KOBELCO WELDING TODAY

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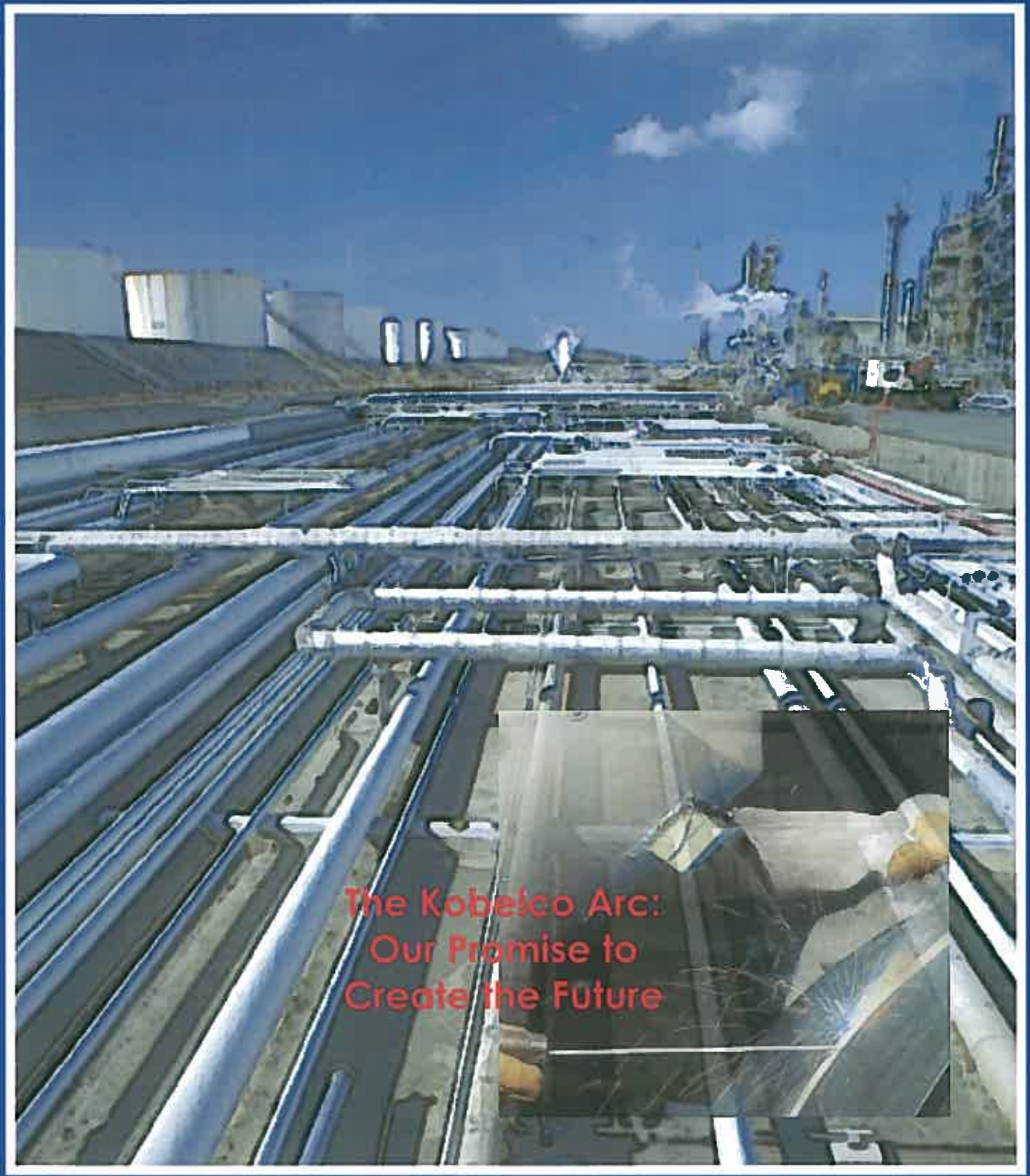

SMOE: A Leader in Offshore Oil and Gas Engineering and Construction

Singapore comprising just 622-km^2 of land at the tip of the Malaysia peninsula is a vibrant country that has the modern and multicultural faces of the New Asia. It has also been a strategic location for offshore oil and gas engineering and construction for the last thirty years. Today, Singapore is a world class leader in this field.

SMOE Pte Ltd (SMOE) is the oil and gas subsidiary of SembCorp Utilities that is the wholly owned utilities arm of the engineering services group, SembCorp Industries. Since its inauguration in 1973, SMOE, as an Engineering, Procurement, Installation and Construction (EPIC) contractor, has been a leader in executing EPIC projects for the oil and gas industry and has worked in the design, procurement, fabrication, installation and commissioning of offshore platforms, modules, and floating production systems for clients worldwide.

SMOE operates one of the finest fabrication facilities involved in the oil and gas industry. Clear access to open sea, construction areas of over 225,000 m^2 and a 14.6-m deep berth side provide SMOE with enviable facilities. The quayside construction sites are capable of fabricating and off-loading structures of up to 17,000 tons. Four dry docks can handle the largest VLCCs. These facilities enable conversion and integration of Floating Production, Storage and Offloading Facilities (FPSO) turrets, mooring systems and process systems in one fabrication yard.

Workshops covering an area of 21,000 m^2 are situated adjacent to the construction sites. These cater to various types of fabrication, including the modularized process equipment, pressure vessels and structure sub-assemblies, specialist electrical instrumentation and corrosion protection work. Controlled welding processes are employed to enhance welding for a range of exotic materials, including duplex stainless steel, copper nickel and titanium. Climate-controlled storage is available.

SMOE's clients include the world's major oil and energy companies such as Shell, ExxonMobil, ChevronTexaco, ConocoPhillips, TotalFinaElf, Occidental, Marathon and Unocal to whom a complete range of offshore production facilities have been delivered. These facilities include

- Integrated production platforms
- Compression, water injection and power generation modules
- Wellhead and riser platforms

Left: The production platform for the Malampaya Deep Water Gas-to-Power project, for separation and condensation of the gas from water (Courtesy of Shell Philippines Exploration B.V. and SMOE)

Right: The Balal-PJ Platform consists of process and living quarters platform and wellhead platform

- Living quarters and pre-assembled modules
- Sub-structures
- A complete range of FPSO topside facilities

SMOE has delivered more than 100 projects in its 30-year history. The company is currently contracting thirteen topsides modules for FPSO of Esso Exploration and Production Nigeria, under sub-contract to Saipem S.A.; it is also under contract to provide an offshore production platform for Occidental Petroleum Company of Qatar, as well as a sour process platform for the PTT Exploration and Production Company. Work on the second North Sea platform of Maersk Oil and Gas AS has also commenced.

In May, SMOE successfully loaded out a drilling/wellhead platform and a living quarters platform for Devon Energy in China's Panyu 4-2 and 5-1 fields. Both process and living quarters platforms of Maersk Oil and Gas Denmark have also been loaded out and will soon sail away for the Halfdan field, off the shore of Denmark.

Kobe Welding Singapore (KWS), since its establishment in 1979, has been a business associate of SMOE, supplying KWS-made covered electrodes such as LB-52U and LB-52-18, as well as special welding consumables such as LB-52NS for high strength and low temperature steel imported from the Kobelco Group companies outside Singapore. The business association with SMOE for Half Dan and Dan FG projects has been one of the greatest successes in our long lasting customer relationships. With the oncoming ERHA project, we will endeavor to add value and be a leading supplier to SMOE by providing quality products with outstanding technical support and quick delivery, following the Kobelco's business slogan, QTQ.

Reported by **Kumar**, KWS

☐ Message from the Editor ☐

Dear Readers:

How are you these days? As with many of you, I have been very anxious about the world-wide health threat, SARS or Severe Acute Respiratory Syndrome. It is also worrying to hear that the development of a vaccine against the new virus causing SARS will take at least five years. I wonder how hard the infectious virus will hit the global economies, causing sluggish international trade, a sharp decline in overseas travelers, or the shutting down of factories. In my business, I am now often obliged to hesitate to send my staff to overseas countries, particularly to WHO-alerted/advised areas. Even if a vaccine were developed and effective medicines to cure people suffering from the pneumonia would be available in the future, it is possible that new viruses might appear, as a result of the circle of viruses and antiviral measures. Therefore, what we can only do is to keep individual, nationwide and worldwide environments as clear as is practical to overcome such an epidemic spread through the globalization of life styles and business.

Meanwhile, customers ' demands for KOBELCO welding consumables are diversifying in terms of upgrading to higher levels of mechanical properties, crack resistibility and usability, reducing fumes and spatter, or requiring quicker delivery. In order to cope with these various demands, we are hard at work to establish, quickly, a new procedure that will be prompt and guaranteed to provide individual customers with the best solutions. In addition, as a routine activity, we are always ready to deal effectively with welding problems customers may have.

General Manager

International Operations Department

Welding Company
Kobe Steel, Ltd.

Masakazu Tojo
Editorial Chairman

Calling from Tokyo

My greetings to dear readers of KOBELCO WELDING TODAY!

My name is Hiroyuki Kawasaki. Transferred to the International Operations Department just last April, I am in charge of ASEAN and Indian markets. Before coming to this Department, I belonged to the Technical Development Department, where I was mainly engaged in development of flux-cored wires for carbon steel. As the present job is entirely different from that of the previous job, there are many things that I have to learn and I am trying hard to acquire such new knowledge. I am also trying day in and day out to improve my ability in English conversation.

At the previous workplace, I used to wear a work uniform common to all the workers at the place. But now I am working in a business suit and with a necktie around my neck. So I feel as if I were a novice in the company. However, taking this new opportunity with a fresh mind, I am determined to make every effort to contribute to the customers of Kobe Steel ' welding materials the world over, though in a different way from that of a development engineer.

Hiroyuki Kawasaki
Assistant Manager
International Operations Dept.
Welding Company
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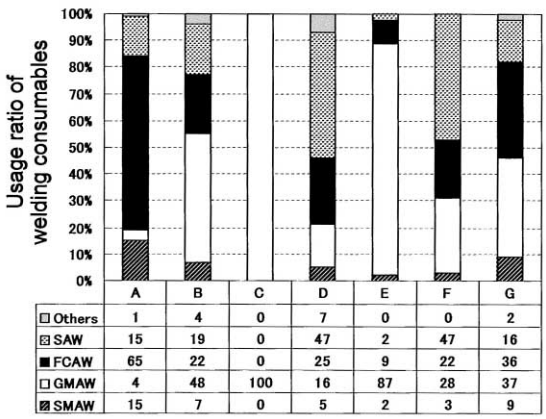
Contents

Kobelco Flux-Cored Wires Shine in Various Applications

The flux-cored-wire (FCW) era began in Japan in 1980 with an epoch-making flux-cored wire, named DW-100, that was developed by Kobe Steel in response to demand from leading shipbuilders. In shipbuilding, they had long desired a highly efficient, out-of-position welding process that could use high welding currents without adjusting the welding current for each welding position. Since DW-100 was accepted by the shipbuilding industry, demand for FCWs has increased and spread to such areas as buildings, bridges, boilers, storage tanks, and construction machinery—**Fig. 1**. Diversified demand has led Kobe Steel to develop new FCWs designed to suit the characteristics of particular applications. Today, Kobe Steel produces over one hundred different brands of FCWs for all sorts of applications. This article describes a number of FCWs to help customers and users select the most suitable wire for a particular application.



	A	B	C	D	E	F	G
Others	1	4	0	7	0	0	2
SAW	15	19	0	47	2	47	16
FCAW	65	22	0	25	9	22	36
GMAW	4	48	100	16	87	28	37
SMAW	15	7	0	5	2	3	9

Figure 1. Monthly usage ratio of welding consumables by welding process in different fields according to a 2000 survey of 194 fabricators in Japan
(Data source: Welding Technique, 2001 Vol. 49, Sanpo)

A: Ships and offshore structures, **B**: Buildings & bridges
C: Rolling stock & autos, **D**: Boilers & storage tanks
E: Industrial and electric machinery, **F**: Others, **G**: Av.

Kobelco FCWs can be Grouped into Three Types: Rutile, Basic, and Metal Type

Rutile type FCWs contain a core of rutile-based (titanium-oxide-rich) powdered materials or flux, which produce an extensive slag cover on the face of a weld bead under CO_2 or Ar-CO_2 shielding gas. Rutile type FCWs provide stable, gentle arcs, low spatter, self-peeling slag removal, and smooth bead appearance.

Basic type FCWs contain a core of lime-fluoride-based flux having a higher basicity than the rutile type to provide superior crack resistibility and notch toughness of the weld metal.

Metal type FCWs are characterized by a core of metal-based flux containing a high amount of metallic powders, which offer higher deposition rates than the rutile type. Some metal type FCWs generate extensive slag cover—but thinner than that of the rutile type—on the surface of the weld bead, which exhibits superior performance particularly in porosity resistibility in fillet welding of primer-coated steel plates. In contrast, some metal type FCWs, which are classified as metal-cored wire per AWS A5.18 and A5.28, produce as little slag as solid wires, producing no more than slag islands on the face of the weld bead. With MX-100, MX-100S and the metal-core wires, multiple-pass welding can be continuously conducted without removing the slag on each pass up to three passes of weld bead.

Kobelco Contributes with Diverse FCWs to the Welding Industry

Tables 1 through **7** show Kobelco's diverse FCWs categorized by applicable steel and alloy, type of cored flux, suitable shielding gas, applicable welding position, AWS classification and intended usage and features. For stainless steels, FCWs for gas tungsten arc welding (GTAW), classified as flux-cored rod per AWS A5.22, are also included.

Table 1. FCWs for Mild steel and 490MPa high strength steel

Type of cored flux	Suitable Shielding gas	Welding position	Brand name	AWS Classification	Intended usage and features
Rutile	CO_2	F,HF,H VU,OH VD	**DW-100**	A5.20 E71T-1	General uses
			DW-100V	A5.20 E71T-1	Excellent in vertical-up welding
			DW-110	A5.20 E71T-1	Excellent in horizontal fillet welding
		F,HF	**DW-200**	A5.20 E70T-1	Large-leg-length fillet welds
	Ar- CO_2	F,HF,H VU,OH,VD	**DWA-50**	A5.20 E71T-1M	General uses
	CO_2 or Ar- CO_2	F,HF,H VU,OH,VD	**FRONTIARC-711**	A5.20 E71T-1 / 1M A5.20 E71T-12 / 12M	Excellent in notch toughness
			DW-50	A5.20 E71T-1 / 1M	General uses (mainly with CO_2)
Basic	Ar- CO_2	F,HF,H VU,OH	**DWA-51B**	A5.20 E71T-5MJ	Excellent in notch toughness and crack resistibility
Metal	CO_2	F, HF	**MX-200**	A5.20 E70T-1	Excellent porosity resistibility to inorganic zinc primer
			MX-100	A5.20 E70T-1	High deposition rates
		F,HF,H	**MX-100S**	A5.20 E70T-1	Excellent in 7-16 mm thick plates, thinner slag
		F, HF	**MX-200H**	A5.20 E70T-1	High speed tandem welding in inorganic zinc primer-coated work
	Ar- CO_2	F, HF	**MXA-200**	A5.20 E70T-1M	Excellent porosity resistibility to inorganic zinc primer
		F, HF, H	**MXA-100**	A5.18 E70C-6M	High deposition rates
	CO_2 or Ar- CO_2	F,HF,H VU,OH	**MX-100T**	A5.18 E70C-6C / 6M	Excellent in thin plate welding

Table 2. FCWs for weather proof steel

Type of cored flux	Suitable Shielding gas	Welding position	Brand name	AWS Classification	Intended usage and features
Rutile	CO_2	F,HF,H VU,OH	**DW-50W**	-	ASTM A709 Gr. 36 or equivalent
			DW-588	A5.29 E81T1-W2	ASTM A588, A709 Gr. 50W, A242 or equivalent

Table 3. FCWs for 490-640MPa high-strength low-temperature steels

Type of cored flux	Suitable Shielding gas	Welding position	Brand name	AWS Classification	Intended usage and features
Rutile	CO_2	F,HF,H VU,OH	**DW-100E**	A5.20 E71T-9	Excellent in notch toughness at −29℃ or higher
			DW-55E	A5.20 E71T-9J	Excellent in notch toughness at −40℃ or higher
			DW-55L	A5.29 E81T1-K2	Excellent in notch toughness at −60℃ or higher
			DW-55LSR	A5.29 E81T1-K2	Excellent in notch toughness at −60℃ or higher in the as-welded and PWHT conditions
	Ar- CO_2	F,HF,H VU,OH	**DWA-55E**	A5.20 E71T-9MJ	Excellent in notch toughness at −40℃ or higher
			DWA-55ESR	A5.20 E71T-12MJ	Excellent in notch toughness at −40℃ or higher in the as-welded and PWHT conditions
			DWA-55L	A5.29 E81T1-K2M	Excellent in notch toughness at −60℃ or higher
			DWA-55LSR	A5.29 E81T1-Ni1M	Excellent in notch toughness at −60℃ or higher in the as-welded and PWHT conditions
			DWA-65L	A5.29 E91T1-K2MJ	Excellent in notch toughness at −40℃ or higher
Metal	CO_2	F, HF	**MX-55LF**	A5.20 E70T-9J	Excellent in notch toughness at −60℃ or higher and in porosity resistibility to inorganic zinc primer
	Ar- CO_2	F,HF,H VU,OH	**MXA-55T**	A5.28 E80C-G	Suitable for thin plate welding and excellent in notch toughness at −60℃ or higher

Table 4. FCWs for heat-resistant low-alloy steel

Type of cored flux	Suitable Shielding gas	Welding position	Brand name	AWS Classification	Intended usage and features
Rutile	CO_2 or Ar- CO_2	F,HF,H VU,OH	**DW-81B2**	A5.29 E81T1-B2 / B2M	Suitable for 1~1.25Cr-0.5Mo steel
			DW-91B3	A5.29 E91T1-B3 / B3M	Suitable for 2.25Cr-1Mo steel
	Ar- CO_2	F,HF,H VU,OH	**DWA-81B2**	A5.29 E81T1-B2M	Suitable for 1~1.25Cr-0.5Mo steel and better impact value than DW-81B2
			DWA-91B3	A5.29 E91T1-B3M	Suitable for 2.25Cr-1Mo steel and better impact value than DW-91B3

Table 5. FCWs for stainless steel

Type of cored flux	Suitable Shielding gas	Welding position	Brand name	AWS Classification	Intended usage and features
Rutile	CO_2 or Ar- CO_2	F, HF, H	**DW-308**	A5.22 E308T0-1 / -4	Suitable for 304 stainless steel
			DW-308L	A5.22 E308LT0-1 / -4	Suitable for 304L stainless steel
			DW-309	A5.22 E309T0-1 / -4	Suitable for dissimilar metal welding
			DW-309L	A5.22 E309LT0-1 / -4	Suitable for dissimilar metal welding, Low-C type
			DW-309MoL	A5.22 E309LMoT0-1 / -4	Suitable for dissimilar metal welding, Low-C type
			DW-316	A5.22 E316T0-1 / -4	Suitable for 316 stainless steel
			DW-316L	A5.22 E316LT0-1 / -4	Suitable for 316L stainless steel
			DW-329A	A5.22 E2209T0-1 / -4	Suitable for JIS SUS329J3L and ASTM S31803 stainless steel
		F,HF,H VU,OH,VD	**DW-308LP**	A5.22 E308LT1-1 / -4	Suitable for 304 and 304L stainless steel
			DW-309LP	A5.22 E309LT1-1 / -4	Suitable for dissimilar metal welding, Low-C type
			DW-309MoLP	A5.22 E309LMoT1-1 / -4	Suitable for dissimilar metal welding, Low-C type
			DW-316LP	A5.22 E316LT1-1 / -4	Suitable for 316 and 316L stainless steel
		F,HF,H VU,OH	**DW-308H**	A5.22 E308HT1-1 / -4	Suitable for 18Cr-8Ni stainless steel for high temperature service
			DW-308LH	A5.22 E308LT1-1 / -4	Suitable for 18Cr-8Ni stainless steel subject to high temperature heat treatment such as solution treatment
			DW-309LH	A5.22 E309LT1-1 / -4	Suitable for dissimilar metal welding for high temperature service and heat treatment
			DW-316H	A5.22 E316T1-1 / -4	Suitable for18Cr-12Ni-2Mo stainless steel for high temperature service
			DW-316LH	A5.22 E316LT1-1 / -4	Suitable for 18Cr-12Ni-2Mo stainless steel subject to high temperature heat treatment such as solution treatment
			DW-316LT	A5.22 E316LT1-1 / -4	Suitable for18Cr-12Ni-2Mo stainless steel for low temperature service
			DW-347H	A5.22 E347T1-1 / -4	Suitable for 18Cr-8Ni-Nb and 18Cr-8Ni-Ti stainless steel for high temperature service
			DW-329AP	A5.22 E2209T1-1 / -4	Suitable for JIS SUS329J3L and ASTM S31803 stainless steel
		F,HF	**DW-308LT**	A5.22 E308LT0-1 / -4	Suitable for 18Cr-8Ni stainless steel for low temperature service
			DW-310	A5.22 E310T0-1 / -4	Suitable for 25Cr-20Ni stainless steel
			DW-317L	A5.22 E317LT0-1 / -4	Suitable for 18Cr-12Ni-2Mo-N and 19Cr-13Ni-3Mo stainless steel
			DW-347	A5.22 E347T0-1 / -4	Suitable for 18Cr-8Ni-Nb and 18Cr-8Ni-Ti stainless steel for high temperature service
	CO_2	F,HF	**DW-312**	A5.22 E312T0-1	Suitable for dissimilar metal welding
Metal	Ar- CO_2	F,HF	**MXA-410NM**	-	Suitable for 13Cr-Ni stainless steel
			MXA-135N	-	Suitable for 13Cr-Ni stainless steel
			MXA-430M	-	Suitable for thin plates of 17Cr and 13Cr stainless steel
-	Ar	F,HF,H VU,OH,VD	**TGX-308L**	A5.22 R308LT1-5	Suitable for GTAW of 304 and 304L stainless steel
			TGX-309L	A5.22 R309LT1-5	Suitable for GTAW of dissimilar metals
			TGX-316L	A5.22 R316LT1-5	Suitable for GTAW of 316 and 316L stainless steel
			TGX-347	A5.22 R347T1-5	Suitable for GTAW of 347 and 321 stainless steel

Table 6. FCWs for Hardfacing

Type of cored flux	Suitable Shielding gas	Welding position	Brand name	Intended usage and features		
				Weld metal microstructure and alloying formula	Nominal hardness of weld metal (Hv)	Resistible type of wear
Rutile	CO_2	F,HF	**DWH-250**	Pearlite	250	Metal-to-metal wear
			DWH-350	Pearlite	350	Metal-to-metal wear and light abrasion
			DWH-450	Martensite	450	Metal-to-metal wear and abrasion
			DWH-600	Martensite	600	Abrasion
			DWH-700	Martensite	700	Abrasion
Metal	CO_2	F,HF	**DWH-800**	Martensite	800	Heavy abrasion
			DWH-30	High Cr-Fe	700	Heavy abrasion
			DWH-30MV	High Cr-Fe	800	Heavy abrasion and high temperature wear
	Ar- CO_2	F,HF	**DWH-11**	13Mn	250	Heavy-impact abrasion
			DWH-16	16Mn-16Cr	300	High temp. wear, impact wear and cavitation

Table 7. FCWs for 9Ni steel and nickel-base alloy

Type of cored flux	Suitable Shielding gas	Welding position	Brand name	Intended usage and features
Rutile	Ar- CO_2	F,HF	**DWN-70S**	Suitable for 9Ni steel
			DWN-82	Suitable for Inconel and dissimilar metal welding
			DWN-625	Suitable for Inconel 625 and dissimilar metal welding
			DWN-625M	Suitable for super stainless steel and dissimilar metal welding

Unsurpassed Performances of Kobelco FCWs

Kobelco rutile type FCWs commonly offer low spatter, excellent slag removal and smooth bead appearance. DW-100, a typical rutile type FCW, provides markedly low spatter over a wide range of welding currents in comparison with a conventional solid wire, as shown in **Fig. 2**. The use of low spatter wire can minimize postweld cleaning work and thereby cut labor costs.

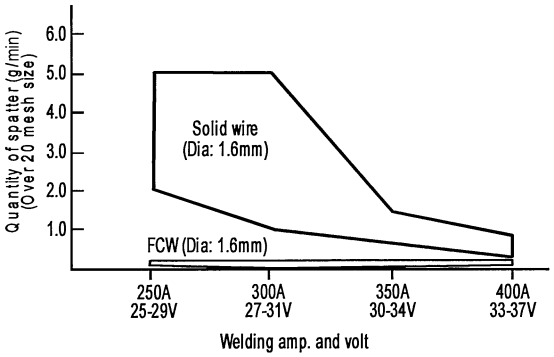


Figure 2. Comparison between DW-100 and conventional solid wire on spatter in use of CO_2 shielding

As shown in **Photo 1**, slag curls up and peels off by itself in welding with DW-100. Excellent slag removal contributes to higher welding efficiency by reducing postweld cleaning work.

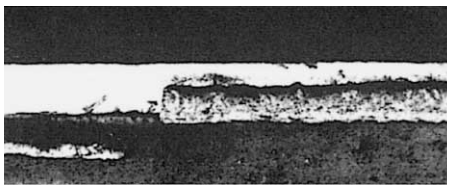


Photo 1. Self-peeling slag removal of DW-100

DW-100 provides flat surface weld beads that fuse smoothly with the base metal as shown in **Photo 2**. This can eliminate additional work to repair welding defects such as undercut, excessively convex bead and overlap, thereby improving welding productivity.

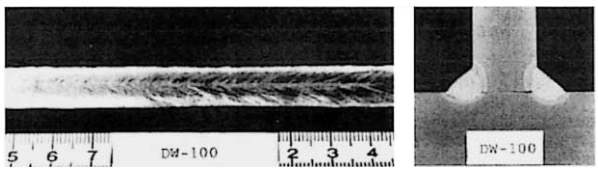


Photo 2. Smooth surface and sufficient penetration of DW-100 weld bead

As shown in **Fig. 3**, Kobelco FCWs exhibit higher deposition rates of 50-60% over covered electrode and 10-20% over solid wire when compared at the same welding current. Comparing the metal type with the rutile type FCW, the former produces deposition rates that are about 10% higher than the latter. This superior deposition rate is common to most of the metal type FCWs. The higher deposition rate enables faster welding, reducing overall welding time and increasing productivity.

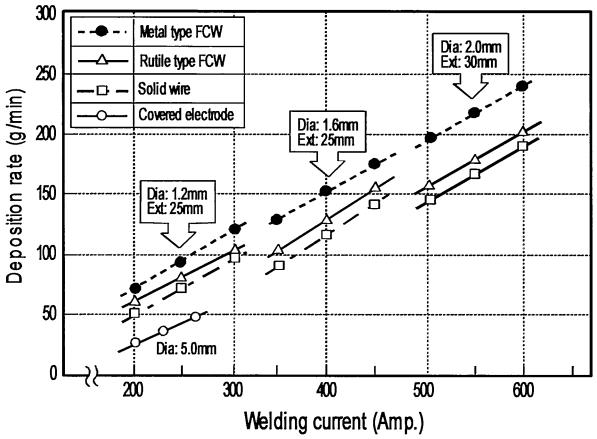


Figure 3. Comparison between FCW, SW and CE on deposition rate, where metal type FCW is MX-100, rutile type FCW is DW-100, SW is conventional solid wire, with CO_2 shielding gas; and CE is conventional covered electrode.

Metal-Type FCWs Contribute with Unique Performances to Highly Efficient Productivity

Some metal type FCWs feature low spatter, excellent slag removal and smooth bead appearance like rutile type FCWs as well as a high deposition rate.

In addition to the excellent performance described above, metal type FCWs offer superior resistibility against primers coated on steel plates. MX-200, for instance, exhibits excellent resistibility to porosity in fillet welding of primer-coated steel plates at high welding speeds, as shown in **Fig. 4**. This unique ability facilitates highly efficient welding by allowing the use of a portable fillet welding carriage as shown in **Photo 3**.

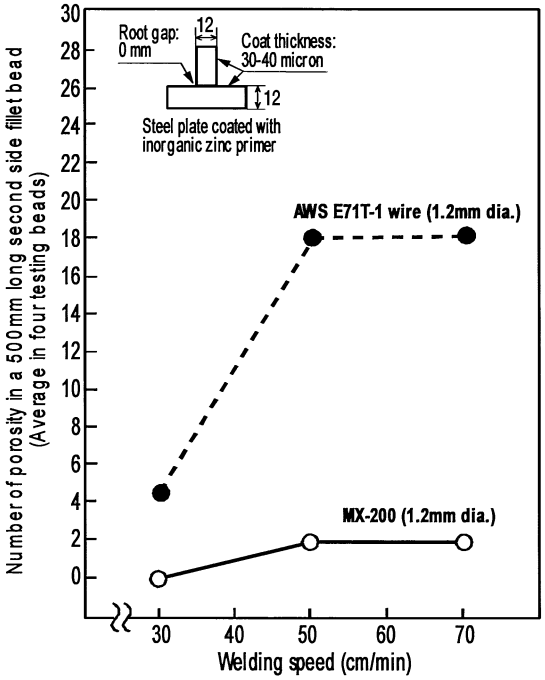


Figure 4. Results of porosity resistibility testing of MX-200 in comparison with a conventional rutile type FCW in fillet welding of primer-coated plates

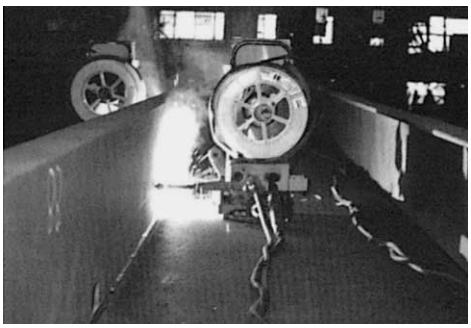


Photo 3. Fillet welding of longitudinal components by using a portable fillet welding carriage and MX-200 in shipbuilding
(Photo courtesy of Tsuneishi Shipyard, Japan)

Revolutionary Low Temperature FCWs satisfy CTOD requirements for North Sea Offshore Structures

Low temperature toughness is an essential quality for offshore weldments. Where the crack tip opening displacement (CTOD) is required, Ti-B micro-alloyed FCWs such as DW-55L, DWA-55L, DW-55LSR and DWA-55LSR are suitable. **Fig. 5** and **Table 8** show typical impact values and CTOD values of DW-55L weld metal.

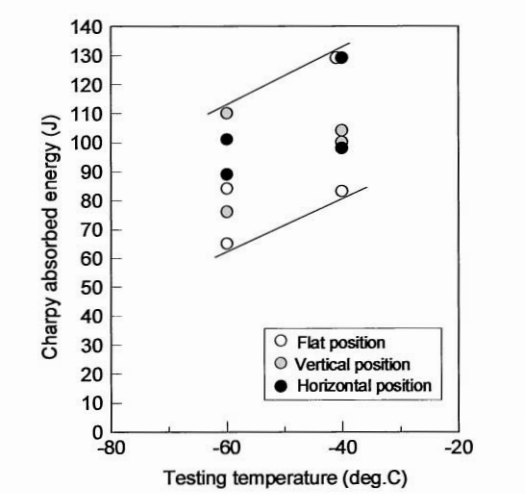


Figure 5. Notch toughness of DW-55L (1.2 mmϕ) multiple-pass weld metal (Each plot shows the average of three specimens), using a double-V groove joint of 40-mm thick steel plate; heat input: av. 18 kJ/cm (Flat), av. 25 kJ/cm (Vertical), av. 11 kJ/cm (Horizontal)

Table 8. Typical CTOD values of DW-55L weld metal

Welding position	Flat	Vertical	Horizontal
CTOD at −10℃ δc (mm)	0.64 0.59 0.34	1.68 2.05 1.55	0.50 0.61 0.51

Note:
- Test plate: BS4360 Grade 50D, 40mmT, double-V groove
- CTOD test piece: 80T×40W×400L (mm), fatigue notch
- CTOD test method: BS7448-1991, three-point bending
- Heat input: Av. 18kJ/cm in flat position welding
  Av. 25kJ/cm in vertical position welding
  Av. 11kJ/cm in horizontal position welding

DW Stainless Series FCWs Cover Almost All Types of Stainless Steel

Targeting the chemical, oil, gas, food processing, electrical power, rolling stock, auto and architectural industries, a sufficient number of DW stainless series FCWs are available today to cover a wide range of stainless steels used at room, elevated and cryogenic temperatures.

To say nothing of such outstanding features as the gentle arc, low fumes, low spatter, self-peeling slag removal, and smooth bead appearance, the use of DW stainless series FCWs provides users with value and economy:

(1) Deposition rates that are three times higher than those of covered electrodes and 1.2 times higher than solid wires enable faster welding.

(2) Deposition efficiency that is 1.6 times higher than

covered electrodes enables 60% less consumption of welding consumables over a certain length of welding line.

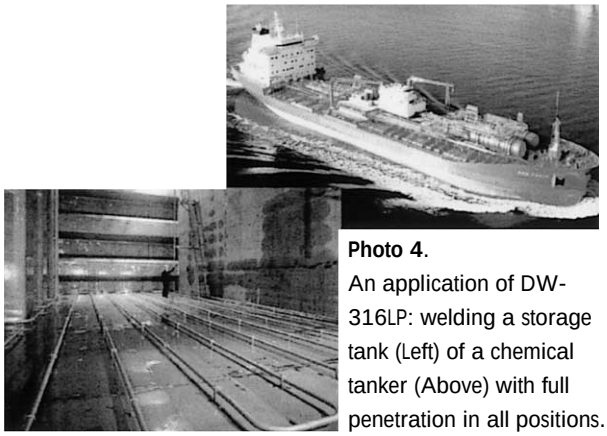


Photo 4.
An application of DW-316LP: welding a storage tank (Left) of a chemical tanker (Above) with full penetration in all positions.

Tips for Higher Quality Welds

(1) Gas shielding

The nominal composition of the shielding gas mixture of Ar-CO_2 shown in **Table 1** through **7** should be 80%Ar-20%CO_2. Where other compositions of Ar-CO_2 mixtures are required, users are recommended to contact the nearest Kobelco office to confirm the performance of the FCW selected. Use shielding gases purified adequately for welding.

The proper flow rate of shielding gas for obtaining sound welds varies, depending on wire diameter, welding current and welding torch nozzle standoff, as shown in **Table 9**.

Table 9. Proper flow rates of shielding gas

Wire diameter (mm)	Welding current (A)	Nozzle standoff (mm)	Gas flow rate (litter/min)
1.2	100-200	10-20	15-25
	200-300	15-25	20-30
1.6	200-300	15-20	20-30
	300-450	20-25	20-30

Note: The inside diameter of a nozzle is 20 mm in this case. A smaller-diameter nozzle uses a shorter nozzle standoff and lower gas flow rates

FCWs possess better resistibility against wind over solid wires, however, the use of windscreens is recommended to prevent porosity and nitrogen pick-up in welds in high winds.

(2) Wire feeding

Confirm that the groove size of the wire feed roller of a wire feeder matches the diameter of the FCW to be used. Adjust the pressure to the wire according to the diameter and material of the wire. Excessively high pressure causes wire deformation and flaking, while, conversely, excessively low pressure can cause slipping of the wire. An excessive amount of both can cause irregular wire feeding and in turn unstable arcs.

Confirm the conduit cable has no sharp bend with a small radius to prevent irregular wire feeding and thus unstable arcs. Refer to the permissible minimum radius of the curvature and diameter of the circle of a conduit cable shown in **Fig. 6**.

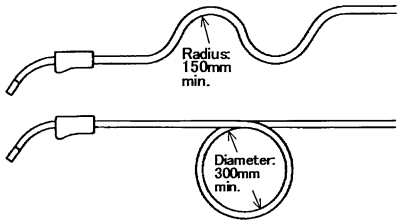


Figure 6. Permissible minimum radius of the curvature and diameter of the circle of a conduit cable to prevent irregular wire feeding and unstable arcs

(3) Welding current and polarity

DWA-51B, TGX-308L, TGX-309L, TGX-316L and TGX-347 use DC-EN, while the other FCWs listed in the tables above use DC-EP for better performance. A proper welding current range varies depending on type and size of wire, and welding position. Refer to the KOBELCO WELDING HANDBOOK for such information.

(4) Electrode orientations and applications

In flux cored arc welding, we can use either backhand technique or forehand technique shown in **Fig. 7**. Fillet welding normally uses forehand technique due to better bead appearance; however, butt welding generally uses the backhand technique for filling passes due to better penetration and forehand technique for covering passes due to better appearance.

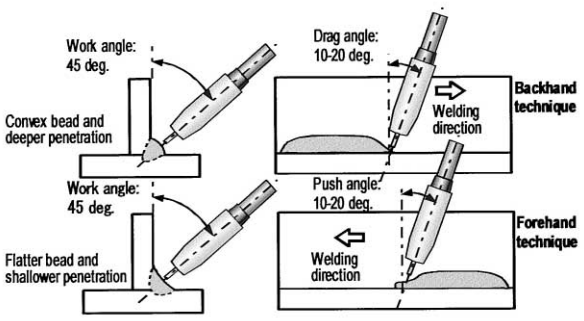
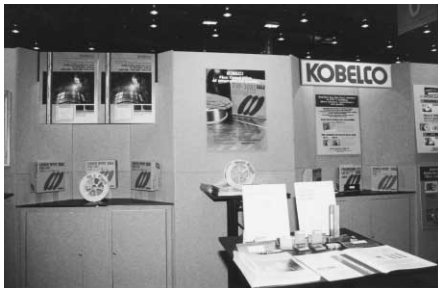


Figure 7. Backhand and forehand techniques

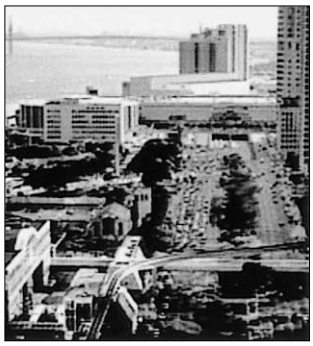
Kobelco's Innovative Stainless Steel Flux-Cored Wires Attract a Number of Visitors to AWS Show 2003



Reformative, DWG series stainless steel flux-cored wires attracted a large number of visitors through the exhibition period

The AWS Welding Show 2003 was held at the COBO Hall Exhibition Site in Detroit from the 8th through 10th of April, 2003. This event was special this year in that the AWS Welding Show celebrated its 50th anniversary and all the visitors to Detroit were greeted with unusual snowy weather and slippery streets.

The exhibition attracted approximately 9,000 visitors at the registration base. Kobelco Welding of America (KWAI) participated as an exhibitor, making its 14th appearance in AWS Shows. In this event, KWAI introduced new stainless steel flux-cored wires: DWG-308L, DWG-309L, and DWG-316L classified as AWS A5.22 E308LT0-1/4, E309LT0-1/4, and E316LT0-1/4, respectively. DWG is a series of innovative flux-cored wires suitable for stainless sheet metals. It offers unsurpassed arc stability at lower currents even below 150A with a 0.045-inch (1.2-mm) wire, which eliminates the need of more expensive smaller size wires in thin plate welding. We received numerous positive responses to the DWG series wires from the visitors to the Kobelco booth, which has convinced us that these new brands will be our "big sellers" in the near future.



COBO Conference/Exhibition Center located on the bank of the Detroit River (Photo source: www.aws.org)

The next AWS Show will happen at McCormick Place in Chicago in 2004. See you in Chicago, then!

Reported by
Andrew Sawada
KWAI

Hello, All the KWT Readers:

Fusaki Koshiishi is my name. I recently moved to the International Operations Department in the Tokyo office to take up my new post in April. My last position was in the Technical Development Department at Fujisawa Works, where I was in charge of developing welding consumables. It goes without saying that arc welding is an indispensable technology. Arc welding technology is so interesting that it has driven my curiosity to learn more about not only welding consumables but also welding processes, power sources, and robotic systems. It has been my pleasure, therefore, to be involved in the propagation of the Kobelco welding technologies, including my particular fields, throughout the worldwide markets.

By the way, let me touch on a few matters from my private life. I often enjoy going out to the park nearby my house and sometimes to hot springs resorts with my family. "Doktor," my pet dog, is a member of my family, too. Doktor relaxes me very much while walking together. I also like so much to do my favorite sports and watch sports on TV. Recently, Japanese baseball players in the US major leagues and football players in the European leagues have inspired me with their successful play.

I will have many occasions to go overseas on business from now on, and it will be my pleasure to meet customers and Kobelco Group's staff and encounter new cultures and indigenous foods. "Enjoy my job" is my motto. I hope this positive attitude will help me build a good partnership with our customers and provide you and me with fruitful results in our business. I am looking forward to meeting all of you sometime in the near future.

Reported by
Fusaki Koshiishi
Dept. General Manager, IOD, KSL

DWA-81B2

E81T1-B2M

DWA-91B3

E91T1-B3M

New Ar-CO_2 Shielding Cr-Mo Flux-Cored Wires with Excellent Notch toughness

DWA-81B2 (AWS A5.29 E81T1-B2M) and DWA-91B3 (AWS A5.29 E91T1-B3M) are rutile type flux-cored wires for 1.25Cr-0.5Mo and 2.25Cr-1Mo steels, respectively, which offer higher notch toughness after postweld heat treatment in comparison with CO_2 shielded Cr-Mo flux-cored wires, DW-81B2 and DW-91B3. The available wire diameter is 1.2 mm. **Tables 1** and **2** show respectively the chemical compositions and tensile properties of weld metals by DWA-81B2 and DWA-91B3 using 80%Ar-20%CO_2. These weld metals feature lower Si and P, higher Mn, and almost the same tensile properties when compared with the conventional DW-81B2 and DW-91B3. In addition, as shown in Table 1, J-factor and X-bar values are controlled lower by minimizing the content of such impurities as Sb, Sn and As to lessen temper embrittlement.

Table 1. Typical chemical compositions of DWA-81B2 and DWA-91B3 weld metals and the AWS requirements (wt%)

Chemical element	DWA-81B2	AWS E81T1-B2M	DWA-91B3	AWS E91T1-B3M
C	0.05	0.05-0.12	0.07	0.05-0.12
Si	0.55	0.80 max	0.35	0.80 max
Mn	0.97	1.25 max	0.85	1.25 max
P	0.006	0.03 max	0.007	0.03 max
S	0.012	0.03 max	0.010	0.03 max
Ni	0.02	-	0.02	-
Cr	1.34	1.00-1.50	2.29	2.00-2.50
Mo	0.49	0.40-0.65	1.00	0.90-1.20
Sb	<0.002	-	<0.002	-
Sn	<0.002	-	0.002	-
As	<0.002	-	0.002	-
J-factor (1)	<122	-	108	-
X-bar (2)	<8	-	<9	-

Note: (1) J-factor = (Si + Mn)×(P + Sn)×10^4 (Unit: wt %)
(2) X-bar = (10P + 5Sb + 4Sn + As) / 100 (Unit: ppm)

Table 2. Typical tensile properties of DWA-81B2 and DWA-91B3 weld metals and the AWS requirements

Brand	PWHT	0.2%OS (MPa)	T.S. (MPa)	El. (%)	R.A. (%)
DWA-81B2	690℃ × 1hr	575	655	25	72
E81T1-B2M	690℃ × 1hr	470 min	550-690	19 min	-
DWA-91B3	690℃ × 1hr	615	705	21	67
E91T1-B3M	690℃ ×1hr	540 min	620-760	17 min	-

Note:
Welding parameters: DC-EP 230-250A, 26-28V, approx. 20cm/min, 1G position

As shown in **Photo 1**, the microstructures of DWA-81B2 and DWA-91B3 weld metals exhibit fine bainite after postweld heat treatment. The fine microstructures contribute to sufficient notch toughness as shown in **Fig. 1**.

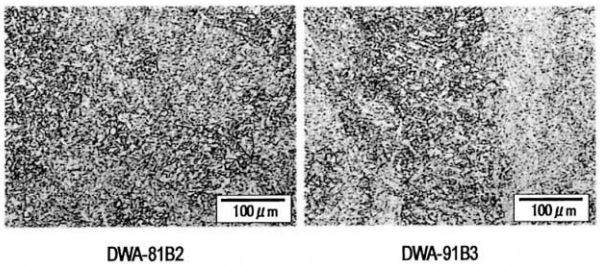


Photo 1. Typical microstructures of DWA-81B2 and DWA-91B3 weld metals after PWHT (690℃×1h)

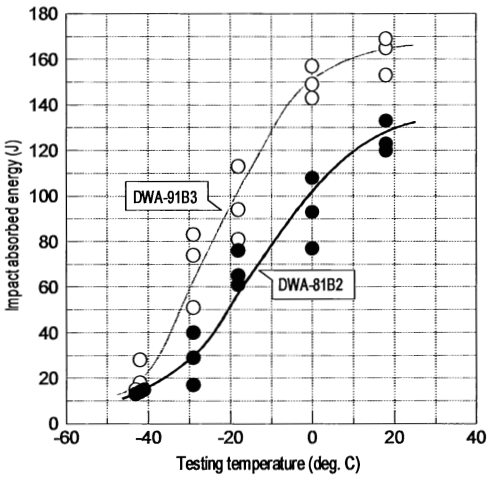


Figure 1. Notch toughness of DWA-81B2 and DWA-91B3 weld metals (PWHT: 690℃×1h, DC-EP, 230-250A, 26-28V, approx. 20cm/min, 1G position, 80%Ar-20%CO_2)

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