Figure 1: Nuclear power supply systems with a boiling water reactor (left) and with a pressurized water reactor (top).
[Source: Graphical Flip-chart of Nuclear & Energy Related Topics 2010 published by The Federation of Electric Power Companies of Japan].

Nuclear power, increasingly highlighted as a cleaner source of energy than fossil fuels, is seeing a brisk rise in power plant construction, particularly in Asian countries. This article introduces the special steels and welding consumables required for nuclear power plant construction.

Systems of Nuclear Power Generation

The electricity derived from nuclear power is a form of heat energy, generated by the fission chain reaction of enriched uranium in a reactor vessel, which is transferred to a coolant that produces the steam that rotates a turbine.

There are several types of nuclear reactors, utilizing different moderators and coolants, as shown in Table 1. Figure 1 (left) shows a typical diagram of boiling water reactor (BWR) and Figure 1 (top), a pressurized water reactor (PWR). Both are light water reactors (LWR), the most common types of nuclear reactors.

Table 1: Types of nuclear reactors

Reactor	Fuel	Moderator	Coolant	Note
Light water reactor	Enriched uranium	Light water	Light water	▪ BWR ▪ ABWR ▪ PWR
Gas cooled reactor	Natural or enriched uranium	Graphite	CO_2	▪ AGR ▪ Calder Hall AGR
Heavy water reactor	Natural or enriched uranium	Heavy water	▪ CO_2 ▪ Light water ▪ Heavy water	
Hot gas reactor	Enriched uranium	Graphite	Helium	
Fast breeder reactor	Enriched uranium or Plutonium	None	▪ Sodium ▪ Na-K alloys	FBR

Nuclear Pressure Vessel Codes

While each country defines its own regulations for its nuclear industries, the ASME codes of The American Society of Mechanical Engineering are widely adopted. ASME Sec. III Div. 1 (Nuclear Power Plant Components) and ASME Sec. XI (Rules for Inservice Inspection of Nuclear Power Plant Components); these codes specify in-depth requirements in terms of design, fabrication, test, inspection, and quality assurance. In particular, fracture toughness is one of the key requirements for materials because it governs the resistance to brittle fracture. For example, Table 2 shows the criteria for evaluating Reference Nil Ductility Transition Temperature (RT_{NDT}) obtained through the fracture toughness tests for ferritic materials such as Mn-Mo-Ni steel and weld metal.

Table 2: Criteria for evaluating RT_{NDT} in ferritic materials such as Mn-Mo-Ni steels and weld metals

Testing method	Evaluation criteria
Drop weight test	Temperature, 5°C lower than the lowest temperature where both of 2 drop weight test pieces are judged as no-break, is defined as T_{NDT}.
Charpy impact test	When all of 3 pieces in a Charpy impact test at the temperature equal to or lower than T_{NDT} + 33°C satisfy the following conditions, T_{NDT} is defined as RT_{NDT}: (1) Absorbed energy is 68 J minimum. (2) Lateral expansion is 0.90 mm minimum.

Specifications for Steels for Nuclear Reactors

Nuclear reactors consist of reactor pressure vessels (RPV); steam generator (SG) and pressurized used only in PWRs; the piping of the primary side cooling; and the containment structure. An RPV operates at high temperatures and high pressures; hence, its components are made of heat resistant steel, namely Mn-Mo-Ni steels as per ASME Sec. II Part A (Ferrous Material Specifications). SA-533 and SA-508 are commonly used for the RPV, as well as the pressurizer and SG in PWRs. Table 3 shows the chemical and mechanical properties and the relevant JIS standards for reference.

For the piping of the primary side cooling system, 304L type stainless steel and Ni-base alloys are mainly used, because of their anti-corrosion properties, high notch toughness and good weldability.

Table 3: Chemical and mechanical properties of steels for reactor pressure vessel

ASME spec	SA-533		SA-508	
Type or grade	Type B		Gr. 2	Gr. 3
Class	1	2	1	1
C (%)	≤ 0.25	≤ 0.25	≤ 0.35	≤ 0.75
Si	0.15-0.40	0.15-0.40	0.15-0.35	0.15-0.35
Mn	1.15-1.50	1.15-1.50	0.40-0.90	0.50-0.90
P	≤ 0.035	≤ 0.035	≤ 0.025	≤ 0.025
S	≤ 0.04	≤ 0.04	≤ 0.025	≤ 0.025
Ni	0.40-0.70	0.40-0.70	≤ 0.4	0.50-1.00
Cr	-	-	≤ 0.25	0.25-0.45
Mo	0.45-0.60	0.45-0.60	≤ 0.1	0.55-0.70
V	-	-	≤ 0.05	≤ 0.05
0.2%YS (MPa)	≥ 345	≥ 485	≥ 345	≥ 345
TS (MPa)	550-690	620-795	550-725	550-725
El (%)	≥ 18	≥ 16	≥ 18	≥ 18
RA (%)	-	-	≥ 38	≥ 38
IV at +4.4°C (J)	-	-	Each ≥ 34 Avg ≥ 41*1	Each ≥ 34 Avg ≥ 41*1
Relevant JIS standard	JIS G 3120 SQV 2 A	JIS G 3120 SQV 2 B	JIS G 3204 SFVQ 2 A	JIS G 3120 SFVQ 1 B

*1: The computed average for three specimens.

Specifications for Welding Consumables

When a nuclear power plant is constructed per ASME Sec. III, the welding consumables must be selected in compliance with ASME Sec. II Part C (Specifications for Welding Rods, Electrodes and Filler Metals), and the welding procedures must be qualified under ASME Sec. IX (Welding and Brazing Qualifications). Because all the welding consumables specified in ASME Sec. II Part C are identical to those in the AWS standard, this article will discuss welding consumables per the AWS standard.

Because safety is of paramount concern in nuclear power generation, the welding consumables must be reliable and have enough strength to withstand at elevated temperatures during operation, low temper embrittlement in case of emergency shutdown, high resistance to neutron irradiation brittleness, and good weldability.

Table 4 shows how welding consumables are matched to Mn-Mo-Ni steels. The welding consumables are divided into two tensile strength classes, 620 and 690 MPa, depending on the applicable steels. The typical chemical and mechanical properties of weld metals by 620 MPa and 690 MPa welding consumables can be seen in Tables 5 and 6, respectively.

Table 4: **TRUSTARC**™ welding consumables categorized by tensile strength level for Mn-Mo-Ni steels

	Tensile strength class of welding consumable			
	620 MPa class		690 MPa class	
Applicable steels (ASME)	SA-533 Type B Cl.1 SA-508 Gr.2 Cl.1 SA-508 Gr.3 Cl.1		SA-533 Type B Cl.2	
Welding process	Trade desig.	AWS class.	Trade desig.	AWS class.
SMAW	**BL-96**	A5.5 E9016-G	**BL-106**	A5.5 E10016-G
SAW	**MF-27X/ US-56B**	A5.23 F9P4-EG-G	**MF-29AX/ US-63S**	A5.23 F10P2-EG-G
	PF-200/ US-56B	A5.23 F9P4-EG-G	**PF-200/ US-63S**	A5.23 F10P2-EG-G
GTAW	**TG-S56**	A5.28 ER80S-G	**TG-S63S**	A5.28 ER90S-G

Note: MF-27X is a fused flux, while PF-200 is a bonded flux.

Table 5: Typical chemical and mechanical properties of weld metals (620 MPa class welding consumables)

Welding process	SMAW		SAW				GTAW	
Trade designation	**BL-96**		**MF-27X/ US-56B**		**PF-200/ US-56B**		**TG-S56**	
Polarity	AC*1		AC*1		AC*1		DCEN	
C (%)	0.06		0.08		0.08		0.05	
Si	0.54		0.28		0.11		0.41	
Mn	1.30		1.05		1.23		1.54	
P	0.005		0.009		0.007		0.008	
S	0.004		0.004		0.003		0.006	
Cu	0.02		0.08*2		0.08*2		0.15*2	
Ni	0.37		0.87		0.83		0.66	
Cr	0.02		0.06		0.02		0.03	
Mo	0.53		0.50		0.43		0.52	
Co	0.005		0.005		0.005		0.005	
PWHT (°C×hr)	620×1	600×16	595×3	635×26	590×3	620×11	620×1	650×15
0.2%YS (MPa)	620	575	528	480	580	490	520	499
TS (MPa)	700	667	618	560	669	580	590	564
El (%)	26	25	33	32	28	30	31	33
IV at 0°C (J)	150	149	-	-	-	-	-	-
IV at –10°C (J)	-	-	-	-	-	-	-	171
IV at –12°C (J)	-	-	174	180	-	-	290	-
IV at –18°C (J)	-	89	-	-	-	-	-	-
IV at –20°C (J)	-	-	-	-	189	210	-	-
IV at –40°C (J)	-	-	137	-	142	-	-	204
RT_{NDT} (°C)	-	–35	–55	-	-	-	-	–70

*1 Only for AC. Not recommended for DC.
*2 Inclusive of Cu coating.

Table 6: Typical chemical and mechanical properties of weld metals (690 MPa class welding consumables)

Welding process	SMAW		SAW				GTAW	
Trade designation	BL-106		MF-29AX/ US-63S		PF-200/ US-63S		TG-S63S	
Polarity	AC*1		AC*1		AC*1		DCEN	
C (%)	0.10		0.10		0.08		0.09	
Si	0.53		0.21		0.10		0.32	
Mn	1.41		1.49		1.51		1.23	
P	0.009		0.006		0.007		0.006	
S	0.005		0.005		0.004		0.006	
Cu	0.02		0.07*2		0.06*2		0.18*2	
Ni	0.76		1.35		1.31		1.58	
Cr	0.04		0.17		0.14		0.04	
Mo	0.50		0.51		0.47		0.40	
Co	0.005		0.005		0.005		0.003	
PWHT (°C×hr)	595× 3	613× 15	595× 3	612× 15	590× 3	600× 16	620× 1	635× 16
0.2%YS (MPa)	670	561	640	589	620	552	570	563
TS (MPa)	770	657	740	691	700	641	620	636
El (%)	28	26	28	22	28	28	28	29
IV at 0°C (J)	110	170	-	-	-	-	-	-
IV at –10°C (J)	-	-	-	-	-	-	-	166
IV at –12°C (J)	-	-	120	105	-	-	-	-
IV at –15°C (J)	-	-	-	-	-	235	-	-
IV at –20°C (J)	-	-	-	-	170	-	-	-
IV at –30°C (J)	-	111	-	52	-	-	-	-
IV at –40°C (J)	-	-	89	-	124	-	-	195
IV at –47°C (J)	-	-	-	-	-	-	200	
RT_{NDT} (°C)	-	–45	-	–45	-	–18	-	–70

*1 Only for AC. Not recommended for DC.
*2 Inclusive of Cu coating.

Several basic design concepts apply to welding consumables for Mn-Mo-Ni steel. One is to add Si, Mn, Ni and Mo to the weld metal in the same manner as the steel, in order to increase the quench-hardenability and to obtain the ferrite-bainite, bainite or bainite-martensite microstructure. Another is the addition of carbon. Carbon increases quench-hardenability and decreases the oxygen content in the weld metal, resulting in better notch toughness. But excessive carbon can also promote brittleness through carbide precipitation (e.g. cementite) during PWHT as well as reduce crack resistance. Therefore, the weld metal's carbon content is controlled to a slightly lower level as compared to the base metal. A third design concept is to minimize such impurities as P and Sn in order to avoid embrittlement of weld metal induced by PWHT. The increase of basicity, particularly on SAW flux, is yet another design concept, whereby the oxygen content in the weld metal is decreased, thereby obtaining high notch toughness. For example the use of TRUSTARC™ PF-200 (a bonded flux) in lieu of TRUSTARC™ MF-27X (a fused flux) obtains higher basicity and thus better notch toughness, as shown in Figure 3.

Increasing the crack resistance of the welding consumables is important to resist the residual stresses induced by welding in a thick pressure vessel. Controlling the S and C content will prevent hot cracks, and minimizing the diffusible hydrogen content will increase the resistance to cold cracks. In particular, the coverings of SMAW electrodes are designed to lessen the moisture absorption, one major source of diffusible hydrogen. As shown in Figure 4, the moisture resistant SMAW electrode offers slow moisture pickup, reducing diffusible hydrogen in the weld metal.

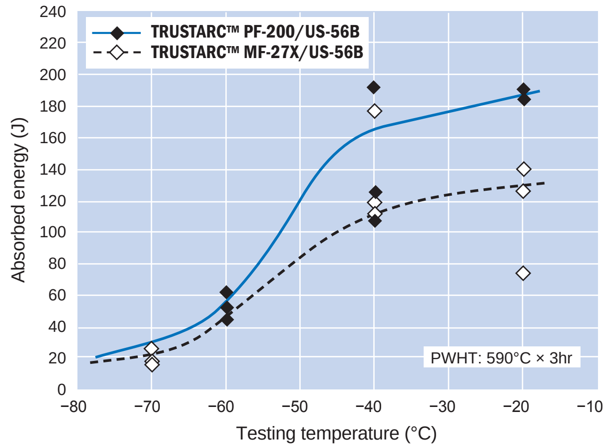


Figure 3: Comparison of notch toughness between fused flux and bonded flux.

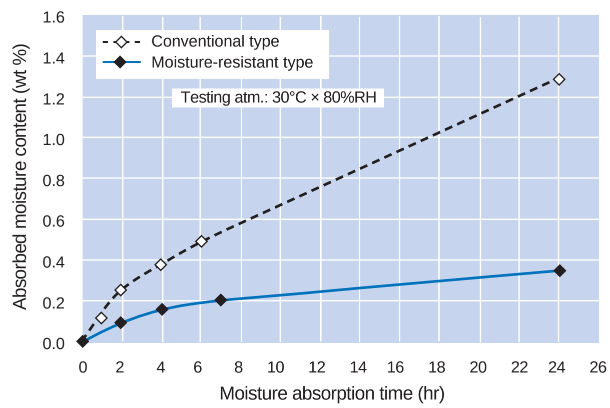


Figure 4: Comparison of moisture absorption rates between conventional and moisture-resistant coverings.

Another basic design concept is to consider neutron irradiation embrittlement and induced radioactivity resistance in relation to both weld metal and base metal. Because neutron irradiation embrittlement occurs in the belt line region of RPVs during operation, it is an important factor for not only steel but also weld metal. Cu and P, which enhance neutron irradiation embrittlement and such elements with high induced radioactivity as Co and Nb are reduced as low as possible. As a matter of fact, Non-Cu-coated SAW wires are now available.

The inner surfaces of an RPV, SG and the primary side piping constitute a severe corrosive environment due to the circulating cooling water contaminated with radioactive elements. The inner surface, in direct contact with the coolant, is overlay-welded with welding consumables for stainless steels or Ni-base alloys in order to protect it from corrosion.

On the shell and end plate inner surfaces of a large RPV, the efficient SAW or ESW mode overlay welding with strip electrode is applied. On the inner surfaces of pipes and nozzles, GTAW and GMAW are used. The concepts and the processes of overlay welding with strip electrode in the two modes are shown in Figures 5 and 6, respectively. The ESW mode is characterized by shallow penetration that reduces dilution by the base metal, thereby providing a low carbon weld with better corrosion resistance. The SAW mode offers low heat input due to faster welding speed; hence, it is a more favorable process for the base metal, which is susceptible to under-clad cracking (UCC).

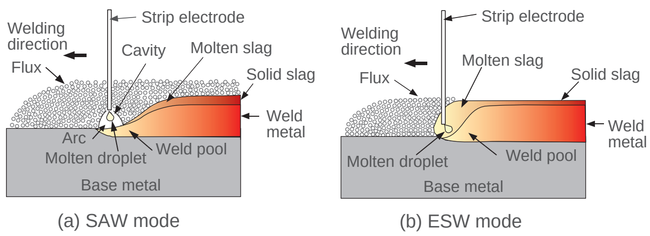


Figure 5: Concepts of overlay welding processes (SAW and ESW) with strip electrodes.

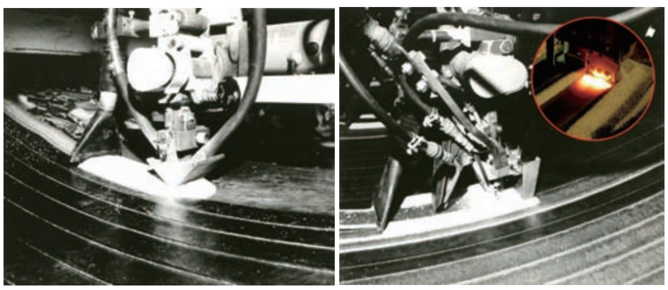


Figure 6: SAW process (left) and ESW process in operation on the inner surface of pressure vessels.

Table 7 shows fluxes and strip electrodes for 304L weld metal by SAW and ESW mode overlay welding and the typical chemistries and ferrite numbers (FN per WRC diagram) of overlaid weld metals.

Table 7: SAW and ESW fluxes and strip electrodes for 304L weld metal and the chemistries and ferrite numbers of overlaid weld metals

Process	SAW		ESW	
	Single layer*1	2nd layer	Single layer*1	2nd layer
Trade desig.*2	**PF-B1/US-BQN309L**	**PF-B1/US-BQN308L**	**PF-B7FK/US-BQN309L**	**PF-B7FK/US-BQN308L**
AWS class.	A5.9 EQ309L	A5.9 EQ308L	A5.9 EQ309L	A5.9 EQ308L
Polarity	DCEP	DCEP	DCEP	DCEP
C (%)	0.030	0.028	0.018	0.015
Si	0.67	0.65	0.53	0.54
Mn	1.14	1.05	1.36	1.14
P	0.018	0.019	0.017	0.020
S	0.004	0.005	0.002	0.004
Cu	0.04	0.05	0.05	0.03
Ni	12.65	10.21	12.80	10.35
Cr	23.05	19.75	23.65	19.87
V	0.05	0.04	0.05	0.04
Co	0.04	0.04	0.04	0.04
N	0.041	0.019	0.048	0.020
FN*3	12	9	15	11

*1 For a single layer process or underlayer in a multilayer process.
*2 Strip size available: 0.4 mm thick × 25, 50, and 75 mm wide.
*3 Per WRC diagram.

Table 8 shows SMAW and GTAW consumables for 304L overlay weld metal and the chemistries of the undiluted deposited metal. Table 9 shows Ni-base alloy welding consumables for SMAW and GTAW and the chemical and mechanical properties of undiluted deposited metal.

Table 8: SMAW and GTAW consumables for overlaying 304L weld metal and the chemistries and ferrite numbers of undiluted deposited metals

Process	SMAW		GTAW	
Trade desig.	**NC-39L**	**NC-38L**	**TG-S309L**	**TG-S308L**
AWS class.	A5.4 E309L-16	A5.4 E308L-16	A5.9 ER309L	A5.9 ER308L
Polarity	DCEP or AC	DCEP or AC	DCEN	DCEN
C (%)	0.023	0.029	0.012	0.007
Si	0.51	0.20	0.41	0.36
Mn	1.56	1.44	1.74	1.91
P	0.021	0.019	0.009	0.016
S	0.003	0.004	0.003	0.003
Cu	0.03	0.03	0.02	0.02
Ni	12.46	10.24	12.29	10.26
Cr	23.92	20.31	23.76	19.86
V	0.05	0.05	0.05	0.05
Co	0.04	0.04	0.05	0.02
N	0.053	0.050	0.048	0.043
FN*1	16	8	14	9

*1 Per WRC diagram.

Table 9: SMAW and GTAW consumables for Ni-base alloys and the chemical and mechanical properties of undiluted deposited metals in the as-welded condition

Process	SMAW	GTAW
Trade designation	**NI-C703D**	**TG-S70NCb**
AWS classification	A5.11 ENiCrFe-3	A5.14 ERNiCr-3
Polarity	DCEP	DCEN
C (%)	0.06	0.02
Si	0.34	0.18
Mn	6.55	2.93
P	0.004	0.001
S	0.003	0.002
Ni	69.40	71.64
Cr	13.21	20.20
Nb+Ta	2.00	2.33
Fe	7.90	1.50
Ti	0.01	0.55
Co	0.03	0.02
0.2%YS (MPa)	360	370
TS (MPa)	620	680
El (%)	45	40
IV at –196°C (J)	110	150

Reactor pressure vessels require an integrated manufacturing technique wherein base metals are matched with welding consumables of high and consistent quality.

References:
[1] Kobe Steel: Welding Technical Report, Vol.49 2009-4.
[2] Kobe Steel: Welding of Nuclear Power Equipment, 1990.


Kobelco Shines at the International Essen Welding & Cutting Fair in 2009

Despite global economic difficulties, the 17th International Essen Welding and Cutting Fair (Essen Fair) was held from September 14 to 19, 2009 in Essen, Germany. 1,015 exhibitors from 42 countries displayed the most comprehensive welding and cutting products in the 100,000 m^2 space at Messe Essen.

Almost 60,000 welding and cutting experts from all over the world visited the Essen Fair to learn about the latest joining, cutting and coating technologies, many of which were presented in live demonstrations. At the Kobelco booth, linguistic differences did not impede communications in the demonstration featuring Mr. Pascal Douma, Dutch Sales Manager of Kobelco Welding of Europe B.V. (KWE), and ARCMAN™ of Japan, Kobe's welding robot. In addition to dancing and talking to Pascal, ARCMAN™ performed outstanding fillet welds at high speed, with a result that amazed the visitors.

Pascal and ARCMAN™, talking in different languages (right).

The live demonstration by ARCMAN™, a robotic welding system, attracted many to the Kobelco booth (left).

Representing Kobelco Welding at the Essen Fair was KWE, Kobe Steel's subsidiary based in the Netherlands. Naturally the main focus was on the flux cored wires (FCWs) for carbon steel and stainless steel that KWE manufactures in the Netherlands.

Another area of focus was our customer commitment "QTQ" — Quality Products, Technical Support, and Quick Delivery. In a market environment that is becoming ever more competitive, the quality of our products, our ability to help customers to use them, and last but not least, delivering the materials on time are essential factors for success. All of these commitments have one common target: to make sure that customers using Kobelco products are more efficient, more productive and more cost-effective than their competitors.

Posing in front of the Kobelco slogan "QTQ" is Mr. Yokota, Research Engineer, Welding Business, Kobe Steel, Japan.

At the Essen Fair, the presentation of new products drew an excellent response from the visitors. Here are some examples of the new products presented at the fair.

TRUSTARC™ DW-A80L, a newly developed rutile type FCW for high tensile strength steels, (YS 690MPa), used for offshore and onshore oil drilling rig fabrication, crane construction, as well as bridges, excavators, and trailers. Because of concerns that customers have had with currently available products, such as notch toughness in low temperature service and crack resistance, this new flux cored wire drew much interest from a large number of fabricators. TRUSTARC™ DW-A80L has proven itself in a job at an offshore fabricator, together with the new metal cored wire, TRUSTARC™ MX-A80L. The latter was developed for the same applications, but is mainly used in flat position welding (1G & 1F) and in horizontal fillet welding (2F) in order to increase productivity.

The brand new wire for super duplex stainless steel, PREMIARC™ DW-2594 for all position welding, was also on display. This FCW will complete our range for duplex stainless steels together with PREMIARC™ DW-329A & DW-329AP, and the new PREMIARC™ DW-2101 designed for LDX 2101®, or Lean Duplex materials. Super duplex stainless steel materials are widely used in offshore and onshore construction, oil & gas handling equipment, oil refineries, and sea-water desalination plants. Introducing the new FCWs for duplex stainless steels means that KWE can offer products to suite applications and materials used by these demanding industries.

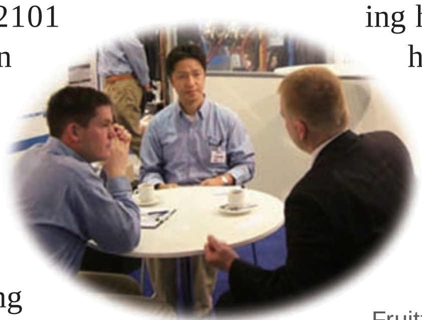
Also displayed at the Essen Fair was Ni-base alloy FCW "PREMIARC™ DW-N625," an important addition to our large family of product ranges. There was great interest in this FCW because it allows all position welding on base materials ranging from 254 SMO®, 9% Ni steels for LNG storage tanks to crack sensitive steel grades. It was clear that many industries would have applications for PREMIARC™ DW-N625.

The work environment is a growing critical issue in the industry. One way to improve the work environment is to cut fume emissions generated from metal cored wires during welding. To that end we introduced FAMILIARC™ MX-A70C6LF which reduces total fume emissions by 30% over conventional wires. It will surely reduce fume levels in workshops and other confined areas.

As mentioned above, we also displayed the ARCMAN™ robot, who performed tandem arc welding, utilizing the unique Dual-Arc sensing technology developed by Kobelco Welding System. This technology significantly reduces weld defects such as undercut — a common problem in tandem arc welding — on the top of fillet welds. The team from Kobelco Welding System put on a magnificent show, not only producing top quality welds, but also having ARCMAN™ answer the question: Are you ready ARCMAN™? Amazingly, ARCMAN™ answered with a nod and started to weld.

The Kobelco Team did a magnificent job throughout the week, with long days, and sometimes even long nights. Even so, the team kept smiling and I believe all visitors felt a warm welcome in our booth.

We wish to thank all the visitors for their genuine interest in our solutions to the challenges of creating high quality welds. We do hope they had an interesting and useful visit to our booth, and that we will see you all again at the 18th International Essen Welding and Cutting Fair in 2013.



Fruitful discussions
with interested visitors.

The Kobelco team, who did a magnificent job throughout the week over long days and even long nights.

Reported by Jorn Ellingsen
Business Development General Manager
KWE

2009 AWS Welding Show in Chicago
KWAI's 20th year of participation

The 2009 FABTECH International & AWS Welding Show was held at McCormick Place in Chicago, Illinois, from November 15 to 18, 2009 for 4 days. Because the fair is held in Chicago every other year and because of the continuing economic crisis, it was feared that attendance would be drastically less than at last year's show in Las Vegas. However, 1,083 companies from 27 countries exhibited and about 25,000 people from more than 90 countries participated in the show. Kobelco Welding of America Inc (KWAI), in its 20th year of participation, introduced the latest welding consumables to many visitors.

New products on display included: Ni-base alloy flux cored wires "PREMIARC™ DW-N625," "PREMIARC™ DW-NC276," and "PREMIARC™ DW-N82," "PREMIARC™ DW-2594" for super duplex stainless steel, as well as a flux cored wire "TRUSTARC™ DW-A80L" and a metal cored wire "TRUSTARC™ MX-A80L" — both for 780MPa class tensile strength steel. Another metal cored wire for 490MPa class carbon steel, "FAMILIARC™ MX-A70C6LF" was also introduced. MX-A70C6LF had been developed especially for the USA market, based on market research carried out there. Reflecting customer needs, this wire was designed to reduce fume emissions and spatter generation to the lowest levels ever. It is rated highly in such major markets as Canada, Eastern and Midwestern USA, and it attracted a lot of attention at the AWS Show as well.

The 2010 FABTECH International & AWS Welding Show will be held in Atlanta, Georgia on November 2–4, and once again KWAI plans to display the most innovative welding consumables and welding technology.

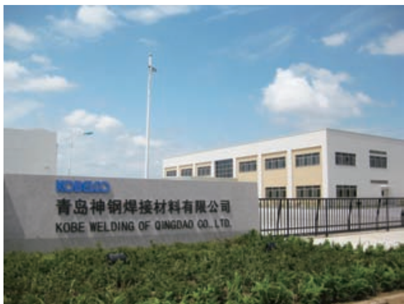
Reported by
Yuji Wakayama
National Marketing Manager
KWAI

Top: Many visitors were welcomed at the entrance to the AWS Welding Show.
Middle: The Kobelco booth, focused on highly competitive flux cored wires.
Bottom: FAMILIARC™ MX-A70C6LF highlights extremely low fume and spatter.

KOBE WELDING OF QINGDAO

...the production & sales base
supporting continuous growth
in the shipbuilding industry

Kobe Welding of Qingdao Co., Ltd. (KWQ) was established in February 2008 under the joint investment of Kobe Steel, Ltd., Shinsho Corp., Sojitz Marine & Engineering Corp., and Tokokosen Corp.



Views of KWQ from its entrance (left) and factory (below).

The city of Qingdao, where KWQ is located, is a summer resort in northeastern China famous for its scenic beauty. It is also one of China's economic centers that attract foreign investment from such countries as Japan and Korea.

With such a background, KWQ was set up to produce and sell a range of flux cored wires that are in growing demand from shipbuilders and offshore/onshore oil drilling rig fabricators. KWQ began production in the autumn of 2009 and established a firm distribution network.

KWQ will contribute to the development of the shipbuilding industry in China under the slogan "KWQ will grow together with customers as the most reliable partner, by supplying both products and services that are No.1 quality in China."

KWQ opening ceremony began with inaugural address (above) and cheerful party (left) on April 16, 2010.

KOBE WELDING OF SHANGHAI

...the sales & marketing base
for welding consumables
and robot systems
for the demanding jobs

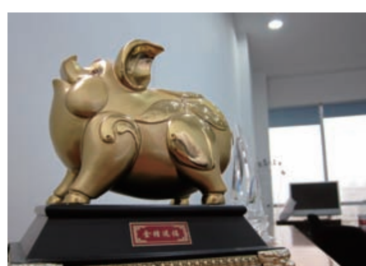
Kobe Welding of Shanghai Co., Ltd. (KWSH) was established in and started sales and marketing from April 2010. It is 100 % owned by Kobe Steel, Ltd.

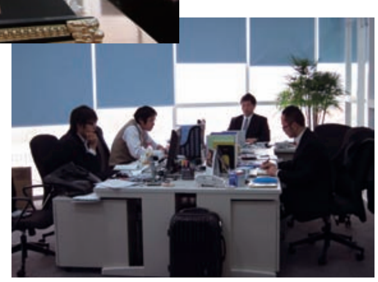
KWSH engages in sales and technical service of high value-added welding consumables and of robotic welding systems. These welding consumables have highly been evaluated and used for a long time by fabricators of such energy-related equipment as pressure vessels, boilers, crude oil storage tanks.

Kobelco robotic welding systems, comprising the most innovative technologies, are appreciated by clients in the construction machinery fields. KWSH provides not only sales and technical service but also maintenance and spare parts supply.

KWSH will do its best to gain high satisfaction from customers by supplying high-quality welding consumables, as well as robotic welding systems. And we see our contribution as a force in the development of the Chinese industries.

Posing are (front row, from left) KWSH President Kimata, General Manager Ding, Technical Director Maruyama, and their staff members.





Chinese beckoning pig (left) inviting successful business in the office (below).

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