KOBELCO WELDING TODAY

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The Kobelco arc...
for a better welding environment
and harmony with people

Zamil Steel, a Global Supplier of Quality Steel Buildings and Structures

Founded in 1977, Zamil Steel Industries (ZSI) is a global leader in the manufacture of pre-engineered steel buildings and the Middle East premier supplier of steel structures.

ZSI products are marketed in more than 70 countries through a network of 50 sales offices, 59 certified builders and 27 agents and distributors, and its main factories are located in Dammam First and Second Industrial Cities, with additional factories located in Egypt and Vietnam.

ZSI is one of the three business sectors of Zamil Industrial Investment Company (ZIIC), and its principal business units are Pre-Engineered Buildings, Structural Steel and Towers, and Galvanizing.

The Pre-Engineered Building Business Unit (PEBBU) is the oldest and largest of the company's business units, with a monthly production capacity of 6,500 metric tons. Its Dammam-based factory is the largest single PEB factory in the world.

Steel structure PEB in UK

Welding is a key integral part of the fabrication process of any pre-engineered steel buildings. In order to manufacture quality products, ZSI uses quality welding consumables such as FCAW wires from KOBELCO due to the prime quality in strength and usability in out-of-position welding that is an essential part in producing good products.

ZSI has built a very unique and long business relationship with both Kobe Steel and United Welding & Supply (a local agent of Kobe Steel in KSA) ever since they started and established their business.

United Welding & Supply, which is a part of Abdullah Hashim Gases, a large industrial and medical gases producer in the Middle East, is a reliable supplier covering most industrial and welding needs including the supply of Kobelco FCAW wires.

The Structural Steel Business Unit (SSBU), established in 1983, is the second business unit of ZSI. It has been awarded recently the OHSAS 18001 and ISO 14001 certifications in addition to the ISO 9001:2001 to make it the only company in Saudi Arabia to have these endorsements. Today, SSBU can satisfy the structural steel requirements for large power and desalination plants, petrochemical, oil and gas plants, fertilizer and cement plants, steel mills, high-rise buildings and other industrial and commercial complexes.

Ras Laffan Power Plant, KSA

Zamil Steel has been especially satisfied using one particular Kobe Steel FCAW wire for over 15 years: DW-Z100. The quality is suitable for and approved by ZSI's clients for manufacturing quality buildings, due to its convenient self-peeling slag removal and glossy bead appearance that contribute to saving time and labor for postweld cleaning.

Reported by Azhar Shafi, Product Manager
United Welding & Supplies Co. Ltd., AWHAS

Enhancing our global view of our business

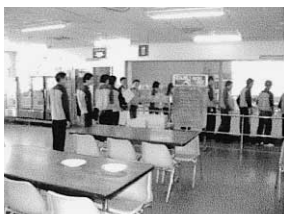
The Japan International Welding Show is scheduled to run from July 14th (Wed) to 17th (Sat) in Osaka, Japan. The Annual Assembly of the International Institute of Welding (IIW) is also going to be held simultaneously at the same place during the Welding Show. KOBELCO is preparing to exhibit the newest products including welding robots. I hope they will be attractive to and helpful for all the visitors to our booths to enjoy and learn new welding technologies. I am also looking forward to seeing our important customers and the long time friends like dear readers of KOBELCO WELDING TODAY at the Show.

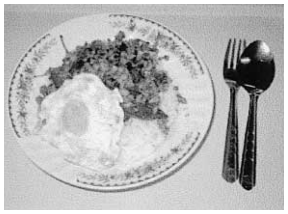
We are enhancing the global view of our business to respond to increasing demands for quality products and services from welding fabricators and distributors, worldwide. As an international manufacturer of welding consumables and robots, we will persistently strive for customer satisfaction by putting all our power and energy into developing advanced technologies and products. If our efforts will provide our customers with fruitful results and contribute to the welding industries by supplying state-of-the-art products, procedures and services, that will be our highest pleasure.

The supply-shortage problem of raw materials caused initially by the sudden boom, in one particular area overseas, is still a big issue for all of us. It is very difficult for us to estimate when this problem will cease. In this situation, what we can do now is to maximize our capability to supply our welding consumables and robots, in cooperation with our customers.

Masakazu Tojo
General Manager
International Operations Dept.
Welding Company
Kobe Steel, Ltd.

Canteen in TKW





Shown top left is the canteen of Thai-Kobe Welding. In a hot country like Thailand, the canteen is of course fully air-conditioned and fills the stomachs of 300 total day and night-shift workers and vendors around the clock. The most popular dish among the employees is *" Kra prao moo "* (bottom left). This is rice topped with fried minced pork and coriander leaves. Perhaps, it is quite hot for you but you can make it milder by placing *" Kai dao "* (a fried egg) on it. You will get addicted to it, so to speak, as you continue to eat it every day. Fried rice with all these materials in it is also very nice... I like this fried rice better.

Reported by Kamata, TKW

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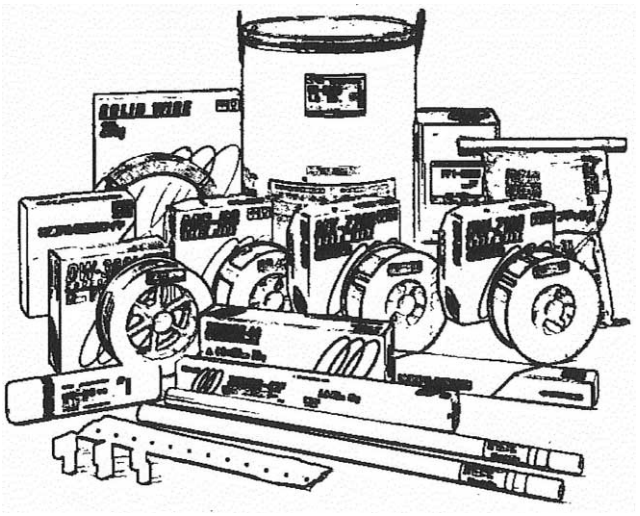
FILLER METAL STANDARDS
Part 1: AWS STANDARD



The number and variety of filler metal brands marketed around the world is enormous. The vast majority of brands are classified and designated in accordance with relevant national standards such as AWS, BS, CSA, DIN, JIS and NF, European standard (EN), and ISO international standard, depending on which welding markets are targeted. Thanks to the specification number and classification system of such standards, selecting the filler metal for a particular base metal is not difficult.

When particular national standards are specified in the international trade, the specifications may become accepted in other national markets. For example, the AWS filler metal specifications are often accepted in the international welding trades because they have prevailed in the welding industry worldwide in conjunction with other American national welding-related standards such as ASME Boiler and Pressure Vessel Codes, AWS Structural Welding Code, and AWS Bridge Welding Code.

Part 1 of this article will show how Kobe Steel has followed the AWS filler metal specifications in the production and supply of welding consumables and participated in the AWS for the standardization of filler metals. Part-2 of this article (appearing in the next issue) will describe the EN standards that prevail more widely in the newly expanded EU countries. Part-2 will also include more information about the AWS standards.

AWS specifications Kobe Steel currently follows

Many of the standards that are concerned with welding, brazing, and related processes are drawn up by the American Welding Society (AWS), which include filler metal classifications for steel, aluminum, copper, nickel, magnesium, titanium, zirconium metals and alloys. There are currently 31 AWS specifications for welding materials, including 29 specifications for filler metals and two for brazing fluxes and shielding gases. **Table 1** is a summary of AWS filler metal specifications that Kobe Steel currently follows when classifying KOBELCO brands for international trades.

Table 1. AWS filler metal specifications which KOBELCO brands follow currently for international trades (1)

	Carbon steel	Low alloy steel	Stainless steel	Ni & Ni alloy
Electrodes for SMAW	A5.1 (1991)	A5.5 (1996)	A5.4 (1992)	A5.11 (1997)
FCWs for FCAW	A5.20 (1995)	A5.29 (1998)	A5.22 (1995)	—
Flux core rods for GTAW	—	—		
Solid wires for GMAW & GTAW	A5.18 (2001)	A5.28 (1996)	A5.9 (1993)	A5.14 (1997)
Solid wires for SAW	A5.17 (1997)	A5.23 (1997)		
Flux-wire combination for SAW			—	—

Note (1) The particular edition of the AWS standards adopted by ASME Sec. II Part C of 2001 edition and 2002 and 2003 addenda are put in parentheses.

Most AWS filler metal specifications have been approved by the American National Standards Institute (ANSI) as American National Standards. They are designated as ANSI/AWS A5.XX (and A5.XXM for the metric edition) and published by the AWS. These specifications have been adopted by the American Society of Mechanical Engineers (ASME) and are published as ASME Sec. II Part C—Specifications for Welding Rods, Electrodes, and Filler Metals. When ASME adopts an AWS filler metal specification, it adds the letters "SF" to the AWS alphanumeric designation. Thus, ASME SFA-5.1, for example, is identical to the AWS A5.1 specification.

However, the year of publication of a particular ASME SFA-5.XX specification is not necessarily the same as that of the relevant AWS A5.XX specification because

of the different procedures for revision and inclusion by the two organizations. Kobe Steel follows the year of publication adopted by current SFA specifications to determine the AWS classifications for KOBELCO products taking into account the convenience for users, as shown in Table 1.

A5.XX and A5.XXM are not equivalent

As described in the relevant specifications, the A5.17/A5.17M specification, for instance, is a combined specification that utilizes both U.S. Customary Units (such as psi and °F) and the International System of Units (such as MPa and °C). Because each system produces measurements that are not equivalent, they must be used independently, without combining values in any way. There are 11 of such combined specifications adopted by ASME Sec. II Part C (incl. 2001 edition and 2002 and 2003 addenda).

A KOBELCO brand, AF-490/US-12K for SAW, for example, has been classified as F7A4-EM12K per A5.17. If this brand were classified in accordance with A5.17M-97, the classification would have to be F48A4-EM12K. Therefore, this change may affect the existing welding procedure specifications developed by customers using the classification per the traditional A5.17. This is why Kobe Steel presently follows the traditional specifications for classifying all the filler metals for international trade.

Classification systems of SMAW electrode specifications

This section summarizes some of the most widely-used classifications in order to show what factors are used to classify shielded metal arc welding covered electrodes by each specification.

A5.1: Carbon steel covered electrodes for SMAW are classified with the basic designation consisting of (1) minimum tensile strength, (2) welding position and (3) type of covering. **Table 2** shows the requirements for some examples of the basic designation. Optional supplemental designations add a suffix to the basic designation to clarify higher elongation, higher notch toughness, lower moisture content, and lower diffusible hydrogen content as compared to the standard designation, as shown in **Table 3**.

Table 2. Chemical and mechanical properties of weld metal and other requirements (AWS A5.1-91)

Classification	E6010	E6013	E6019	E7016	E7024
Type of covering	High cellulose	High titania	Iron oxide titania	Low hydrogen	Iron power, titania
Welding position	F, V, OH, H				H-fillet, F
Type of current	DCEP	AC, DCEP or DCEN		AC or DCEP	AC, DCEP or DCEN
TS (ksi)	60 min			70 min	
0.2%OS (ksi)	48 min			58 min	
El (%)	22 min	17 min	22 min		17 min (1)
Av. IV (J), min	27 at −29°C	Not specified	27 at −18°C	27 at −29°C	Not specified
Single IV (J), min	20 at −29°C		20 at −18°C	20 at −29°C	
Chemistry	Not specified			Mn, Si, Ni, Cr, Mo, V (2)	
As-received or conditioned Moisture content	Not required			0.6 wt% max	Not required

Note (1) E7024-1 shall have minimum 22% elongation
(2) Maximum of each element and total content are specified.

Table 3. Supplemental designations (AWS A5.1-91)

Designation	E7016-1, E7018-1		E7024-1
Av. IV (J), min	27 at −46°C		27 at −18°C
Single IV (J), min	20 at −46°C		20 at −18°C
Designation	E7016, E7016-1, E7018, E7018-1		
	H16	H8	H4
Diffusible H_2 content, Av. (ml/100g deposited metal)	16.0 max	8.0 max	4.0 max
Designation	E7016R, E7016-1R, E7016-1HZR (Z: 16, 8, or 4)		
As-received or conditioned moisture content	0.3 wt% max		
As-exposed moisture content	0.4 wt% max		

A5.5: Low-alloy steel covered electrodes (no single alloying element exceeding 10.5 percent) for SMAW are classified with the basic designation consisting of the chemical composition of the weld metal together with the same factors as stated in A5.1. **Table 4** shows the requirements for some classifications. Similar to A5.1, supplemental classifications, with additional suffixes, can designate diffusible hydrogen and moisture content. The scope of applications for covered electrodes classified by this specification ranges widely and includes high strength steels, weather proof steels, heat-resistant low-alloy steels, and pipeline steels.

A5.4: Stainless steel covered electrodes for SMAW are classified with the basic designation comprised of (1) weld metal chemical composition and (2) welding current and position. The first three digits designate the

chemical composition. Occasionally, more than three digits are used, and letters may follow the digits to indicate a specific composition. The last two digits designate the usability with respect to welding position and type of current. **Table 5** shows some examples of the basic and supplemental designations that specify type of welding current and position of welding.

Table 4. Chemical and mechanical properties of weld metal and other requirements (AWS A5.5-96)

Classification	E8016-B2	E8016-C1	E7010-P1	E9016-G (1)
Type of covering	Low hydrogen	Low hydrogen	High cellulose	Low hydrogen
Welding position	F, V, OH, H			
Type of current	AC or DCEP		DCEP	AC or DCEP
Application	Cr-Mo steel	Nickel steel	Pipeline	—
C (%)	0.05-0.12	0.12 max	0.20 max	—
Mn	0.90 max	1.25 max	1.20 max	1.00 min
Si	0.60 max	0.60 max	0.60 max	0.80 min
Ni	—	2.00-2.75	1.00 max	0.50 min
Cr	1.00-1.50	—	0.30 max	0.30 min
Mo	0.40-0.65	—	0.50 max	0.20 min
V	—	—	0.10 max	0.10 min
Cu	—	—	—	0.20 min
TS (ksi)	80 min		70 min	90 min
0.2%OS (ksi)	67 min		60 min	77 min
El (%)	19 min		22 min	17 min
Av. IV (J), min	Not specified	27 at −59°C	27 at −29°C	Not specified
Single IV (J), min		20 at −59°C	20 at −29°C	
PWHT (°C × hr)	690±14 × 1	605±14 × 1	As-welded	— (2)
As received or reconditioned moisture content	0.2 wt% max		NA	0.15 wt% max

Note (1) At least one of the chemical elements shall be met.
(2) As agreed between supplier and purchaser

Table 5. Chemical and mechanical requirements for weld metal and usability suffixes (AWS A5.4-92)

Classification	E308	E308L	E309	E316	E316L
C (%)	0.08 max	0.04 max	0.15 max	0.08 max	0.04 max
Cr	18.0-21.0		22.0-25.0	17.0-20.0	17.0-20.0
Ni	9.0-11.0		12.0-14.0	11.0-14.0	
Mo	0.75 max			2.0-3.0	
Mn	0.5-2.5				
Si	0.90 max				
TS (ksi)	80 min	75 min	80 min	75 min	70 min
El (%)	35 min			30 min	
PWHT	As-welded				

Suffix	Welding current	Welding position
EXXX(X) -15	DCEP	All (1)
EXXX(X) -25	DCEP	H, F
EXXX(X) -16	DCEP or AC	All (1)
EXXX(X) -17	DCEP or AC	All (1)
EXXX(X) -26	DCEP or AC	H, F

Note (1) 4.8-mm or thicker electrodes are not recommended for welding all positions.

A5.11: Nickel and nickel alloy covered electrodes for SMAW are classified according to the chemical composition of their undiluted weld metal. **Table 6** shows the requirements for some widely used classifications.

Table 6. Weld metal chemical and mechanical requirements (AWS A5.11-97)

Classification	ENiCrFe-1	ENiCrFe-3	ENiCrFe-9	ENiMo-8
C	0.08 max	0.10 max	0.15 max	0.10 max
Mn	3.5 max	5.0-9.5	1.0-4.5	1.5 max
Fe	11.0 max	10.0 max	12.0 max	10.0 max
Si	0.75 max	1.0 max	0.75 max	0.75 max
Cu	0.50 max	0.50 max	0.50 max	0.50 max
Ni	62.0 min	59.0 min	55.0 min	60.0 min
Co	—	— (1)	—	—
Ti	—	1.0 max	—	—
Cr	13.0-17.0	13.0-17.0	12.0-17.0	0.5-3.5
Nb+Ta	1.5-4.0 (1)	1.0-2.5 (2)	0.5-3.0	—
Mo	—	—	2.5-5.5	17.0-20.0
W	—	—	1.5 max	2.0-4.0
TS (ksi)	80 min		95 min	
El (%)	30 min		25 min	

Note (1) Cobalt−0.12% maximum, when specified
(2) Tantalum−0.3% maximum, when specified

Classification systems of FCAW and GTAW flux-cored wire/rod specifications

In a simplified manner, this section shows the classifications for flux-cored wires used in FCAW of carbon, low-alloy and stainless steels and flux-cored rods for GTAW of the root-pass of stainless steels.

A5.20: Carbon steel flux-cored wires for FCAW are classified with the designators combining (1) minimum tensile strength, (2) welding position and (3) usability characteristics (incl. suitable shielding gases). The classifications can be suffixed to designate diffusible hydrogen similarly to A5.1. **Table 7** shows the requirements for some widely used classifications and supplemental designations.

Table 7. Chemical and mechanical properties of weld metal and other requirements (AWS A5.20-95)

Classification	E70T-1 E70T-1M	E71T-1 E71T-1M	E70T-9 E70T-9M	E71T-9 E71T-9M	E71T-12 E71T-12M
Chemistry (%)	C, Mn, Si, P, S, Cr, Ni, Mo, V, Al, Cu are specified as individual maximums				
TS (ksi)	70 min				70-90
0.2%OS (ksi)	58 min				
El (%)	22 min				
Av. IV (J), min	27 at −18°C		27 at −29°C		
Welding position	H, F	H, F, VU, OH	H, F	H, F, VU, OH	
Shielding gas	E70T-1/-9, E71T-1/-9/-12: CO_2, E70T-1M/-9M, E71T-1M/-9M/-12M: 75-80%Ar/bal CO_2				
Polarity	DCEP				
Optional designation for IV	E7XT-1J, -1MJ, -5J, -5MJ, -6J, -8J, -9J, -9MJ, -12J, -12MJ shall meet 27J at −40°C				

A5.29: Low alloy flux-cored wires for FCAW are classified with designators combining (1) minimum tensile strength, (2) welding position, (3) usability characteristics, (4) weld metal chemistry and (5) applicable shielding gas. The classifications can be

suffixed with the extra notch toughness designator (J) similar to that in A5.20 and with the diffusible hydrogen designators similar to those specified in A5.1. **Table 8** shows the requirements for some extensively used classifications.

Table 8. Chemical and mechanical properties of weld metal and other requirements (AWS A5.29-98)

Classification	E81T1-B2 E81T1-B2M	E81T1-Ni1 E81T1-Ni1M	E81T1-K2 E81T1-K2M	E91T1-K2 E91T1-K2M
Application	Cr-Mo steel	Ni steel	Other low alloy steel	
C (%)	0.05-0.12	0.12 max	0.15 max	
Mn	1.25 max	1.50 max	0.50-1.75	
Si	0.80 max	0.80 max	0.80 max	
Ni	—	0.80-1.10	1.00-2.00	
Cr	1.00-1.50	0.15 max	0.15 max	
Mo	0.40-0.65	0.35 max	0.35 max	
V	—	0.05 max	0.05 max	
TS (ksi)	80-100			90-110
0.2%OS (ksi)	68 min			78 min
El (%)	19 min			17 min
Av. IV (J), min	—	27 at −29°C		27 at −18°C
PWHT (°C × hr)	690±15 × 1	As-welded		
Welding position	H, F, VU, OH			
Shielding gas	E81T1-XX/E91T1-XX: CO_2, E81T1-XXM/E91T1-XXM: 75-80%Ar/bal CO_2			
Polarity	DCEP			
Optional designation for IV	The additional digit " J " shall meet 27J at 11°C lower than the temperature shown above.			

A5.22: Stainless steel flux-cored wires for FCAW and rods for GTAW are classified with designators that combine (1) weld metal chemistry, (2) welding position, and (3) type of shielding gas. **Table 9** shows the requirements for some widely used classifications.

Table 9. Chemical and mechanical properties of weld metal and other requirements (AWS A5.22-95)

Classification (FCAW wire)	E308LT1-1 E308LT1-4	E309LT1-1 E309LT1-4	E309LMoT1-1 E309LMoT1-4	E316LT1-1 E316LT1-4
C (%)	0.04 max			
Cr	18.0-21.0	22.0-25.0	21.0-25.0	17.0-20.0
Ni	9.0-11.0	12.0-14.0	12.0-16.0	11.0-14.0
Mo	0.5 max		2.0-3.0	
Mn	0.5-2.5			
Si	1.0 max			
TS (ksi)	75 min			70 min
El (%)	35 min	30 min	25 min	30 min
Welding position	All position			
Shielding gas	EXXXTX-1: CO_2 EXXXTX-4: 75-80%Ar/bal CO_2			
Polarity	DCEP			
Classification (GTAW rod)	R308LT1-5	R309LT1-5	R316LT1-5	R347T1-5
C (%)	0.03 max			0.08 max
Cr	18.0-21.0	22.0-25.0	17.0-20.0	18.0-21.0
Ni	9.0-11.0	12.0-14.0	11.0-14.0	9.0-11.0
Mo	0.5 max		2.0-3.0	0.5 max
Mn	0.5-2.5			
Si	1.2 max			
TS (ksi)	75 min		70 min	75 min
El (%)	35 min	30 min		
Welding position	All position			
Shielding gas	EXXXTX-5: 100%Ar			
Polarity	DCEN			

This article on classification systems will continue by describing the specifications for A5.18, A5.28, A5.9, A5.14, A5.17, and A5.23 in the next issue.

How Kobe Steel complies with customer requests for " G "grade filler metals

Like the A5.5 specification summarized in Table 4 above, other classifications, such as A5.20, A5.29, A5.22, A5.18, A5.28, A5.9 and A5.23, can specify a supplemental designation with the " G "suffix. As declared in the annex of A5.5, this allows a useful filler metal—that would otherwise have to await a revision of the specification—to be classified immediately under the existing specification. However, such " G "classifications are specified with very limited information about filler metal characteristics. This means, then, that two filler metals, each bearing the same " G "classification, may be quite different in some certain respect (chemistry for example).

Many KOBELCO brands, particularly the low-alloy filler metals, bear the G-classification because of unique chemical and mechanical properties designed to meet strict customer requirements for specific applications. Users that need more information on a particular KOBELCO filler metal of that classification for a certain application should refer to KOBELCO WELDING HANDBOOK or contact their nearest Kobe Steel office or distributor. Then, Kobe Steel will provide an appropriate document such as technical reports and " Guarantee of Quality "for the user. The user may want to incorporate that information (via ANSI/AWS A5.01, Filler Metal Procurement Guidelines) in the purchase order.

KOBELCO participates in the AWS to standardize filler metals

Kobe Steel has long been participating in the activities of the AWS Filler Metal Committee for the establishment and revision of filler metal standards, in collaboration with Kobelco Welding of America Inc., a " Sustaining Company Member "of the AWS. During Kobe Steel's long history of such collaboration, the establishment of E6019 per A5.1, ENiCrFe-9 and ENiMo-8 per A5.11, ERNiMo-8 per A5.14, and R308LT1-5, R309LT1-5, R316LT1-5 and R347T1-5 per A5.22 are noticeable results from the standpoint of industrial and commercial significance of the products developed by Kobe Steel.

Stricter Quality Requirements Increasingly Demanded for DC-spec. Cr-Mo Filler Metals

CMA-96MBD and PF-200D/US-511ND for 1-1.25Cr-0.5Mo Steel, CMA-106ND and PF-200D/US521S for 2.25Cr-1Mo Steel: Our New Challenges

Most filler metals suitable for alternating current (AC) may be used with direct current (DC), unless the quality requirement is strict. When requirements are strict, the matter is treated seriously, even when a particular filler metal is classified by the AWS as an AC-or-DCEP type. This is because the polarity of welding current affects the chemical composition (C, Si, Mn, and O in particular)—and thus the mechanical properties—of the weld metal.

Kobe Steel has long been producing Cr-Mo steel filler metals for oil refinery reactor vessels and heat exchangers, which include CMA-96MB (E8016-B2) and PF-200/US-511N (F8P2-EG-B2) for 1-1.25Cr-0.5Mo steel and CMA-106N (E9016-B3) and PF-200/US-521S (F9P2-EG-B3) for 2.25Cr-1Mo steel. These filler metals have a high reputation in the domestic and overseas markets. Unlike in the domestic market, DC power sources are often used overseas, increasing demand for filler metals designed for DC current use with better performance in notch toughness, resistance to temper embrittlement and high-temperature strength. To meet this demand, Kobe Steel, with its reputation for filler metal technical know-how, has developed brand new DC-spec. filler metals that are more suitable for DCEP welding and able to meet stringent requirements.

SMAW covered electrodes for 1-1.25Cr-0.5Mo and 2.25Cr-1Mo steel

With the elaborate chemical composition of the weld metal, CMA-96MBD (E8016-B2) and CMA-106ND (E9016-B3) exhibit excellent room and high-temperature tensile properties, low-temperature impact toughness and resistance to temper embrittlement, as well as good usability, with DCEP currents. Typical chemical and mechanical properties are shown in **Tables 1** and **2**, respectively.

Table 1. Typical chemical properties of CMA-96MBD and CMA-106ND weld metals (1)

Brand (Application)	CMA-96MBD (1-1.25Cr-0.5Mo)		CMA-106ND (2.25Cr-1Mo)	
Size and Welding position	4.0ϕ, 45-deg. vertical-up	5.0ϕ, Flat	4.0ϕ, 45-deg. vertical-up	5.0ϕ, Flat
C (wt %)	0.06	0.06	0.11	0.11
Si	0.37	0.49	0.32	0.42
Mn	0.76	0.79	0.84	0.84
P	0.006	0.006	0.004	0.004
S	0.004	0.004	0.002	0.002
Cu	0.01	0.02	0.032	0.031
Ni	0.03	0.02	0.13	0.14
Cr	1.29	1.30	2.41	2.42
Mo	0.57	0.56	1.04	1.03
Sb	0.002	0.002	< 0.002	< 0.002
Sn	< 0.002	< 0.002	0.002	0.002
As	0.002	0.002	0.002	0.002
X-bar (2)	< 8 ppm	< 8 ppm	< 6 ppm	< 6 ppm
J-factor (3)	< 90.4	< 102.4	69.6	75.6

Note (1) Base metal: ASTM A387 Gr. 11, Cl. 2 for CMA-96MBD; A387 Gr. 22, Cl. 2 for CMA-106ND; Plate thickness: 19 mm
(2) X-bar = (10P + 5Sb + 4Sn + As) / 100 (ppm)
(3) J-factor = (Si + Mn) × (P + Sn) × 10000

Table 2. Typical tensile properties of CMA-96MBD and CMA-106ND weld metals (1)

Brand (Application)	Size, welding position	PWHT (°C × hr)	Test temp. (°C)	0.2%OS (MPa)	TS (MPa)	El (2) (%)	RA (%)
CMA-96MBD (1-1.25Cr-0.5Mo)	4.0ϕ 45-deg. vertical-up	690 × 1	RT (19)	515	617	27	76
			454	394	484	19	73
		690 × 8	RT (20)	469	583	29	76
			454	368	456	25	76
	5.0ϕ Flat	690 × 1	RT (19)	476	588	29	77
			454	371	468	24	76
		690 × 8	RT (20)	435	557	30	76
			454	342	438	24	78
CMA-106ND (2.25Cr-1Mo)	4.0ϕ 45-deg. vertical-up	690 × 8	RT (20)	501	635	26	72
			454	402	483	19	73
		690 × 26	RT (20)	440	588	28	72
			454	343	446	23	73
	5.0ϕ Flat	690 × 8	RT (20)	504	644	28	71
			454	405	489	20	73
		690 × 26	RT (20)	435	594	30	72
			454	344	449	23	73

Note (1) Base metal: ASTM A387 Gr. 11, Cl. 2 for CMA-96MBD; A387 Gr. 22, Cl. 2 for CMA-106ND; Plate thickness: 19 mm
(2) Gauge length: 4D for RT, 5D for 454°C

X-bar and J-factor, shown in Table 1, are the index of control against the susceptibility to temper embrittlement of the weld metal: the higher the index, the more susceptible the weld metal becomes, according to the most commonly-accepted embrittlement mechanism. To

confirm the temper embrittlement susceptibility, Charpy impact testing is conducted for the weld metal in the as-PWHT and PWHT + step-cooling (**Figure 1**) conditions. **Figure 2** shows typical Charpy test results of CMA-96MBD and CMA-106ND weld metals that confirm their high resistance to temper embrittlement.

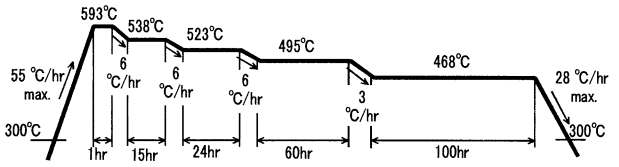


Figure 1. Step-cooling (SC) heat treatment (Socal No. 1)

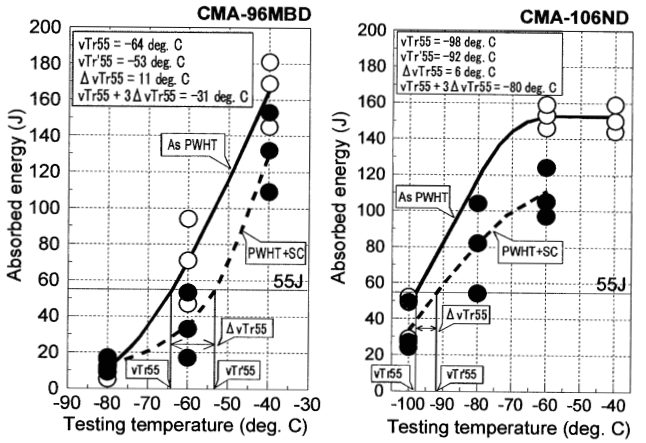


Figure 2. Temper embrittlement test results of CMA-96MBD and CMA-106ND weld metals in the as-PWHT (690°C × 8 hr) and PWHT+ SC (4.0ϕ, 45-deg. vertical-up position)

SAW flux/wire combinations for 1-1.25Cr-0.5Mo and 2.25Cr-1Mo steel

With sophisticated wire electrode chemistry and a unique bonded flux, PF-200D/US-511ND (F8P2-EG-B2) and PF-200D/US-521S (F9P2-EG-B3) offer first-class performance in room and high-temperature tensile strength and ductility, low-temperature notch toughness and resistance to temper embrittlement, as well as outstanding usability, with DCEP currents.

Table 3 shows typical chemical composition and temper embrittlement index values of the weld metals. **Table 4** presents typical tensile properties of the weld metals, as a function of PWHT, tested at room and high temperatures. **Figure 3** exhibits the unsurpassed resistance of the weld metals against temper embrittlement, with a comparison of 55-J absorbed energy transition temperatures in the as-PWHT and PWHT + SC conditions.

Table 3. Typical chemical properties of PF-200D/US-511ND and PF-200D/US-521S weld metals by single SAW (1)

Brand (Application)	PF-200D/US-511ND (1-1.25Cr-0.5Mo)	PF-200D/US-521S (2.25Cr-1Mo)
C (wt %)	0.08	0.09
Si	0.21	0.16
Mn	0.82	0.81
P	0.007	0.006
S	0.003	0.003
Cu	0.09	0.13
Ni	0.15	0.13
Cr	1.39	2.41
Mo	0.56	1.07
Sb	0.002	0.002
Sn	< 0.002	< 0.002
As	0.002	0.002
X-bar (2)	< 9 ppm	< 8 ppm
J-factor (3)	< 93	78

Note (1) Base metal: ASTM A387 Gr. 11, Cl. 2 for PF-200D/US-511ND; A387 Gr. 22, Cl. 2 for PF-200D/US-521S; Plate thickness: 20 mm; Wire size: 4.0 mmϕ
(2) X-bar = (10P + 5Sb + 4Sn + As) / 100 (ppm)
(3) J-factor = (Si + Mn) × (P + Sn) × 10000

Table 4. Typical tensile properties of PF-200D/US-511ND and PF-200D/US-521S weld metals by single SAW (1)

Brand (Application)	PWHT (°C× hr)	Test temp. (°C)	0.2%OS (MPa)	TS (MPa)	El (2) (%)	RA (%)
PF-200D/ US-511ND (1-1.25Cr0.5Mo)	640 × 5	RT (19)	522	630	25	69
		454	408	491	17	64
	690 × 4	RT (19)	477	589	27	73
		454	376	465	17	72
	691 × 20	RT (19)	424	546	29	73
		454	336	437	21	73
PF-200D/ US-521S (2.25Cr-1Mo)	690 × 6	RT (20)	507	621	26	75
		454	414	485	17	70
	690 × 13	RT (20)	484	602	28	73
		454	403	472	17	72
	690 × 28	RT (20)	468	584	28	72
		454	380	452	20	72

Note (1) Base metal: ASTM A387 Gr. 11, Cl. 2 for PF-200D/US-511ND; A387 Gr. 22, Cl. 2 for PF-200D/US-521S; Plate thickness: 20 mm Wire size: 4.0 mmϕ
(2) Gauge length: 4D for RT, 5D for 454°C

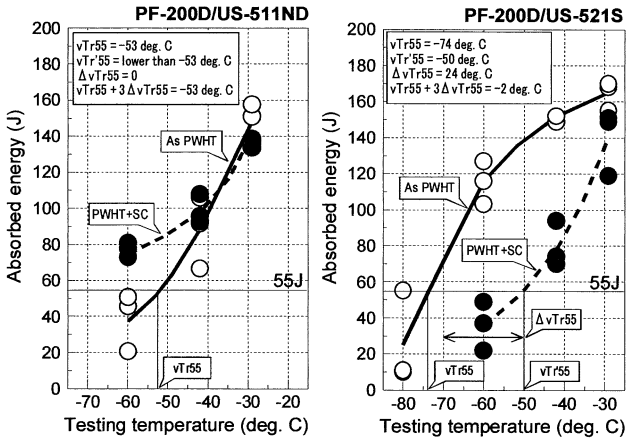


Figure 3. Temper embrittlement test results of the weld metals made with PF-200D/US-511ND in the as-PWHT (640°C × 5 hr) and PWHT + SC conditions and with PF-200D/US-521S in the as-PWHT (690°C × 6 hr) and PWHT + SC conditions (Wire size: 4.0ϕ, single SAW)

AWS Welding Show 2004 heats up the welding business

The AWS Welding Show was held at McCormick Place in Chicago from the 6th through the 8th of April, 2004. This year, the AWS Show was combined with the Gases and Welding Distributors Association (GAWDA), who mounted, as a part of their Regional Conference (from April 4-5), a special pavilion within the AWS Show. This expanded AWS exposition succeeded in bringing more visitors than a single exposition by the American Welding Society (AWS) would have. A total of 6,687 people attended, which was 11.5% increase from the last Show in Detroit.

Kobelco Welding of America (KWAI) attended as an exhibitor—making its 15th appearance in an AWS Show—and continued our promotion of the new "DWG Series" stainless flux cored wires. We received numerous positive leads from this Show which will certainly bring us lots of new business.

Hello, from KWAI staff at the KOBELCO booth

The KOBELCO and neighboring booths at the Show

The AWS Show in 2005 will be held in Dallas Texas which is Kobelco's backyard. See you in Dallas!

Reported by Andrew Sawada, KWAI

Greetings from a new member of the IOD: Applause encourages anybody

Yuji Wakayama
IOD, Welding Co.
Kobe Steel, Ltd.

My name is Yuji Wakayama. I came to the International Operations Department last January. Still in my fourth year with Kobe Steel, I need much more experience and job knowledge. I hope you will kindly assist me.

Before coming to the IOD, I was in Kyushu and was in charge of sales through distributors. On a busy day, I could drive as far as 500 km my car loaded with Kobelco welding consumables, working on sales to customers throughout my territory. My guiding principle was to visit users at all events and thus I developed close contacts with many users in a period of a little less than three years. Now I am in charge of the Korean Market. Though the business arena has changed from the domestic to the international market, I believe the basics of my job remain the same. I wish to introduce as many of our products as possible that will serve our customers' purposes to the fullest extent.

My hobby is wind music. It is 12 years since I started playing the tuba. I take part in a concert once or twice in a year where we play pieces arranged from orchestra music and film music. An important factor for achieving good performances is that every player should show his full ability. However, even more important is that each player should not go-it-alone, but be aware of belonging to a band that seeks to make a piece of music in harmony with the other performers. In fact, this is the biggest attraction for members of a musical band. Once you are given applause on the stage from the audience after a performance, you never can stop being a player.

I believe that the same factors apply to business. It is a splendid thing for me to be conscious of an objective, such as the welded structure that the user wishes to make, and, together with the user and distributor, stimulate each other until we finally accomplish it. I will never forget the applause I will be given after accomplishing an objective, even though the sound will be different from the applause after a stage performance. I wish to tackle my job with such a frame of mind.

Good bye to KWAI...

After six years assignment as president of KWAI, I have come back to Kobe Steel, Japan, in May. During my stay in the US, I had tremendous support from KWAI customers and distributors in USA, Canada and Mexico. I really appreciated the great encouragement extended to me. Thanks to the combined effect of quality product, quick delivery and distributors' strong support, Kobe Steel has been successful to strengthen its business foundation in North America and Latin America.

My new assignment is as the General Affairs Manager of the Fujisawa Industrial Operations that is recognized as the Kobelco Welding Center consisting of R&D Dept., Welding System Dept., and the group companies for producing welding wires and conducting welding-related testing and inspection. I will tackle my new job with a new frame of mind so that I can contribute to the development of the KOBELCO welding business.

Yoshiki (Duke) Kawaue
Former President of KWAI

...then Hello from KWAI

I am Akihiko Alan Egami, the new president of KWAI, succeeding Mr. Kawaue, the former president. The assignment to this post was nothing but a surprise to me, because I had been working for the iron and steel business all my company life with Kobe Steel, except for the period when I was engaged in the headquarters' administrative affairs for the Personnel and Planning Departments. I believe this kind of personnel relocation is unusual with only a few precedents. My most recent post was in Hokkaido, the northernmost island of Japan where there was much snowfall. Further back, I was in Singapore, a land of perpetual summer, before snowy Hokkaido! Thus, it really has been a series of physically tough relocations for me, going from a hot land to a cold land and now to hot Houston.

Akihiko Alan Egami
President of KWAI

All the same, I am excited with my new assignment. For, the Welding Company of Kobe Steel is one of the leading companies in the world, and I am convinced that our products are the best in quality, the world over. With this new assignment, I am now given the responsibility of sales of our welding products in North America. This new challenge thrills me. I am firmly determined to bring KWAI to such a position comparable to the BIG 3 of the USA with a view to local production in the future. Let me sincerely ask you for your kind cooperation in achieving this end.

I have always had to wear a business suit to work. But here in Texas, I may even have the freedom to work in a cowboy suit! (Well, perhaps that is exaggerating a little.) Seriously, it will be a pleasure for me to meet various sorts of people and have a wide range of cross-cultural experiences. My immediate personal goal is to brush up my English so that I can cheer and shout and converse with fellow spectators at the games of the four major professional sports leagues: MLB (Major League Baseball), NFL (National Football League), NBA (National Basketball Association) and NHL (National Hockey League). My three sons have grown up and stay in Japan, and at this time I live with my wife alone after twenty odd years. Taking this opportunity, I hope we will be able to enjoy a second honeymoon together.

I plan to visit many places in the KWAI's wide territory starting today! It will be a real pleasure to meet our precious distributors, who are also dear readers of Kobelco Welding Today.

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