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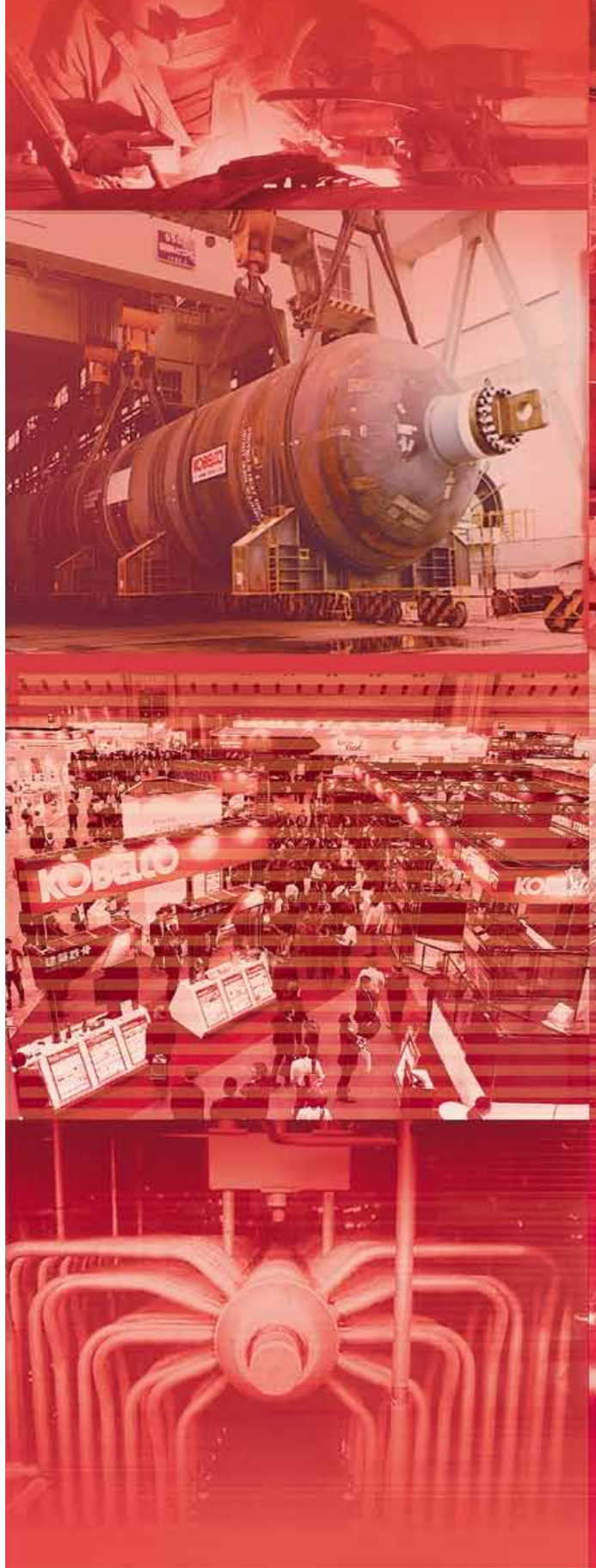

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KOBELCO Puts the Customer First with All-in-One Product and Service

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KOBELCO WELDING TODAY No.2 2018

CONTENTS Vol.21

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Preface

Inaugural address by Akira Yamamoto, new Head of the Welding Business

Akira Yamamoto
Managing Executive Officer,
Head of the Welding Business
KOBE STEEL, LTD.

Dear KWT readers! My name is Akira Yamamoto, the new Head of the Welding Business. I succeeded Mr. Koshiishi, my predecessor, in April 2018. I would like to express my heartfelt gratitude for your kind patronage of and continuous support for KOBELCO products.

I wish to begin my inaugural address by deeply and sincerely apologizing for having caused you substantial trouble and inconvenience due to the misconduct related to quality management committed by KOBE STEEL and the KOBE STEEL Group. As for the Welding Business, I would like to report that we commissioned an independent body to evaluate our voluntary inspections of quality at domestic as well as overseas production sites and that nothing inappropriate related to quality has been observed. In addition, we promise that we will continue to carry out the highest standard of quality control.

We in the Welding Business have been conducting our activities in accordance with our vision, "to be the most reliable welding solutions company in the world." Some of these activities were on display at the Japan International Welding Show held in Tokyo last April, including a proposed means of manpower-saving automation that combines four robotic welding systems with the most suitable consumable, as well as our range of welding consumables created specifically for the shipbuilding, energy and automobile industries. (See the bulletin article on pages 9-10 in this issue for more details.)

During the show, we could highlight the achievements of our activities to many visitors at the KOBELCO booth, while emphasizing our plans to develop welding automation and manpower savings further by utilizing IoT and AI technologies in the future.

On the other hand, the welding solution many of our customers rely on is not related to robotic automation at all; for example, shielded metal arc welding with covered electrodes remains one of the most convenient of welding processes.

The environment surrounding the welding business is changing day by day, and so are most customers. By staying sensitive to the changes, we will be able not only to develop new products that match their needs but to enhance the distinctiveness and added-value of our products.

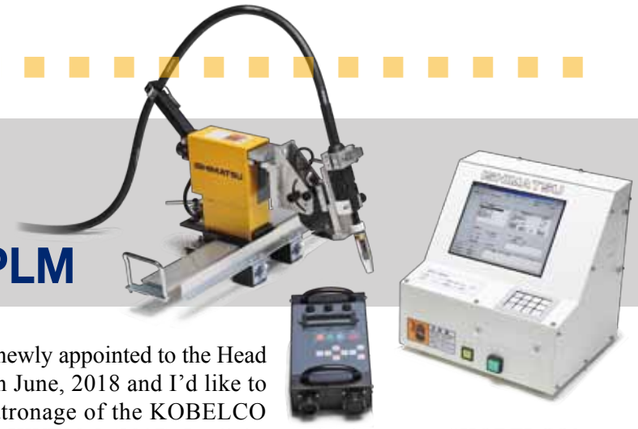
As our KOBELCO members continue to visit your countries and regions, please let them know your problem(s), trouble(s) and/or needs for your welding operations.

Lastly, our vision, "aiming to be the most reliable welding solutions company in the world" that was established and succeeded by my predecessors, Messrs. Kasuya and Koshiishi, will never be changed even as I become the Head of the Welding Business. I surely believe that our responsibilities are to provide you with stable, high quality products and excellent services, cultivated by the high capability of Monodzukuri (production system innovation), so as to obtain your full trust in the KOBELCO brands.

As we promise to make wholehearted efforts in order to meet your expectations, your support is most appreciated.

Preface

Welding automation with ISHIMATSU, the portable robot, and PLM



Dear KWT readers! My name is Hiroyuki Shimizu, newly appointed to the Head of the Technical Center as Mr. Nagata's successor in June, 2018 and I'd like to express my warmest thanks for your continuous patronage of the KOBELCO group's products. Following Mr. Nagata's last article in KWT20-2 (2017), I will discuss the direction of KOBELCO's technological development and focus on how welding automation is part of our effort in the Welding Business to achieve the KOBE STEEL group's mid-term management plan called "KOBELCO VISION G+."

Firstly, I am happy to introduce the new, small portable welding robot named ISHIMATSU (Figure 1) that was added to our robotic product range last December. It has already been utilized in parallel with ARCMAN™ robots, the main Series of KOBELCO robots used by a number of steel fabricators in Japan. While an ARCMAN™ robot takes up space in a factory, the ISHIMATSU does not because it is both portable and fixed directly upon the work pieces it is welding. On the other hand, it requires some assistance from an operator, whereas the ARCMAN™ can finish welding an entire workpiece without any help. Remarkably, ISHIMATSU has increasingly been used for welding on building construction sites. While there are pros and cons to both ISHIMATSU and ARCMAN™, we are happy to be able to offer a choice that will match users' situations. We believe that there are large potential markets for the ISHIMATSU, particularly in areas or on workpieces where a large robotic system like ARCMAN™ is not applicable but automated welding is desired. While we have not yet started marketing it overseas, we are investigating whether to start recommending it for automation on large-scale structures.

Figure 1: ISHIMATSU welding robots

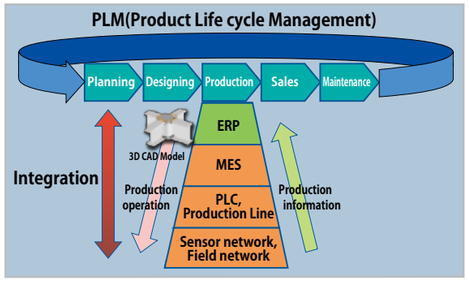


Figure 2: Integration of product life cycle in PLM

Secondly, I will discuss the function of robotic welding systems utilizing KOBELCO's Information and Communication Technology (ICT). We have already improved productivity by using ICT as discussed in last year's KWT. "Vertical integration of production" is a key concept of our activity, as shown in Figure 2. Product life cycle management (PLM) is a holistic management system, based on ICT, of product-related information covering the whole lifecycle of products, such as design, production, maintenance, disposal and recycling, with the aim of maximizing profits. Although it is not easy to create operation commands that order a robot to conduct steady welding with three-dimensional CAD data, ICT has allowed us to achieve it. Furthermore, it will allow us to achieve better traceability and perform organic control by recording the conditions at times of spatter and fume generation and stops, in addition to recording overall welding conditions and system operations.

Hiroyuki Shimizu
Head of the Technical Center
Welding Business
KOBE STEEL, LTD.

The above-mentioned robots and PLM were exhibited at the Japan International Welding Show (JIWS) held in Tokyo last April. KOBELCO representatives will visit your countries and regions directly to introduce our latest products and technologies including the above and listen to your requests. As your requests are always changing, I believe it is important for us to deal with your needs properly. By rotating the circle of "needs→dealing→improvement" and receiving feedback on progress, we will continue deepening our activities to achieve our business vision of "being the most reliable welding solutions company in the world."

B91 Series welding consumables for Grade 91 steels

KOBELCO WELDING TODAY
Vol.21 No.2 2018

1 Preface

The biggest concern in the field of thermal power generation is the reduction of CO_2 emissions. However, the most effective way of achieving that is to improve the efficiency of power generation, which requires steam at high temperature and pressure to be fed into power generating turbines. In Figure 1, it can be seen that steam conditions (temperature and pressure) at thermal power generation plants in Japan have trended up over the decades.

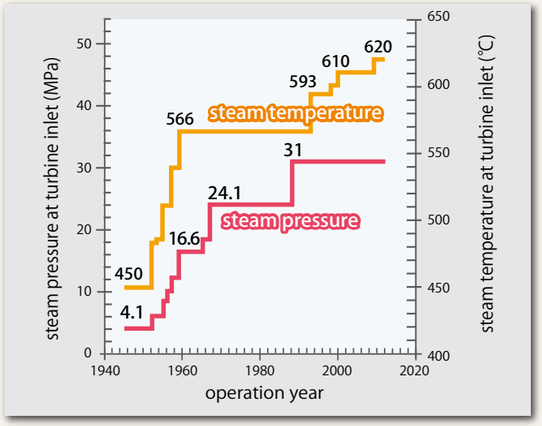


Figure 1: Steam pressure and temperature for thermal power generation in Japan

Thermal power generation plants, therefore, require special steels that can be utilized for long periods under such high temperature and pressure steam conditions, such as high chromium (Cr) ferritic heat resisting steels containing 9-12% Cr. Grade 91 (Gr. 91) steel is the main high Cr ferritic steel that has been put into practical service in thermal power plant boilers worldwide. KOBE STEEL, LTD. (KSL) has developed and marketed both 9Cb Series and B9 Series consumables for welding Gr. 91 steels, and they have been well-received by many domestic and overseas boiler fabricators.

On the other hand, an issue concerning high Cr ferritic steel is the combined amount of Mn+Ni, which has gradually come to be a subject of regulation. For example, such international standards bodies as ASME and AWS have started to review the issue accordingly.

The B91 Series consumables, developed in accordance with these concerns, will be discussed as products corresponding to the AWS standards.

2 International standards

In recent years, international standards bodies have moved to continuously modify requirements for both the Mn+Ni content and the post weld heat treatment (PWHT) temperature.

Tables 1 and 2 show the trends of ASME B31.1 and AWS B9/B91 standards respectively.

Table 1: Trend of ASME B31.1 standard

Year	Mn+Ni content (mass %)	Upper limit of PWHT temperature at actual procedure (℃)		Reference (Year of revision)
		Recommended condition	Mandatory condition	
2008 and before	Not regulated	760	Base metal A_{c1}: about 800	Table 132 P-No. 5B Group No. 1→ Group No. 2
2009 -2013	Filler metal unknown	775	Base metal A_{c1}: about 800	Table 132 P-No. 15E Group No. 1 (2009)
	1.0≤Filler metal <1.5	790		
	Filler metal<1.0	800		
2014 and after	Filler metal<1.2	775	Base metal A_{c1}: about 800 and filler metal A_1 or A_{c1}*2	Table 132 P-No. 15E Group No. 1 (2014)
	<1.0 *1	———		125.1.3 (2014) For repair of casting

Note: *1 B9: SMAW, SAW, GTAW and FCAW
*2 A_1 or A_{c1} in filler metals is determined either by analysis and calculation or by actual measurement

Table 2: Trend of AWS B9/B91 standard

Year	Upper limit of Mn+Ni content in deposited metal (mass %) *1	Upper limit of PWHT temperature at specified for testing (°C)	Reference (Year of revision) *2
Up to 2004	Not regulated*3	759 (SMAW) or 760	B9: SMAW, GMAW, GTAW (1996) SAW (1997)
2005 -2010	1.5 or 1.50	775	B9: GMAW, GTAW (2005) SMAW (2006) SAW (2007) FCAW (2010)
From 2010 onwards	1.40	775	B9 deleted → B91 newly established B91: SAW (2011), FCAW (2012) SMAW (2014) *4

Note: *1) Wire or cut rod chemistry in case of GMAW and GTAW
*2) AWS Specification No.: SMAW: A5.5; SAW: A5.23; GMAW & GTAW: A5.28; FCAW: A5.36
*3) Sum of both Mn and Ni specified upper limit figures is 2.25
*4) Revision of GMAW and GTAW is under discussion as of May, 2018.

Both tables show that the upper limits for Mn+Ni content have been repeatedly reduced in both sets of standards. In welding Gr. 91 steels, this has allowed the upper limits on the temperature for PWHT, which is essential for reducing residual stress after welding, to be eased higher. Following optimum PWHT, Gr. 91 weld metal exhibits a tempered martensite structure that provides excellent high temperature strength and toughness. However, it is well-understood that once the PWHT temperature exceeds the A_{c1} transformation point, fresh martensite transforms back into austenite, and, during cooling, returns to become fresh martensite again, leading to deterioration of creep and toughness properties. Therefore, the content of Mn and Ni needs to be kept low because these elements lower the A_{c1} transformation point. (See Figure 2)

3 Chemical compositions and A_{c1} transformation point of B91 Series welding consumables

Although 9Cb Series welding consumables are not entirely compatible with AWS specifications because they are designed to obtain comparatively high Mn+Ni content, they have been utilized successfully in domestic and overseas projects in which PWHT temperature requirements have been relatively low. However, in cases where following AWS specifications is mandatory, particularly in overseas projects, these consumables could not be applied.

KSL originally developed and marketed the B9 Series consumables to be compatible with AWS specifications. The B91 Series consumables were later developed to comply with stricter AWS requirements in 2012, especially the ever-stricter limitations on Mn+Ni content.

Table 3 shows the typical chemical compositions of deposited metals and A_{c1} transformation points, and Table 4, the typical mechanical properties after PWHT, of the 9Cb and B91 Series consumables, respectively. It can be seen that the B91 Series consumables are designed to provide the designated mechanical properties after PWHT while Mn+Ni content is controlled to be equal to or less than 1.0%, lower than that of the 9Cb Series consumables. Figure 2 shows the relationship between Mn+Ni content and actually measured A_{c1} transformation points. It can be seen that typical A_{c1} transformation points actually measured with the B91 Series consumables show 800 °C or over. Therefore, it is certain that higher PWHT temperatures can be applied.

Table 3: Typical chemical composition of weld metal and A_{c1}

Process	Polarity	Consumables	Chemical composition of weld metal (mass%)											A_{c1} (°C)
			C	Si	Mn	Ni	Cr	Mo	Nb	V	Co	N	Mn+Ni	
SMAW	DCEP	CM-9Cb	0.05	0.26	1.38	0.97	9.21	1.10	0.02	0.21	–	0.04	2.35	733
SAW	AC	PF-200S/US-9Cb	0.07	0.13	1.55	0.67	8.54	0.89	0.04	0.22	–	0.03	2.22	750
GTAW	DCEN	TG-S9Cb (100%Ar)	0.07	0.18	1.01	0.69	8.63	0.91	0.04	0.18	–	0.02	1.70	765
GMAW	DCEP	MG-S9Cb (Ar-20%CO_2)	0.08	0.27	1.29	0.38	8.86	0.98	0.03	0.19	–	0.02	1.67	–
SMAW	DCEP	CM-95B91	0.09	0.23	0.71	0.10	8.40	0.99	0.06	0.21	0.42	0.03	0.81	809
SAW	AC	PF-200S/US-90B91	0.09	0.29	0.74	0.16	8.64	1.03	0.04	0.20	0.40	0.04	0.90	808
GTAW	DCEN	TG-S90B91 (100%Ar)	0.09	0.27	0.73	0.11	8.61	1.02	0.06	0.19	0.40	0.03	0.84	820
GMAW	DCEP	MG-S90B91 (Ar-5%CO_2)	0.12	0.24	0.64	0.15	8.47	0.98	0.05	0.18	0.41	0.04	0.79	813

Table 4: Typical mechanical properties after PWHT of 9Cb Series and B91 Series consumables

Process	Polarity	Trade Name	PWHT condition	0.2%OS (MPa)	TS (MPa)	vE+20°C (J)	Process	Polarity	Trade Name	PWHT condition	0.2%OS (MPa)	TS (MPa)	vE+20°C (J)
SMAW	DCEP	CM-9Cb	750°Cx5h	593	756	129	SMAW	DCEP	CM-95B91	760°Cx2h	593	730	70
SAW	AC	PF-200S /US-9Cb	740°Cx8h	584	709	95	SAW	AC	PF-200S /US-90B91	760°Cx4h	578	719	62
GTAW	DCEN	TG-S9Cb (100%Ar)	740°Cx8h	701	777	> 260	GTAW	DCEN	TG-S90B91 (100%Ar)	763°Cx4h	579	713	216
GMAW	DCEP	MG-S9Cb (Ar-20%CO_2)	740°Cx8h	568	698	120	GMAW	DCEP	MG-S90B91 (Ar-5%CO_2)	760°Cx8h	529	689	74

KOBELCO WELDING TODAY
Vol.21 No.2 2018

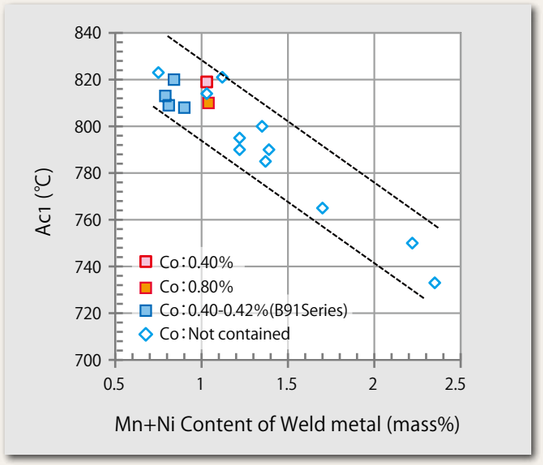


Figure 2: Relationship between Mn+Ni content and Ac1

Another feature of B91 Series consumables is the addition of cobalt (Co). As Figure 2 suggests, the Ac1 transformation point tends to fall in relation to the increase in Mn+Ni content. While the B91 Series consumables contain Co, the element is not likely to affect the Ac1 transformation point; after all, the consumables without Co also show a Ac1 transformation point that decreases in relation to increases in Mn+Ni content. In fact, Co is added for a different reason – restraining delta (δ) ferrite formation. Besides the Ac1 transformation point, another influential factor on the Gr. 91 steels is the formation of δ ferrite structure. Because it is desirable that a weld contains no δ ferrite structure but 100% martensite structure, the Electric Power Research Institute (EPRI) proposed an index called Cr-Ni balance (CNB) less than 10% in its report No. 1023199 "Guidelines and Specifications for High-Reliability Fossil Power Plants." The CNB equation is as follows:

$$\begin{aligned} CNB &= (\text{Cr equivalent}) - (\text{Ni equivalent}) \\ &= (Cr+6Si+4Mo+1.5W+11V+5Cb+9Ti+12Al) - \\ &\quad (40C+30N+4Ni+2Mn+1Cu) \\ &< 10\ \%\ (\text{mass}\ \%) \end{aligned}$$

Although Mn and Ni are known as the austenite forming elements and the CNB equation also shows they can prevent δ ferrite formation, excessive amounts of Mn and Ni are not allowed from the view point of AWS specification as well as Ac1 transformation point. For this reason, Co, another austenite forming element, is added in order to restrain δ ferrite formation without changing Ac1 transformation point.

Figure 3 shows the microstructure of TRUSTARC™ CM-95B91 (AWS A5.5 E9015-B91), one of the B91 Series consumables. The full tempered martensite structure is easily recognized.

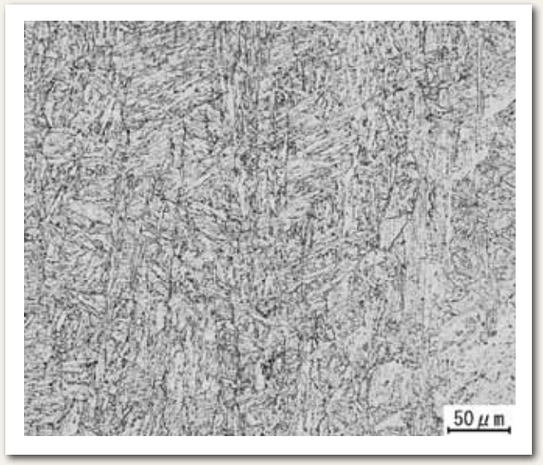


Figure 3: Microstructure of CM-95B91

4 Mechanical properties of B91 Series consumables

Figure 4 shows the relationship between tensile strength (TS), 0.2% offset yield strength (0.2%OS) or 0.2% proof stress (0.2%PS) and the heat treatment parameter, referred to as the Larson-Miller Parameter (L.M.P.), in relation to CM-95B91, TRUSTARC™ TG-S90B91 (AWS A5.28 ER90S-B9) and TRUSTARC™ PF-200S/US-90B91 (AWS A5.23 F9PZ-EB91-B91).

It is clear that these welding consumables fully satisfy the mechanical property requirements of Gr. 91 steels (0.2%PS equal to or more than 415MPa and TS equal to or more than 585MPa) even at L.M.P.=22.0 x 10^3 equivalent to PWHT parameter of 780°C x 8 hours (i.e. high temperature and extended time).

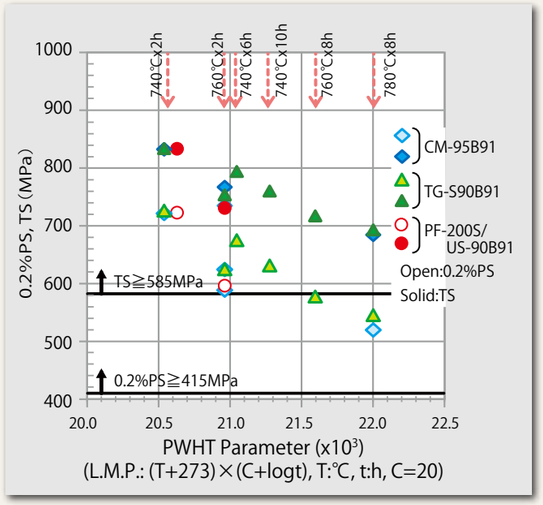


Figure 4: Relationship between L.M.P. and 0.2%P.S., T.S.

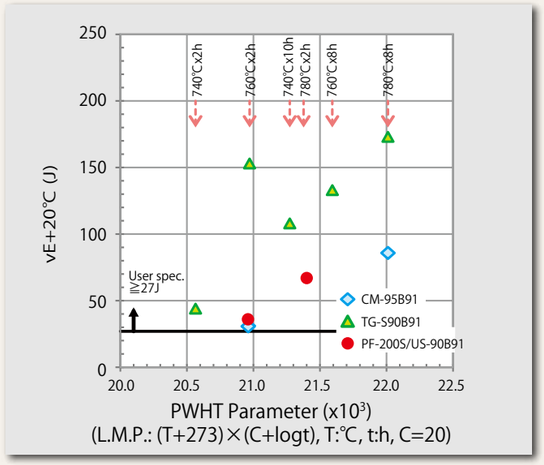


Figure 5: Relationship between L.M.P. and vE+20C°

Figure 5 shows the relationship between L.M.P. and notch toughness at +20°C.

While notch toughness differs depending on the welding consumables, all consumables exhibit better notch toughness when the L.M.P. is larger. In cases where the L.M.P. exceeds 21.0 x 10^3, the obtained notch toughness values are sufficient enough for practical use.

Figure 6 shows the creep rupture properties of CM-95B91 and TG-S90B91.

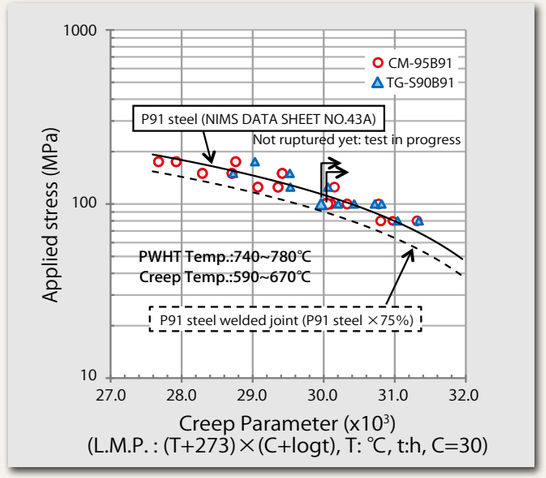


Figure 6: Creep rupture test results of CM-95B91 and TG-S90B91

It confirms that these consumables provide more sufficient creep rupture properties than those of the butt joint welds (dotted line) even at PWHT temperature as high as 780°C. Testing of the creep rupture properties of these consumables under an extended time creep condition of 600°C x 100MPa is being carried out. For example, the tests of CM-95B91 and TG-S90B91 have passed 26,000 and 21,000 hours respectively and are still in progress.

5 Usability of the B91 Series consumables

The usability of B91 Series consumables has also been improved. As for covered electrodes for SMAW, alloy core rods are generally used to stabilize the alloying element quality in welds of high-Cr ferritic steels; however, electrode burn frequently happens during welding especially with DC (Direct Current). CM-95B91 is designed to reduce electrode burn and can achieve welding even in a higher range of welding current than the conventional TRUSTARC™ CM-9Cb. A problem peculiar to SAW consumables on high-Cr ferritic steels, namely, the burnt-slag that sticks on weld bead surface, has also been reduced. Figure 7 shows a comparison of bead appearances by SAW with the combination of B91 wire and the newly improved flux, and the conventional flux, respectively. It can be seen that the adhesive slag on bead surface is greatly reduced with the improved SAW flux.

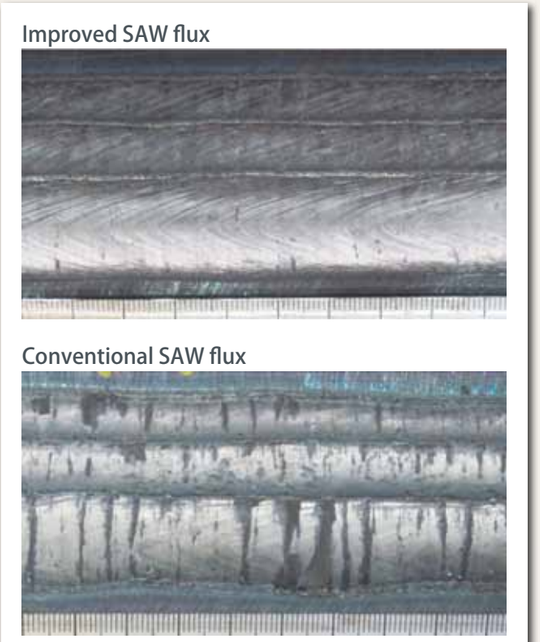


Figure 7: Bead appearance comparison by SAW between improved fluxes and conventional fluxes with B91 wire

6 Notes on usage

As B91 Series consumables provide high Cr-ferritic weld metals with a high degree of self-hardening, in comparison with those for 1.25Cr-0.5Mo and 2.25Cr-1Mo steels, their weld metals also have high delayed-crack susceptibility. It is, therefore, essential to strictly control welding procedures. If the pre-heating and interpass temperatures are properly controlled, delayed cracks are prevented and sound weld metals can be obtained. Pre-heating as well as interpass temperatures of 250-350°C are generally recommended. Impurities like P and S in the B91 Series consumables should be kept as low as possible in order to prevent hot cracks from occurring during welding.

Because the weld metals by the B91 Series consumables are more susceptible to hot crack and have a higher solid-liquid coexistent region than those of 1.25Cr-0.5Mo and 2.25Cr-1Mo steel weld metals, welding should not be performed with excessively high welding current and speed from the view point of welding procedure. As for PWHT condition, it should be carefully selected, taking required tensile strength and notch toughness properties into consideration, even though B91 Series consumables can be utilized at a high temperature such as 760-780°C.

7 Postscript

There are three characteristics of the B91 Series welding consumables. The first is that they correspond to international standards such as ASME and AWS. The second is that high PWHT temperatures can be applied due to their high Ac1 transformation point. And third, they are designed to obtain excellent creep rupture properties even in high PWHT conditions. Table 5 compares the features of the B91 and 9Cb Series consumables.

Table 5: Feature of B91 and 9Cb Series consumables

	B91 Series	9Cb Series
AWS Specification	◎ (Mn+Ni≤ 1.0%)	G grade (Mn+Ni>1.5%)
Recommended PWHT temperature	760-780°C	740-760°C
Ac1 temperature	Approx. 800°C	Approx. 740°C
Creep properties	◎	○

Note: ◎: excellent ○: good

In the future, we will continue contributing to customers' expectations for diverse product ranges while maintaining high reliability as well as the capabilities for state-of-the-art development of welding consumables.

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KOBELCO WELDING TODAY
Vol.21 No.2 2018

PF-N5/US-609S for SAW on 9%Ni steels: Excellent solution in horizontal and flat positions

PREMIARC™ US-609S wire with PREMIARC™ PF-N5 bonded type flux provides an excellent solution for submerged arc welding (SAW) of 9% Ni steels in horizontal and flat positions. The US-609S wire is made of Hastelloy*1 C276 and is classified in AWS A5.14/A5.14M as ERNiCrMo-4. Its typical chemical composition is shown in Table 1. The mechanical properties of all weld metal by PF-N5/US-609S are shown in Table 2.

(Note:*1 Hastelloy is a trademark of Haynes International.)

Table 1: Typical chemical composition of US-609S (wire mass%)

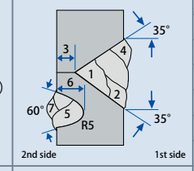
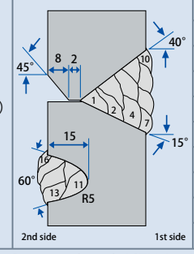
	C	Si	Mn	P	S	Cu	Ni
US-609S wire	0.01	0.03	0.5	<0.001	0.003	<0.01	58.3
AWS A5.14/A5.14M ERNiCrMo-4	≤0.02	≤0.08	≤1.0	≤0.04	≤0.03	≤0.50	Rem
	Cr	Mo	Fe	W	Co	V	Other
US-609S wire	15.9	15.9	5.6	3.5	<0.01	<0.005	<0.1
AWS A5.14/A5.14M ERNiCrMo-4	14.5 to 16.5	15.0 to 17.0	4.0 to 7.0	3.0 to 4.5	≤2.5	≤0.35	≤0.50

Table 2: Typical mechanical properties of all weld metal

	Tensile test			Charpy impact test
	0.2% PS (MPa)	TS (MPa)	EL (%)	vE-196°C (J)
PF-N5/US-609S	459	729	46	88, 102, 99: Ave 96

Butt joint welding was performed on plates with thicknesses of 12 and 30 mm according to the welding parameters in Table 3.

Table 3: Welding parameters

Plate thickness mm (in.)	Pass sequence	Pass	Welding condition			
			Current (A)	Voltage (V)	Speed (cm/min.)	Speed (in./min.)
12 (15/32)		1	300	26	30	12
		2	340		40	16
		3	360		40	16
		4	360		50	20
		5	360		40	16
		6	360		50	20
		7	300		40	16
30 (19/16)		1	300	26	30	12
		2	340		35	14
		3	320		30	12
		4~5	340		45	18
		6	300		40	16
		7~9	340		50	20
		10	340		55	22
		11	320		30	12
		12	300		40	16
		13~15	360		35	14
		16	340		40	16

Note : Base metal used: ASTM A553 Type-1.
Welding position: horizontal
Interpass temperature: ≤150°C; No preheating
Polarity: DCEP, Wire extension: 25mm, Torch angle: 22°

The welded bead appearances of the first side and cross-sectional macrostructures of both the 12 and 30 mm plates are shown in Figures 1 and 2, respectively.

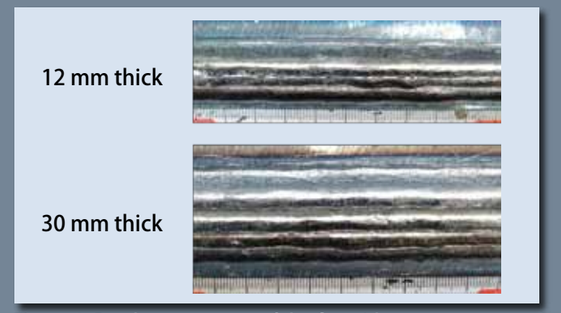


Figure 1: Bead appearances of the first side

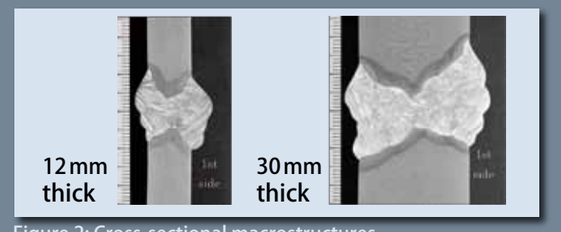


Figure 2: Cross-sectional macrostructures

The results of radiographic tests, butt joint tensile tests and Charpy impact tests as low as -196°C (shown in Tables 4, 5, and 6 respectively) indicate that the combination of PF-N5/US-609S can be applied for welding 9%Ni steels with satisfactory performances.

Table 4: Radiographic test results

Plate thickness (mm)	Indication size <0.8mm in 600mm length	Indication size ≥0.8mm in 600mm length
12	0	6
30	20	8

Table 5: Tensile test results of butt joint welds

Plate thickness (mm)	Tensile stress (MPa)	Fractured position
12	736, 736	Weld metal
30	780, 783	Weld metal

Test method: ASME Sec. IX QW-150

Table 6: Charpy impact test results of butt joint welds

Plate thickness (mm)	Charpy impact test	
	vE-196°C (J)	Lateral expansion (mm)
12	99, 110, 106: Ave 105	1.11, 1.03, 1.14: Ave 1.09
30	106, 102, 100 Ave 103	1.31, 1.13, 1.24: Ave 1.23

For detailed notes on usage such as recommended re-drying flux to prevent defects caused by moisture and first pass welding parameters to avoid hot cracks, please refer to the catalog.

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"KOBELCO-Your Best Partner" is highlighted at JIWS 2018

The 25th Japan International Welding Show (JIWS) 2018, Japan's largest exhibition specializing in welding and joining technology was held at Tokyo Big Sight from April 25 to 28, 2018.

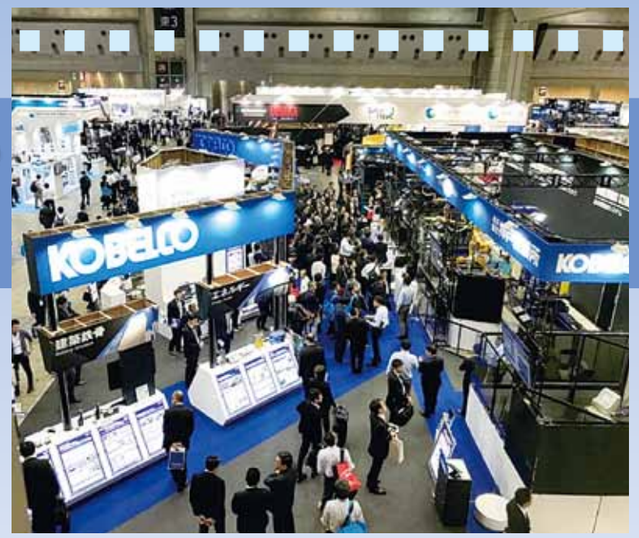
Under the exhibition's main theme: "Think Future, Act Now! Gateway to Great Success in Asia," a record 240 companies and groups exhibited, while the total number of participants over four days reached 100,428. According to the organizer, it was the largest number of participants since the Lehman financial crisis.

KOBE STEEL, LTD. displayed welding systems, consumables and procedures by means of live demonstrations and panels in order to support our customers' "Monodzukuri" (production system innovation), under the catchphrase of "KOBELCO - Your Best Partner ~Welding solutions for generations beyond." In this report, I will provide some pictures and describe the KOBELCO displays.

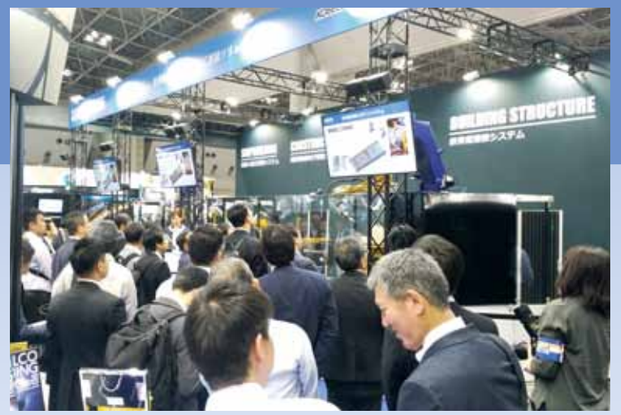
Located near the entrance of East Hall 3, the KOBELCO booth, decorated in black and KOBELCO blue, featured live demonstrations of robotic welding systems for shipbuilding, construction machinery and steel fabrication. Crowds of visitors gathered to watch and listen to the presenters from early morning of the first day to the end of the final day, probably because welding automation is an urgent topic due to growing shortage of skilled welding operators.

For the shipbuilding industry, visitors could see a live demonstration of the robotic welding system for hull assembly that was launched into the market last year. It is comprised of ARCMAN™ A30S, a small-sized robot designed for automatic robotic welding of hull assembly, an auto-teaching system utilizing 3D-CAD data for designing and FAMILIARC™ DW-100R, a flux cored wire (FCW) exclusively developed for the system to provide excellent gap resistance and high speed vertical upward welding.

For the construction machinery industry, the live demonstrations featured the Ultra High Current GMAW Process, which pairs the new, large-sized ARCMAN™ A80 with FAMILIARC™ MX-A100D to deliver high efficiency, deep penetration and low spatter welding. It can produce welded butt joints with fluctuated root gaps by using a newly-installed LASER gap-sensing function to sense the width of gaps instantaneously and continuously. Because the welding parameters are automatically adjusted to control the optimum amount of deposited metals, the system can provide beautiful bead appearances, which attracted the interest of all visitors.



Overview of the KOBELCO booth



Live demonstration of the robotic welding systems (for steel fabrication)


At the panel corner of the KOBELCO booth

And for the steel fabrication industry, the demonstrations highlighted the "beam welding system," which is comprised of a special positioner, a boxing welding function and FAMILIARC™ MX-Z200MP (FCW). Visitors from Japan and overseas seemed impressed at how the welding lines, including the insides of scallops, were welded with excellent bead shape and low spatter.

Another live demonstration for the steel fabrication industry featured ISHIMATSU, the small-sized portable type welding robot that was newly added to KOBELCO's product range in December, 2017, in combination with the REGARC™ Process, the innovative low spatter welding process. It showed low spatter welding of a column-to-beam connection part. Surprised at the big difference of arc sound and spatter generation between the REGARC™ Process and the conventional welding with constant voltage characteristics, many visitors watched test pieces being welded and then asked a barrage of questions to the presenters from KOBELCO ROBOTiX CO., LTD. (formerly KOBELCO ROBOTICS SERVICE CO., LTD.).

On display at the panel corner were the welding consumables and processes that respond to such needs as automation, high efficiency and declining welding skills in industries such as steel fabrication, automobile, shipbuilding, energy and construction machinery. For examples, new consumables - FAMILIARC™ LB-50FT, a low hydrogen type electrode featuring a soft arc and FAMILIARC™ MX-Z50F, an FCW exclusively used for steel plates with mill scale - were introduced for the steel fabrication industry, which has become more active due to the Tokyo Olympics in 2020. The 1Z Series FCWs and solid wires for galvanized steel sheets also drew considerable attention (despite their being aimed at a niche market) presumably because of the interest in reducing the generation of porosity and spatter in the welding of Zn-coated steel sheets.

The new F Series solid wires were also on display. A recent trend in high speed welding of thin steel plates, such as used by car manufacturers, has been to apply a method that carefully controls the wire feeding, which greatly minimizes spatter generation but can result in more rapid wear of contact tips. The F Series solid wires were designed to minimize spatter and restrain unstable wire feeding caused by wear of contact tips. One of the F Series solid wires was seen to have been applied at another company's robotic welding demonstration.

The future of welding, in which the Internet of Things (IoT) has the potential to further improve productivity and quality of robotic welding in the construction machinery was also on display. For example, one proposed process would improve the ability to visualize welding procedures, by combining AP-SUPPORT™ (software to support production) with a production monitoring camera. Another showed how advanced automation and no-man operation could be achieved by applying the automatic off-line teaching system that creates teaching data automatically after detecting the abnormalities during welding with AI.

The welding experience corner was set up so that anybody could experience welding with the aforementioned new products for the steel fabrication industry. Under the guidance of the Customer Service Promotion Department, SHINKO WELDING SERVICE CO., LTD. (SWS), a wide range of visitors could experience and enjoy hands-on welding, including potential customers, high school students participating in a welding competition held at the exhibition site, their friends, members of some Southeast Asian welding institutes, our agents' sales representatives and even KOBELCO employees who rarely experience actual welding despite their affiliation with a well-known welding products manufacturer.

At the Shin-Yo-Kai (KOBELCO's welding distribution network in Japan) corner, a contest was held in which participants were quizzed on their knowledge of important campaign products. Winners received a reprinted box of the old FAMILIARC™ B-17 containing not welding electrodes, but Pocky® – a chocolate snack confectionary in the shape of thin sticks. Many participants had fond memories of the package and eagerly took it home as a gift to their family.

At the SWS corner, information on joining technology research, material testing, and analysis of chemical components were displayed. Visitors could see actual analysis of ferrite content in duplex stainless steels being carried out with a digital microscope, which offers clear magnification and image analysis from multiple fields. Visitors appeared interested in the high-speed analysis derived from automatic consecutive photographing.

We can proudly say that the exhibition allowed many visitors to understand that "KOBELCO is your best partner" due to our welding solutions resulting from combinations of welding consumables and robots, investigation and inspection as well as technical services that characterize the KOBELCO group.

In summary, we would like to express our sincere appreciation to all who visited us at the KOBELCO booth.

Reprinted packages of older products containing Pocky®, a snack confectionary and Al-foiled vacuum pack (in front)

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