KOBELCO WELDING TODAY

OCTOBER 2008 VOL.11 [NO.4]

The KOBELCO Arc: Energy that Strengthens the World

TRUSTARC™ LB-80L

Ultra-Low Hydrogen Covered Electrode Excellent in DCEP Welding of 780-MPa High Tensile Strength Steel

LB-80L offers unsurpassed performance in DCEP current welding of 780-MPa high tensile strength steels used mainly for offshore structures, penstock and spherical storage tanks. LB-80L, classified as AWS A5.5 E11018-G H4, is characterized by ultra-low hydrogen deposited metal (Table 1) and superior impact notch toughness at low temperatures down to –40°C (Figure 1). Table 2 shows the typical chemical composition and tensile properties of the weld metal with a fine grain microstructure (Figure 2).

Table 1: Typical diffusible hydrogen content in deposited metal with LB-80L (4.0 mmØ)*1

Diffusible hydrogen content (ml/100g)				
2.2	1.9	2.0	1.8	Av. 2.0

1. Testing method: AWS A4.3 (Gas Chromatography)
   Welding current: 150 Amp. (DCEP)
   Welding atmosphere: 21°C × 10%RH.

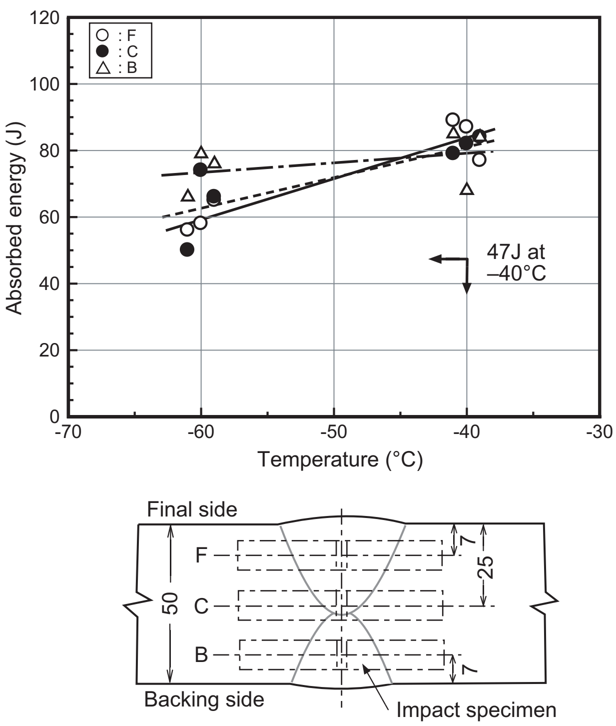


Figure 1: Charpy impact properties of LB-80L (4.0mmØ) weld metal (Base metal: 50-mm-thick 780-MPa high tensile steel of K-TEN780 with double-V groove; Welding position: Vertical-up; Welding parameter: 120Amp./22V; Heat input: 2.0kJ/mm; Preheating and interpass temperature: 150°C).

Table 2: Typical chemical composition and tensile properties of LB-80L (4.0mmØ) weld metal*1

Chemical composition of weld metal (%)						
C	Si	Mn	P	S	Ni	Mo
0.05	0.56	1.37	0.009	0.005	2.77	0.76

Tensile properties of weld metal			
0.2%PS (MPa)	TS (MPa)	El (%)	RA (%)
767	848	22	70

1. Testing specimens were removed from the final-side weld metal of the welded joint shown in Figure 1.

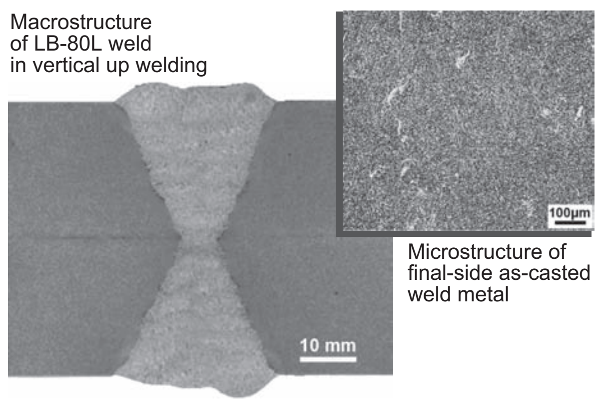


Figure 2: Typical macroscopic and microscopic structures of LB-80L weld (Refer to Figure 1 for welding conditions).

With LB-80L the preheating and interpass temperature can be decreased due to ultra-low diffusible hydrogen in the weld metal. For instance the window-restrained cracking test (at 30°C×80%RH) of an LB-80L weld shows that 100°C for preheating and interpass temperature plus 200°C immediate postweld heating can prevent cold cracking. From this laboratory test result, 100-200°C for preheating and interpass temperature plus 200°C immediate postweld heating is recommended in on-site welding of 780-MPa high tensile strength steels. Heat input should also be controlled according to the requirements of mechanical properties (Table 3).

Table 3: Mechanical properties and recommended heat input

Minimum mechanical properties	Heat input*1
0.2%PS: 690MPa; TS: 760MPa; Kv-40°C: 47J	1.0-2.5kJ/mm

1. Plate thickness: 50mm min.; Preheating temp.: 100-200°C.

The new business environment leads to a new struggle for survival

Supply of steel products was tight worldwide due to heavy demand that lasted until the Beijing Olympic Games, the biggest international event in 2008. However, the end of the games coincided with the global recession, and demand for steel fell sharply; the the prices of steel products have also fallen precipitously. These trends have been accelerated further by the financial crisis that started in the USA. As a result steel industries around the world, reeling from the downward spiral in the prices of steel products, are facing an unprecedented critical situation. Furthermore, sharp declines in share stock prices and violent currency exchange fluctuations are likely to affect steel consumers. For instance, in the auto industry, which includes a wide web of supporting industries, production and sales plans are being scaled down, and new factories are being postponed in such newly emerging countries as China, India and Russia. In the shipbuilding industry, the customer orders are being cancelled one after another.

We are determined to survive such a period of turbulence and to implement hard-hitting measures to expand our business for the future. Under such circumstances, our business slogan is unchanged, and we will secure our foothold to prepare for the next business chance. In order to overcome business hardships, with your help, we will use secured foothold as the platform from which to seek chances for mutual growth. We are convinced that the quality, technology and delivery of our products will prove their worth all the more in the severe business environment. We, therefore, should like to regard this harsh business environment a golden opportunity and dash forward.

Toshiyuki Okuzumi
General Manager
International Operations Dept.
Welding Company
Kobe Steel, Ltd.

A New KOBELCO Production Base in Malaysia

In August 2008, the KOBELCO welding group companies acquired ST KOBE WELDING (MALAYSIA), whose top shareholder was a petrochemical company (SIT-TAT), and established KOBE WELDING (MALAYSIA) SDN. BHD. (KWM). This new KOBELCO production base is expected to increase annual production capacity of covered electrodes from 2,000 to 5,000 MT, thereby allowing the welding group companies to increase market share in Southeast Asia. The welding group companies annually supply welding consumables of around 120,000 MT (in 2008) for total demand of about 300,000 MT a year in this market. KWM is expected to contribute to the business expansion for you and us.

CONTENTS

Offshore Structures Exploring Deeper Seas Demand Higher Quality Filler Metals

Exploration for oil and natural gas has shifted from land to the seabed in recent decades and has been increasing in such areas as the North Sea, the Gulf of Mexico, and the waters off the Bo Hai seacoast, Sakhalin Island, and Southeast Asia. The importance of ocean exploration will continue to increase in order to ensure the stable supply of energy resources. For underwater drilling of oil and gas, such offshore structures as jack-up rigs, jackets, compliant towers, and semi-submersible rigs have traditionally been used. As exploration has expanded to deeper and colder seas, the construction of offshore structures has accordingly required higher quality steels and filler metals that can resist the challenging marine environment. This article discusses recent trends in the design of offshore structures for deep sea operations and the development of high quality filler metals.

Varieties of offshore structures

Offshore structures can be categorized into two families, with one designed to facilitate trial drilling and the other for production of oil or natural gas. Jack-up rigs and semi-submersible rigs (SSR) are used in trial drilling, while production may utilize jackets, compliant towers (CT), tension-leg platforms (TLP), floating production, storage and offloading facilities (FPSO), and spars. Figure 1 shows schematics of such offshore structures in relation to suitable water depth.

A jack-up rig is a mobile rig for trial drilling. Its truss type legs, consisting of racks and pinions, are used to jack the platform up or down and rest on the seabed during operation. Because the racks and pinions support the whole platform, they must be made of high strength steel, such as 690 MPa yield strength steel.

Jackets are the braced tubular legs that support the fixed production platform, which is anchored onto the seafloor for operation. Jackets are fabricated by welding many tubular components; at the nodes, multiple numbers of pipes are joined. The nodes are also known as TKY joints where pipe-to-pipe joints form T-, K-, and Y-connections. Because these joints are characterized by multidirectional curved welding lines, the groove gap accuracy is apt to be wider and positional one-sided welding is required. In addition, as the welding residual stresses tend to concentrate at the node, careful welding procedures are required to satisfy stringent quality requirements. Jackets have mainly been fabricated of high strength steels with yield strengths of 460 MPa or lower. Recently high yield strength steel, 500 MPa class steel, has been used for jacket superstructures in order to reduce labor

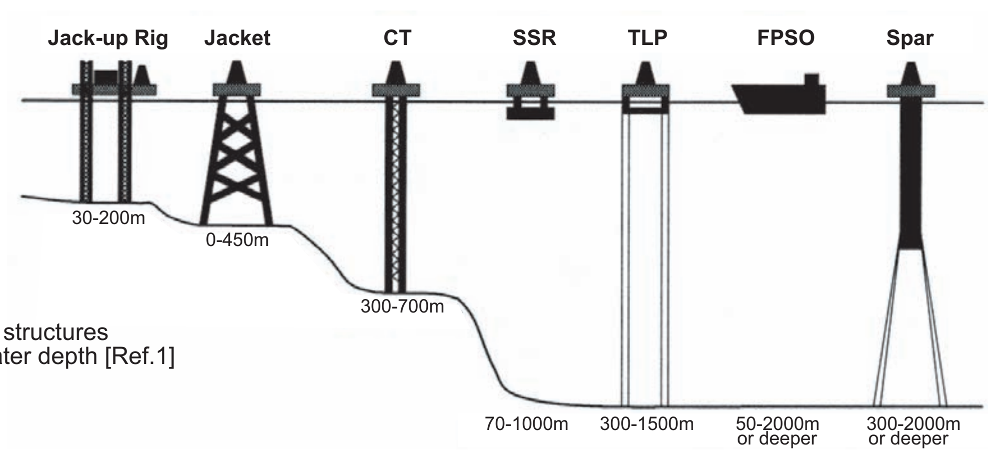


Figure 1: Varieties of offshore structures and their working water depth [Ref.1]

costs during construction. As shown in Figure 1 the maximum working water depth is 450 m for jackets due to the characteristic waving period.

Compliant towers can extend the working water depth of jackets by employing a narrow, flexible tower substructure. CTs are designed to sway above the seabed and resist storm waves, and so the maximum operating water depth can be 2 or 3 times that for jackets. CTs are believed to be most cost effective operating in water depths ranging from 300 to 700 m.

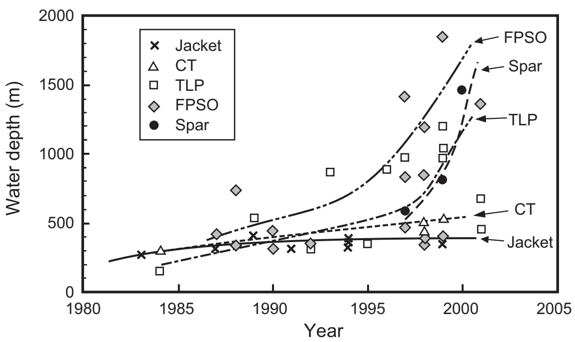


Figure 2: Water depth transition for offshore structures [Ref.1]

As shown in Figure 2, since the later half of the 1990s, oil and gas exploration in deeper seas has been increasing, expanding the use of such floating offshore structures as TLPs, FPSOs, and spars. A TLP is a floating rig similar to a conventional SSR but different in that it is vertically moored by means of a group of tethers or tendons called a tension leg. An FPSO is a floating tank system designed to process and store the oil or gas produced at a nearby platform, until it can be can be offloaded onto waiting tankers, or sent through a pipeline. A more recent development is the spar, a floating oil platform typically used in deep waters ranging from 300 to 2000 m or deeper. A spar platform consists of a single, large-diameter, vertical cylinder supporting a deck. The main steels used for TLPs, FPSOs, and spars are those with yield strengths of 460 MPa or lower.

Filler metals for offshore structures

Offshore structures utilize a wide range of high yield strength steels (320-420 MPa, 460-500 MPa, and 690 MPa) that are welded with filler metals matching in strength. With all the high-strength

Table 1: Chemical and mechanical properties of low temperature filler metals for offshore structures

Welding process	Filler metal (Trade designation of **TRUSTARC**™)	Y.S. level (MPa)	Lowest temp. for Kv: 47J min.	Lowest temp. for CTOD, δ: 0.25mm min.	Typical chemical composition of weld metal (%)*1							Remarks
					C	Si	Mn	Ni	Mo	Ti	B	
SMAW	**LB-52NS**	400/350*2	–60°C	–30°C	0.08	0.4	1.4	0.5	-	0.02	0.002	AC or DCEP
	NB-1SJ	420/400*2	–80°C	–40°C	0.08	0.3	1.3	1.3	-	0.02	0.002	
	LB-62L	460/420*2	–60°C	–10°C	0.07	0.3	1.0	2.1	0.1	0.02	0.002	
	LB-65L	500	–60°C	–20°C	0.06	0.3	1.1	2.6	0.1	-	-	DCEP
	LB-88LT	700	–60°C	-	0.04	0.6	1.8	2.6	0.7	-	-	AC
	LB-80L	700	–40°C	-	0.04	0.5	1.6	3.0	0.8	0.01	-	DCEP
SAW	**PF-H55LT/US-36**	400	–60°C	–50°C	0.08	0.2	1.4	-	-	0.02	0.004	AC
	PF-H55LT/US-36J	420	–60°C	–20°C	0.09	0.3	1.7	-	-	0.02	0.004	
	PF-H80AK/US-80LT	700	–80°C	-	0.08	0.3	1.7	2.5	0.7	-	-	
	PF-H55AS/US-36J	400	–60°C	–20°C	0.07	0.2	1.4	-	-	0.02	0.004	DCEP
	PF-H80AS/US-80LT	700	–80°C	-	0.06	0.5	1.6	2.4	0.7	-	-	
GMAW	**MG-S50LT**	400	–60°C	–30°C	0.07	0.3	1.4	-	-	0.02	0.003	80%Ar-20%CO_2
	MG-S88A	700	–60°C	-	0.07	0.3	1.2	3.4	0.8	-	-	
FCAW	**DW-55L**	400	–60°C	0°C	0.04	0.4	1.3	1.4	-	0.05	0.003	CO_2
	DW-55LSR	420	–60°C	–10°C	0.06	0.4	1.4	1.4	-	0.05	0.004	
	DW-62L	500	–60°C	–40°C	0.06	0.3	1.2	2.4	-	0.06	0.004	
	DW-A81Ni1	420	–60°C	–10°C	0.05	0.3	1.3	0.9	-	0.04	0.005	80%Ar-20%CO_2
	DW-A55L	460	–60°C	–20°C	0.06	0.3	1.2	1.4	-	0.06	0.003	
	DW-A55LSR	420	–60°C	–20°C	0.05	0.3	1.3	0.9	-	0.04	0.003	
	DW-A62L	500	–60°C	–40°C	0.07	0.3	1.3	2.1	-	0.07	0.005	

1. The chemical compositions of LB-52NS, NB-1SJ and LB-62L weld metals are for AC current.
2. The left value is for AC current and the right value is for DCEP current.

steels except for 690 MPa steel, shipbuilding filler metals approved by the ship classification societies may be used. On the other hand, the requirements of filler metals used in offshore structural applications may need to be strict (e.g. low temperature notch toughness) because of the thickness of the high-strength steel components and the icy temperatures of the seas. Low temperature filler metals may also be required. Most of the KOBELCO low temperature filler metals listed in Table 1 for offshore applications satisfy the Charpy impact requirement at low temperatures down to –60°C, and many of them can meet the requirement of CTOD (crack-tip opening displacement) at –10°C or lower.

Low oxygen and fine microstructure weld metal is indispensable for low temperature filler metals to meet stringent notch toughness requirements, regardless of the strength level and welding process. However, the chemistry of individual filler metals differs depending on the strength level and welding process. For example, filler metals with yield strengths of 550 MPa or lower are characterized by the Ti-B combined alloying to refine the microstructure of the weld metal. By contrast, filler metals with yield strengths of 600 MPa or higher feature higher Ni content to refine the microstructure.

Filler metals for shielded metal arc welding (SMAW) and flux cored arc welding (FCAW) are characterized by the C-Si-Mn-Ni-Ti-B system to overcome such drawbacks as nitrogen fluctuation (SMAW) or high oxygen content (FCAW) in the weld metal. Filler metals for submerged arc welding (SAW) and gas metal arc welding (GMAW) are designed with the Ni-free Ti-B-combined alloying due to the low oxygen content of the weld metal. The low oxygen content is provided by the basic-type bonded flux (SAW) and oxygen-controlled solid wire (GMAW).

The SMAW covered electrode and SAW flux for high strength steels with 690-MPa-class yield strength are designed so that the weld metal contains an ultra-low amount of diffusible hydrogen to reduce the susceptibility to hydrogen-induced cold cracking. These filler metals were developed in the beginning of the 1980s and have been used increasingly for large jack-up rigs.

Highlighted filler metals and their characteristics

The KOBELCO group companies have been producing and supplying specific and general purpose filler metals to meet the diverse customer requirements. This article will now highlights some brands that can be used in the construction of offshore structures. These brands include those that have enjoyed steady consumption for long years and those that have been developed recently to specific customer requirements.

FAMILIARC™ LB-7018-1

(AWS A5.1 E7018-1)

LB-7018-1 is an iron-powder low-hydrogen electrode for all-position welding. It offers excellent notch toughness at low temperatures and unsurpassed usability with DCEP currents. Being classified with a supplementary designation suffix as E7018-1 per AWS A5.1, LB-7018-1 meets the low temperature impact requirement of 27J at –46°C in the as-welded condition. In addition, this electrode offers the excellent property of CTOD at 0°C. Table 2 shows the typical chemical and mechanical properties of LB-7018-1 weld metal.

Table 2: Typical chemical and mechanical properties of LB-7018-1 weld metal*1

Chemical composition of weld metal (%)				
C	Si	Mn	Ti	B
0.06	0.36	1.48	0.03	0.004
Mechanical properties of weld metal				
0.2% OS (MPa)	TS (MPa)	El (%)	RA (%)	Kv at –46°C (J)*2
483	565	32	73	Av. 127

1. Welding conditions as per AWS A5.1 — 4.0 mmØ: 160A, 8 layers with 16 passes; DCEP; Preheat and interpass temperature: 125°C.
2. The average of three values as per AWS A5.1.

TRUSTARC™ LB-52NS

(AWS A5.5 E7016-G)

LB-52NS ensures adequate notch toughness over a wide range of such welding variables as heat input, plate thickness, cooling rate, welding position, and postweld heat treatment. In addition, specific technical data on CTOD and sulfide stress corrosion cracking (SSCC) are available, which are sometimes required for special applications. Such dependable performance and technical data helps users control the welding quality. LB-52NS can maintain fine microstructure with higher heat input compared to conventional electrodes, due to the specific chemical composition (Si-Mn-0.5Ni-Ti-B). Figure 3 shows Charpy impact test results of LB-52NS weld metals with three different plate thicknesses using the groove preparation and weld pass sequence shown in the figure. It is clear that LB-52NS provides adequate notch toughness, even in the severe condition of vertical-up welding, over a range of plate thicknesses.

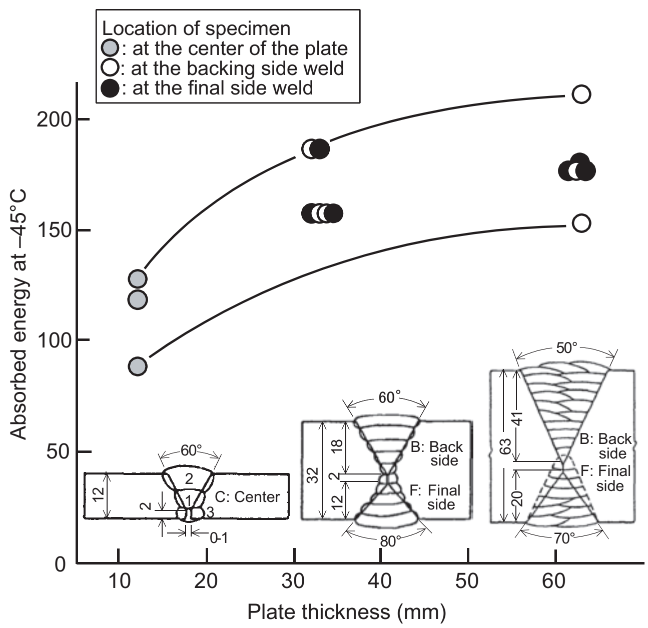


Figure 3: Charpy impact test results of LB-52NS (4.0 mmØ) weld metals in vertical-up AC welding (interpass temperature: 100-150°C).

TRUSTARC™ LB-62L

(AWS A5.5 E8016-C1)

LB-62L ensures sufficient notch toughness at low temperatures down to –60°C over a wide range of heat inputs, plate thicknesses, cooling rates, and welding positions. Extra-low hydrogen weld metal is one of the noticeable characteristics of this electrode, which can be used with a lower preheating temperature for preventing cold cracking. In addition, LB-62L picks up less moisture due to its moisture resistant coating when compared with conventional low-hydrogen electrodes as shown in Figure 4. Such outstanding features can make quality control easier and more economical by reducing the costs for preheating the work and redrying the electrode.

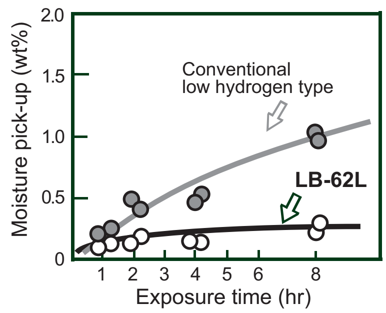


Figure 4: Test results of LB-62L and conventional low-hydrogen electrode on moisture pick-up under the controlled atmosphere: 30°C × 80%RH.

TRUSTARC™ LB-88LT

(AWS A5.5 E11016-G)

LB-88LT is an ultra-low hydrogen and moisture resistant covered electrode for 780-MPa high tensile strength steel, which is suitable for low-temperature applications such as jack-up rigs due to its unsurpassed notch toughness at low temperatures down to –80°C. However, the use of an AC power source is a must to obtain the specific characteristics of LB-88LT. For DC power sources, LB-80L is suitable (Table 1). The unique chemical composition (Low C-Si-Mn-2.5Ni-Mo) of LB-88LT weld metal creates fine microstructures, thereby exhibiting consistent high tensile strength as well as high notch toughness. Additionally, the sophisticated coating flux composition offers very low moisture absorption in the atmosphere and in turn very low diffusible hydrogen in the weld metal (Table 3), thereby improving crack resistance.

Table 3: Typical diffusible hydrogen content (ml/100g) of LB-88LT (4.0 mmØ) weld metal (gas chromatographic method

Testing atmosphere condition	Testing condition of electrode*1		
	Right after redrying	1-hour exposure to the testing atm. after redrying	4-hour exposure to the testing atm. after redrying
30°C × 80%RH	Av. 5.0	Av. 5.2	Av. 5.7
21°C × 10%RH	Av. 3.0	-	-

1. Redrying condition: 400°C × 1h.

TRUSTARC™ DW-62L

(AWS A5.29 E91T1-Ni2C-J)

TRUSTARC™ DW-A62L

(AWS A5.29 E91T1-GM)

DW-62L (for 100%CO_2 shielding) and DW-A62L (for Ar-CO_2 shielding), innovations in rutile-based flux-cored wires, offer excellent notch toughness suitable for low temperature steel of the 500-MPa yield strength class. Both wires offer high notch toughness at temperatures down to –60°C by Charpy impact testing and stable fracture at temperatures down to –40°C by CTOD testing. Both wires contain Ni at around 2% and micro-alloyed Ti and B (Table 4). This sophisticated chemistry of these weld metals enables fine microstructures.

Table 4: Typical chemical compositions and tensile properties of DW-62L and DW-A62L weld metals tested per AWS A5.29

Trade designation	**DW-62L**	**DW-A62L**
C (%)	0.08	0.07
Si (%)	0.27	0.32
Mn (%)	1.32	1.33
Ni (%)	2.6	2.1
Ti (%)	0.05	0.07
B (%)	0.004	0.005
0.2%OS (MPa)	601	561
TS (MPa)	660	641
El (%)	25	27
Kv–60°C (J)	Av. 100	Av. 82
Shielding gas	CO_2	80%Ar-20%CO_2

TRUSTARC™ DW-A65L
(AWS A5.29 E91T1-K2M-J)

Expanding the uses of 500-MPa yield strength steel to low temperature offshore applications has triggered the development of DW-A65L. Ti-B micro-alloyed DW-A65L weld metal provides excellent impact notch toughness at low temperatures down to –40°C and guarantees a minimum yield strength of 540 MPa and tensile strength of 620 MPa as shown in Table 5.

Table 5: Typical chemical and mechanical properties of DW-A65L (1.2mmØ) weld metal*1

Chemical composition of weld metal (%)						
C	Si	Mn	Ni	Mo	Ti	B
0.05	0.35	1.17	1.69	0.11	0.05	0.004

Mechanical properties of weld metal			
0.2%OS (MPa)	TS (MPa)	El (%)	Kv–40°C (J)
601	660	24	Av. 82

1. Welding position: Flat; Welding amperage and voltage: 280A/27-29V; Heat input: 1.7kJ/mm; 6 layers with 12 passes; Shielding gas: 80%Ar-20%CO_2; Preheat and interpass temperature: 150°C.

TRUSTARC™ PF-H80AS/US-80LT
(AWS A5.23 F11A10-EG-G)

PF-H80AS is a bonded flux featuring ultra-low diffusible hydrogen. US-80LT is a solid wire containing alloying elements of Ni and Mo. The flux-wire combination offers consistent strength and toughness at low temperatures down to –80°C with DCEP currents. It can also be characterized by low susceptibility to cold cracking in multipass welds on thick-wall 780-MPa high tensile strength steel for such heavy duty applications as jack-up rigs (Figure 5). Table 6 shows typical chemical and mechanical properties of the weld metal.

Table 6: Typical chemical and mechanical properties of PF-H80AS/US-80LT weld metal tested as per AWS A5.23

Chemical composition of weld metal (%)				
C	Si	Mn	Ni	Mo
0.06	0.51	1.64	2.42	0.73

Mechanical properties of weld metal			
0.2%OS (MPa)	TS (MPa)	El (%)	Kv–73°C (J)
740	860	23	Av. 83

Figure 5:
A jack-up rig is a typical construction that requires high performance filler metals with high impact toughness and low crack susceptibility. (Photo courtesy of Kansai Design Co., Ltd., Japan)

Perspectives and challenges for the future

Research continues for advanced exploration and production systems for energy resources. The designs of offshore structures are becoming larger thus requiring weight reduction for the exploration of new energy resources in colder and deeper seas. These trends will also require steels and filler metals to have higher strength and toughness at lower temperatures. Kobe Steel is determined to promote research and development of high efficient filler metals with higher qualities in order to keep up with such industrial trends.

Ref.1: Kobe Steel Technical Reviews, Vol.53 No.2, Sep.2003

Transition Temperature for Toughness

The resistance of steels and weld metals to brittle fractures can be evaluated by means of several fracture toughness tests. In particular, Charpy impact testing with V-notch specimens is often used to confirm compliance with a code or specification that includes impact test requirements, or when monitoring toughness with a quality control program.

The Charpy impact energy absorption of mild steel and low alloy steel weld is profoundly influenced by temperature, and therefore the specification includes the temperature at which a particular absorbed energy is required. For instance, if a steel weld for an offshore structure is likely to be exposed to temperatures as low as –40°C, the specification may require a minimum 47J at that temperature.

By contrast, transition temperature requires impact tests at temperatures that range from relatively high levels, at which the steel weld exhibits its highest toughness, down to low temperatures, at which the steel weld depicts its lowest toughness. When absorbed energy is plotted against temperature, mild steel and low alloy steel welds undergo a precipitous drop in energy over a relatively narrow mid-range span of temperature in the *energy absorption transition* curve shown in Figure 1. Of the various methods for defining energy absorption transition, the one most often used is to compute the mean energy absorption (TrE) between the upper shelf and lower shelf.

This drop in energy absorption starts when some cleavage occurs during fracture, which usually can be confirmed by the appearance of some brittle fracture surfaces on the broken specimen. The relative proportions of brittle fracture to ductile fracture observed on the broken surfaces (Figure 2) tested over the range of temperatures exhibit another transition curve as shown in Figure 1. The temperature at which a tested specimen will display half-brittle and half-ductile fracture texture denotes the *fracture appearance transition temperature* (FATT).

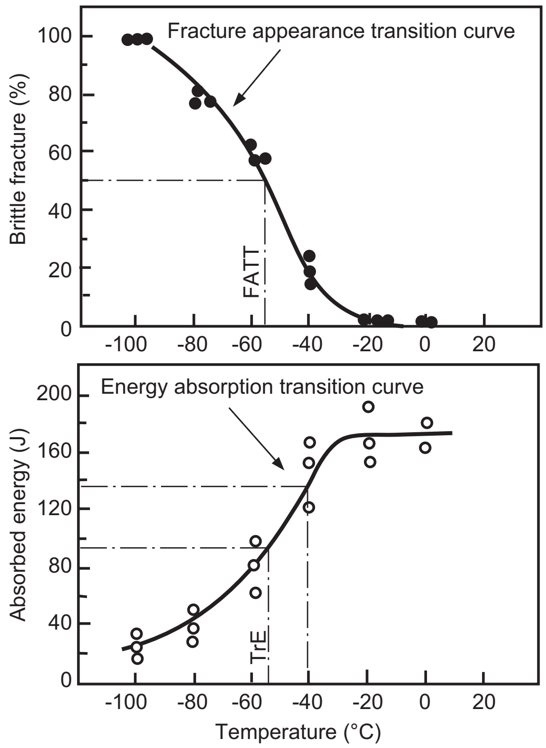


Figure 1: Energy absorption transition and fracture appearance transition curves of mild steel or low alloy steel welds.

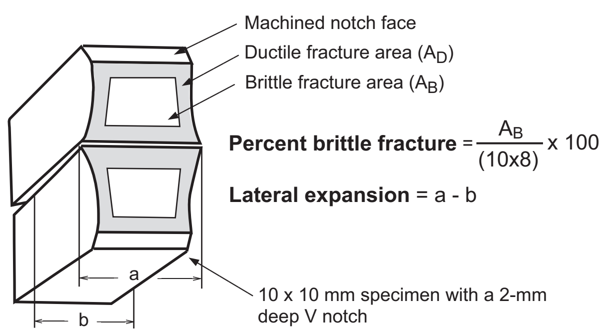


Figure 2: Schematic fracture appearance of a Charpy impact test specimen after breakage and definition of percent brittle fracture and lateral expansion.

The energy transition curve (Figure 1) exhibits about 134J at –40°C — above the aforementioned example of acceptance criteria (47J at –40°C) — and TrE and FATT are about –55°C. Obviously this steel weld would be judged to have an acceptable absorbed energy to the acceptance criteria.

The extent of lateral expansion (a-b in Figure 2) is also considered an acceptable means of quantitative toughness evaluation. Lateral expansion measurements obtained in testing over a range of temperatures can develop a transition temperature similarly to TrE and FATT.

Technical Services for Customers in USA

Hello dear readers of Kobelco Welding Today. In May 2007, I was posted to Kobelco Welding of America (KWAI) as a senior welding engineer. KWAI was incorporated in Houston, Texas, in 1990 and relocated to Stafford, Texas, in 2002. KWAI has expanded its welding business by supplying mainly flux-cored wires for mild steel and stainless steel to users in such fields as energy processes, autos, chemical machinery, and shipbuilding in the North America market. In addition, we are trying to expand sales into the South America market.

I am in charge of technical services for customers in the North America market in collaboration with Mr. David Haynie, a KWAI welding engineer. Typically, we respond to our customer's technical problems or proposals to help them improve welding quality and efficiency. We also consult and give suggestions to improve weld quality; for instance, how to reduce spatter and improve bead appearance. Through our technical services, we strive to grow our customer's reliance on KOBELCO filler metals and their satisfaction in using them. Furthermore, we endeavor to know what the customer needs in terms of the development of new filler metals for specific applications.

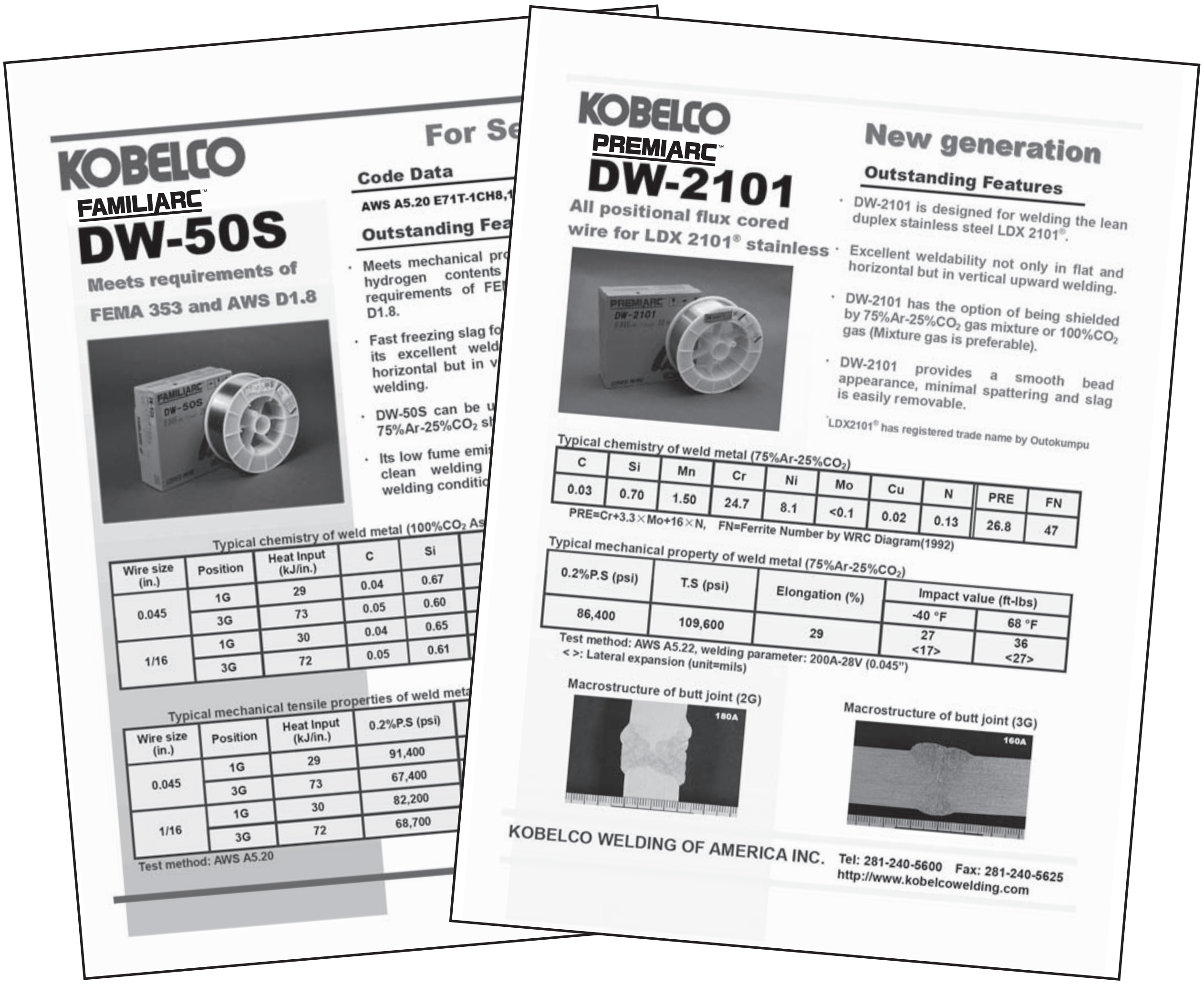
Mr. Keito Ishizaki (right) and Mr. David Haynie posing at the KWAI booth at the AWS welding show.

Once a new product has been developed to suit customer requirements, we can introduce it and promote sales through demonstrations at exhibitions such as the AWS welding show. In order to accurately transfer customer needs into the improvement and development of new products, KWAI's sales and technical personnel meet researchers in the Technical Development Department of Kobe Steel at the Product Development Committee (PDC), which is held two times a year. New products developed through the PDC include a metal-cored wire and a seismic application wire in the **FAMILIARC™** line, MX-A70C6LF (AWS A5.18 E70C-6M) and DW-50S (AWS A5.20 E71T-1C/1M, 9C/9M) respectively, as well as a lean duplex stainless wire in the **PREMIARC™** line, DW-2101.

MX-A70C6LF, which has been evaluated highly by customers, was developed to respond to the need of metal-cored wire users to reduce fume emission rates and lower suitable arc voltages.

Strong user demand, mainly on the West Coast, triggered the development of DW-50S which is suitable for seismic welding in accordance with FEMA 353 (*Recommended Specifications and Quality Assurance Guidelines for Steel Moment Frame Construction for Seismic Applications*) and AWS D1.8 (*Seismic Supplement to the D1.1 Structural Welding Code—Steel*). The specifications and code require a seismic welding wire to be tested at heat inputs (30kJ/in and 80kJ/in) that are used in actual construction sites.

Applications for lean duplex stainless steel that contains moderate amounts of Cr, Mo and N are expected to increase due to excellent resistance to pitting corrosion. Examples of this type of duplex stainless steel include LDX2101® from Outokump and UR2202 from Arcelor Mittal. To keep up with this industrial trend, KWAI has marketed a suitable flux-cored wire, DW-2101.



KWAI has marketed many advanced filler metals to meet customer requirements. We are determined to promote the Kobelco business slogan, QTQ (quality products, technical wupport, and quick delivery), to increase the satisfaction of customers and to expand our welding business for the future.

Reported by
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KOBELCO WELDING TODAY
October 2008 Vol. 11 No. 4

Publisher:
International Operations Dept., Welding Company, Kobe Steel, Ltd.
Editor:
KOBELCO WELDING TODAY Editorial Staff
URL: http/www.kobelco.co.jp
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THE KOBELCO GUARANTEE: QTQ
QUALITY PRODUCTS
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QUICK DELIVERY

International business slogan of Kobelco Welding Group