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

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PREMIARC™ DW-N609SV: Ni-based alloy welding consumable for fuel tanks on LNG-powered ships and ship exhaust scrubbers

KOBE STEEL has been producing the flux cored wire, [P]DW-NC276 (equivalent to AWS 5.34 ENiCrMo4) applied for flat position, groove welding (1G), for Ni-based alloys such as Hastelloy C276 and super austenitic stainless steels. And now [P]DW-N609SV has been developed to meet demand for 100% CO_2 shielding gas for welding the fuel tanks on LNG-powered ships as well as ship exhaust scrubbers.

[P]DW-N609SV offers the following features:

(1) Designed to fulfill the properties generally required for welding LNG tanks made of 9%Ni steels on ships.

(2) Excellent hot crack resistance that is common to Hastelloy type alloys.

(3) Superb usability in 1G and 3G positions, frequently used for Type C (cylindrical pressure) tanks.

(4) Highly efficient welding to produce fuel tanks on LNG-powered ships and ship exhaust scrubbers, which are expected to increase in the near future as one of the measures for International Marine Organization (IMO) emission regulations.

Approvals of major shipping classifications such as DNV • GL, ABS, LR, BV, CCS and NK have been acquired, and for more details, please contact our nearest offices or local agents.

General features between [P]DW-N609SV and [P]DW-NC276 are compared in Table 1. And typical chemical composition and mechanical properties of the deposited metal are shown in Tables 2 and 3, respectively.

Table 1: Comparison of general features

Trade name	[P]DW-N609SV	[P]DW-NC276
AWS classification	–	A5.34 ENiCrMo-4
Wire diameter	1.2mm	1.2mm
Shielding gas	100%CO_2 or Ar+20-25%CO_2	Ar+20-25%CO_2
Welding position	1G; 1F; 2F; 3G uphill	1G; 1F; 2F

Table 2: Typical chemical composition of deposited metal by 100% CO_2 shielding gas (mass%)

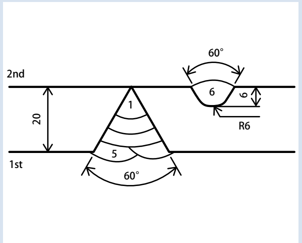
	C	Si	Mn	P	S	Ni	Cr	Mo	W	Fe
[P]DW-N609SV	0.01	0.27	0.27	0.012	0.002	57.5	15.7	16.2	3.3	6.6

Table 3: Typical mechanical properties of deposited metal by 100% CO_2 shielding gas

		0.2%PS (MPa)	TS (MPa)	El (%)	Absorbed energy at -196°C (J)
[P]DW-N609SV		483	742	44	45, 43, 46; Avg. 45
Requirement of shipping approvals	NK KSWL92	≥410	≥660	≥25	≥27 (Avg)
	LR 9Ni	≥400	640-790	≥25	≥34 (Avg)
Guarantee		≥430	≥690	≥25	≥34 (Avg) ≥27 (Each)

The welding condition for a butt joint is shown in Table 4 and the macrostructure and the results of mechanical property tests are shown in Figure 1 and Table 5, respectively. The recommended welding conditions are shown in Table 6.

Table 4: Test condition for butt joint welding

Test wire	[P]DW-N609SV 1.2mm dia.	Groove shape and pass sequence (Unit: mm)
Base metal	9%Ni steel (JIS G 3127 SL9N590Q)	
Polarity	DCEP	
Welding position	Vertical up (3G)	
Welding current-Arc voltage	160A-25V	
Shielding gas	100%CO_2	
Interpass temp.	≤150°C	

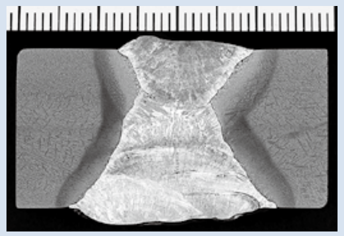


Figure 1: Macrostructure of butt joint weld metal

Table 5: Results of transverse tensile test and Charpy impact test of butt joint weld metal

	TS (MPa)	Fractured position	Absorbed energy at -196°C (J)
[P]DW-N609SV	735	Weld metal	63, 63, 62; Avg 63
Requirement of NK	≥670	–	≥27 (Avg)
Requirement of LR	≥640	–	≥27 (Avg)

Note: Location of impact test specimen: Center of weld metal

Table 6: Recommended welding conditions

Welding position	Flat (1G); Horizontal fillet (2F)	Vertical up (3G)
Shielding gas and flow rate	Ar+20-25%CO_2 or 100%CO_2; 20-25L/min	
Wire extension	10-20mm	10-15mm
Welding current	180-250A	140-180A
Arc voltage	24-35V	22-29V
Interpass temp.	≤150°C	

KOBELCO's spirit for service, contribution, cooperation and hospitality

Dear KWT readers! I'd like to express my sincere gratitude for your warmest patronage of KOBELCO products.

KOBELCO WELDING ASIA PACIFIC PTE. LTD. (KWAP) celebrated its 40th anniversary this year. Following last year's 50th anniversary at THAI-KOBE WELDING CO., LTD. (TKW) and 30th at KOBE MIG WIRE (THAILAND) CO., LTD. (KMWT), the important ASEAN basis has marked a significant milestone. In parallel with KWAP's anniversary celebration and in order to show our appreciation for our partners' support as well as to promise our further unity, we held the ASEAN Shin-Yo-Kai (KOBELCO's welding distribution networks in the ASEAN countries) Meeting in Singapore in June. This allowed us to share the status of our latest technical developments and discuss customer trends in the meeting, and then deepen our mutual friendship at the party with our partners, who came from as many as 16 countries.

Our philosophy of cherishing our partnerships around the world will never change. As a matter of fact, we have strengthened our contributions toward the Asian regions and cooperation with interested parties. For example in Vietnam, we have joined an international industry-university collaborative research initiative with Hanoi University of Science and Technology, Osaka University and KOBE STEEL. Because the shortage of welding professionals who can support the development of industrial infrastructure is a major issue, we are extending our support to the advancement of development capability and human resources in the field of welding and joining.

We have been making steady progress in our aim to be "the most reliable welding solutions company in the world." Although demand worldwide seems to be for automation and high efficiency, inquiries for stabilizing the quality of welds and improving working environments have been increasing. The KOBELCO group, with our capabilities in the development of welding procedures, consumables and robotic systems, can respond to diverse requests while at the same time deliver our well-known and trusted products and services. Please do not hesitate to let us know or contact our nearest agents if you have any request and/or question.

In the meantime, since KOBE STEEL owns a rugby football club named the Kobelco Steelers, rugby is a sport we have a strong feeling about. The Rugby World Cup (RWC) 2019 was held in Japan and many heated matches took place across the country. Because the Olympics and Paralympics will be held in Tokyo next year, construction of athletic facilities and transportation systems has been progressing across the city. Fortunately, this is the kind of work that most Japanese can do well and reliably. Even in KOBE STEEL, we have been preparing satellite offices as well as working from home positively, in order to help alleviate traffic congestion in the city during the time when large numbers of visitors are expected to come to Japan.

Please don't forget that the Japan International Welding Show will be held in Osaka, in April 2020, before the Olympics. We will welcome you with more hospitality than ever. We look forward to seeing you then!

Koichi (Jay) Sugiyama
General Manager
Global Operations and Marketing Department,
Marketing Center
Welding Business, KOBE STEEL, LTD.

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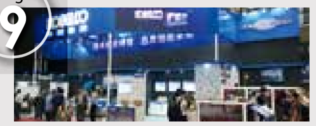

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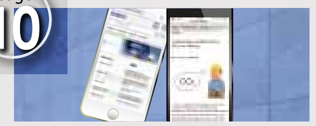

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[F], [T] and [P] in trade designation indicate FAMILIARC™, TRUSTARC™ and PREMIARC™ respectively.

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Technology to prevent end cracking in one-side submerged arc welding

1 Preface

One-side submerged arc welding (SAW) is a highly efficient welding process that enables complete welding in one layer from one-side. KOBE STEEL has developed three one-side SAW processes: FCB™, RF™ and FAB, which differ in terms of backing materials/methods. All have been well utilized for butt joint welding of steel plates, in accordance with their respective features and merits in the shipbuilding and bridge construction fields.

Developed almost 50 years ago, all three processes have been in practical use ever since. However, one issue that has not yet been effectively resolved is solidification cracking at the end of welded joints (hereinafter called end cracking) during one-side SAW.

While a number of preventive methods have been developed, some of which remain in use, none of them can achieve both a high ratio of crack prevention and no repair-welding: therefore, a method that fundamentally solves the issue has long been sought in order to improve weld quality as well as boost operation efficiency.

In this article, the mechanisms of end cracking generation and the characteristics of conventional prevention methods will be discussed. The article goes on to report on the factors that are most effective in preventing end cracking, which were revealed through simulation analysis technology and then verified in actual welding.

2 Mechanisms of end cracking generation and conventional prevention methods

At the end of a weld joint, rapid deformation occurs on the steel plate right after the first (or leading) electrode (hereinafter called L electrode) reaches the run-off plate (or tab plate) as shown in Figure 1. End cracking can be generated when the tensile stress caused by deformation is added into the final solidification of the weld metal.

A schematic drawing of the conventional methods to prevent end cracking is shown in Figure 2, and their features are listed in Table 1.

In the sealing cascade method (Figure 2 (a)), sealing beads are layered in at the end of the weld joint so as not to form a back bead but leave an unmelted binding bead, thus restraining deformation. It provides a high crack prevention rate; however, repair welding after one-side SAW is required.

In the slit-tab plate method (Figure 2 (b)), making slits on the run-off plate (i.e. using a slit-tab) restrains rapid deformation even when the arc of the L electrode reaches the run-off plate. However, while the end cracking prevention rate is high for thinner plates, it is low for thick plates, which require high heat input. In addition, how a tack weld bead is placed inside a groove can also lessen the effectiveness of this method.

Ultimately, both methods have merits and demerits but neither suffices as a technique that is excellent in end cracking prevention as well as welding efficiency.

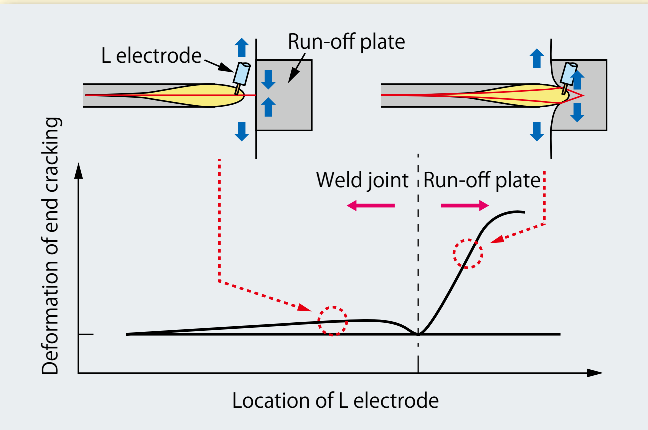

Figure 1: Outline of end cracking

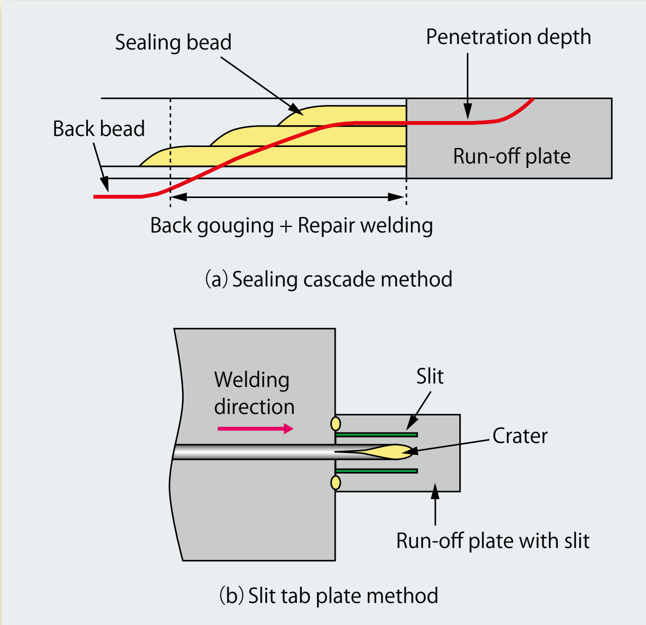

Figure 2: Schematic drawing of conventional methods to prevent end cracking (a) and (b)

Table 1: Conventional methods to prevent end cracking

	Merit	Demerit
Sealing cascade method	High prevention rate	Require repair welding
Slit tab plate method	High prevention rate in thin plates	Require a large run-off plate
Joining-crater method	High prevention rate	Require repair welding

3 Using FEM simulation to isolate the factors that restrain distortion

As steel plates available for welding under laboratory conditions tend to be small in size, the results of investigations into end cracking cannot necessarily be applied to actual work sizes. Therefore, in joint research with Osaka Prefecture University (OPU), the variables that restrain distortion generated at the end of weld joints were extracted by heat conduction analysis and thermal elastic-plastic analysis by means of the idealized explicit finite element method (FEM), a proprietary technology developed by OPU that is excellent in analysis of large-sized models.

According to heat conduction analysis, as shown in Figure 3, the idealized explicit FEM simulation obtained a penetration configuration similar to that of conventional actual welding as well as similar results for temperature increase and cooling rate at heat affected zones.

With thermal elastic-plastic analysis, several variables were evaluated utilizing plastic strain increment in the brittleness temperature range (BTR) during cooling (hereinafter called plastic strain increment in BTR) as an index of crack generation (see Figure 4). The result suggested that as the plastic strain increment in BTR was reduced by shortening the intervals between tack weld beads and using slower welding speeds (see Table 2), distortion at the end of a weld joint was restrained.

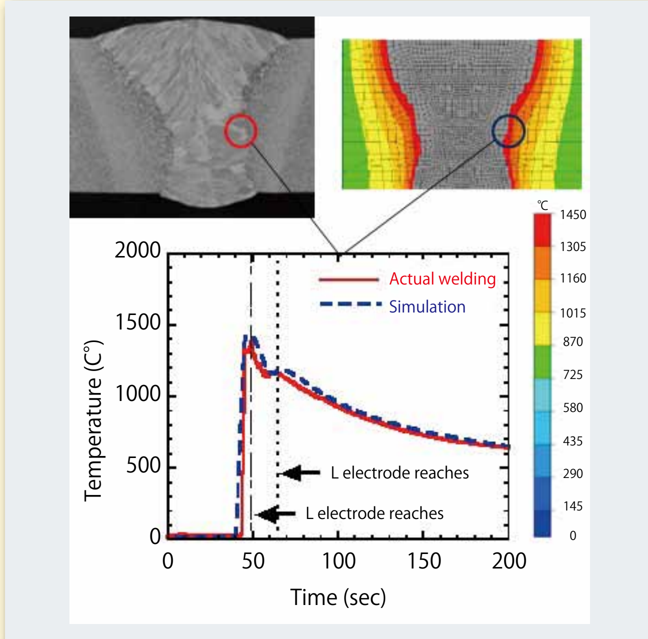

Figure 3: Example of heat conduction analysis by means of idealized explicit FEM

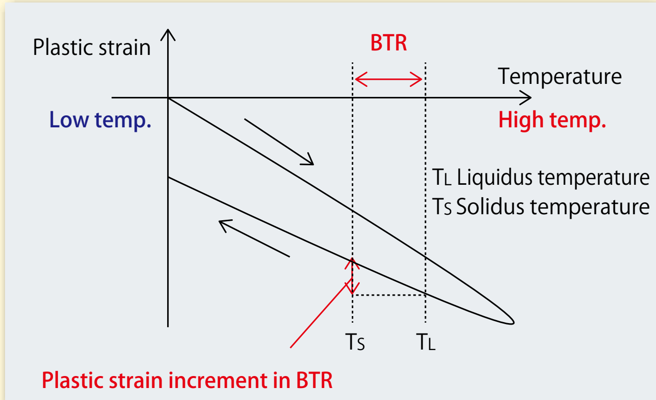

Figure 4: Model of solidification cracking generation

Table 2: Effects of variables studied by simulation

Various factors	Plastic strain increment in BTR	
	Large	Small
Interval of tack weld beads	Long→Short	
Welding speed	Fast→Slow	
Width of a run-off plate	Narrow→Wide	
Connection between work piece and run-off plate	Weak→Strong	
Width of steel plates to be welded	Narrow→Wide	
Length of steel plates to be welded	No influence *	

Note: * indicates that the length equal to or more than a certain length has no influence.

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4 Verification of simulation results by actual welding

4-1. Test method

The verification of variables isolated via simulation was performed by measuring displacement and carrying out non-destructive test (NDT) at the end of a weld joint obtained by actual welding. The welding process and tested consumables are shown in Table 3.

As shown in Figure 5, a moving jig placed in the vertical position against the welding line during welding allowed for taking moving image photography, which was then used to measure displacement at the end of the weld.

The obtained displacement was plotted along the time axis. The incline was defined as the displacement rate, providing an index of crack generation. Weld specimens were tested to determine the existence of crack by radiographic examination within a range of 700 mm from the extreme end of a weld joint, using Japanese Industrial Standard (JIS) Z 3104 (1995): Methods of radiographic examination for welded joints in steel.

Table 3: Welding process and tested consumables

Welding process		FCB™ one-side SAW with three (L, T1 and T2) electrodes
Welding consumables	Welding wire	F US-36
	Flux	F PF-I55E
	Backing flux	F PF-I50R

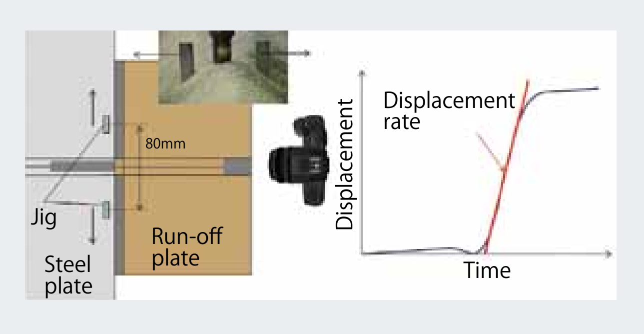


Figure 5: Method of measuring the displacement rate at the end of a weld joint

4-2. Effects of different factors in restraining the displacement rate

The results of actual welding accorded with those of the simulation on the effects listed in Table 4, confirming further that these variables can bring about a lower displacement rate of the end of a weld joint during welding.

Figure 6 shows the verified results of welding a 20 mm thick plate and testing such variables as the intervals between tack weld beads, welding speed and the width of run-off plates.

It was found that the displacement rate could be decreased by placing sealing beads instead of tack welding beads at the end of a weld joint, adopting low welding speed, and setting a wider run-off plate, respectively.

Table 4: Effects of certain variables on distortion at the end of a weld joint

Variables		Simulation	Actual welding
		Plastic strain increment in BTR	Displacement rate
Interval of tack weld	Long→Short	↘	↘
Welding speed	Fast→ Slow	↘	↘
Width of run-off plate	Narrow→Wide	↘	↘
Connection between work piece and run-off plate	Weak→Strong	↘	↘
Width of steel plates to be welded	Narrow→Wide	↘	↘
Length of steel plates to be welded		No influence *	–

Note: * indicates that the length equal to or more than a certain length has no influence.

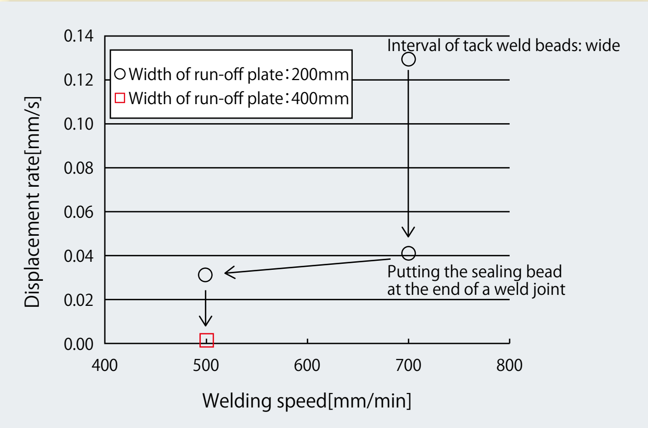


Figure 6: Relationship between variables and displacement rate

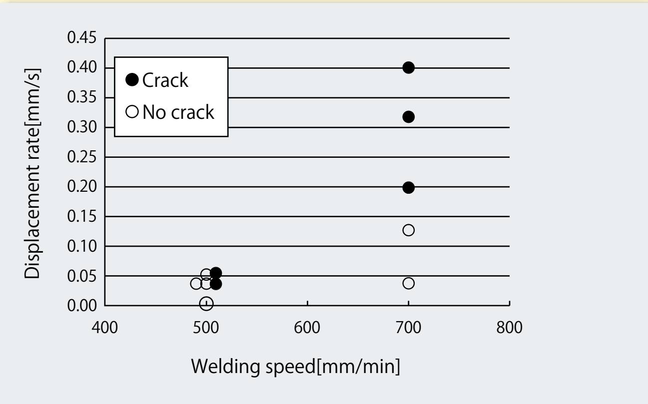


Figure 7: Crack or no crack found under low welding speed condition

On the other hand, as shown in Figure 7, some of the welded joints showed end cracking despite a small displacement rate and the application of low speed welding.

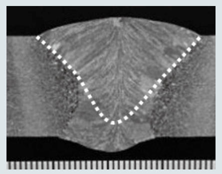
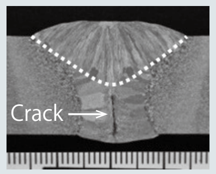
4-3. Control of solidification microstructure

In order to understand the disparity above, the solidification microstructures of instances in which end cracking occurred under low welding speed condition were compared with the instances in which no end cracking occurred but welding was carried out under standard conditions (see Table 5).

It was confirmed that under the low welding speed condition, the solidification of the weld metal at the root grew out in a horizontal direction from both sides; in other words, it showed a solidification microstructure that can easily generate crack. Because it is necessary to keep the same heat input on each corresponding electrode under both low welding speed and standard conditions, a low welding current must be applied to each electrode under the low speed welding condition.

However, a low welding current applied to the third (or second trailing) electrode (hereinafter called T2 electrode) under low speed welding condition caused shallow penetration as well as a temperature drop in the weld metals formed by both the L electrode and the second (or first trailing) electrode (hereinafter called T1 electrode). The penetration of the T2 electrode can be easily increased by raising its welding current; however, the corresponding heat input increase can lead to an increase in the displacement rate. Therefore, adjusting the distance between the T1 and T2 electrodes was selected as an effective countermeasure.

Table 5: Comparison of penetration under standard and low speed welding conditions

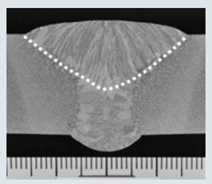
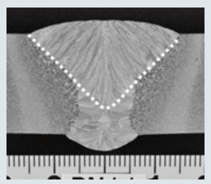
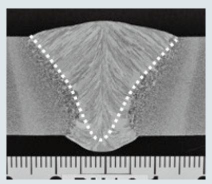
Welding condition	Standard	Low speed
Cross-sectional microstructure		
Displacement rate (mm/s)	0.13	0.04

Note: White dotted lines show a penetration (or fusion line) by T2 electrode.

Table 6 shows the relationship between the distance of T1 and T2 electrodes and the solidification microstructure under low welding speed condition.

It was found that the solidification microstructure at the root could be improved by adjusting the distance between the T1 and T2 electrodes. Therefore, in order to control the solidification microstructure, it is important to choose an optimum distance that corresponds to the welding speed.

Table 6: Relationship between the distance of T1 and T2 electrodes and penetration by the T2 electrode

Distance of the second and the third electrodes (mm)		
120 (standard)	100	80
		

Note: White dotted lines show penetration (or fusion line) by T2 electrode.

4-4. Influence of plate thickness

The influence of plate thickness on the displacement rate and end cracking was investigated on steel plates with thicknesses of 12, 16, 20 and 25 millimeters. In order to isolate this particular variable, welding was carried out after applying sealing beads, strengthening the connection between the run-off plate and the actual work piece and optimizing the low welding speed condition and the distance of T1 and T2 electrodes. The results are shown in Figure 8.

It can be seen that under the low speed welding condition, the displacement rate was significantly lower in all cases except for the 12 mm thick plate. In addition, end cracking did not occur in steel plates of any thickness.

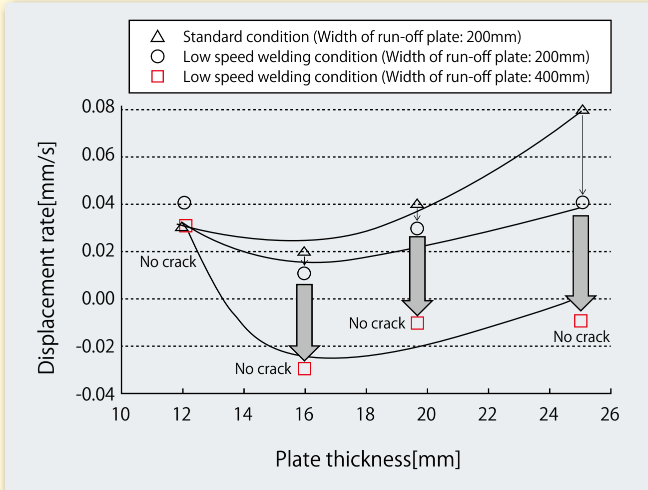


Figure 8: Relationship between plate thickness and displacement rate

5 Development of equipment with functions installed to prevent end cracking

Because end cracking occurs only at the end of weld joints, it is there where low welding speeds are required; indeed, standard welding conditions should be applied at the start and middle sections of the weld. However, In order to realize this, functions to automatically change welding conditions as well as the distance of T1 and T2 electrodes must be installed.

As an abrupt change in welding conditions can affect the quality of welds, a transfer zone should be set for adjusting to the condition that prevents end cracking, as shown in Figure 9. Specifically, once the end zone of a steel plate is detected, the welding current, arc voltage and welding speed must be gradually adjusted within the designated transfer zone, and, simultaneously, the T1 and T2 electrodes are shifted to a set distance so that welding throughout the end part of the weld joint is performed under the low speed welding condition.

Testing has confirmed that the mechanical properties of weld metals within both the transfer zone and the end zone of the plate are equivalent to those formed under conventional standard welding conditions. The welding equipment with the necessary functions installed has already been developed and is ready to be evaluated in actual welding.

6 Postscript

From the results obtained through testings and investigation, end cracking may be prevented on plates up to 25 mm thick without repair welding by adopting the following:

① Setting sealing beads at the end of a weld joint
② Increasing the width of the run-off plate and strengthening the connection between the run-off plate and the work piece.
③ Adopting low welding speed
④ Controlling the solidification microstructure by adjusting the distance between the T1 and T2 electrodes

Because this technology is expected to contribute greatly to improving weld quality and productivity, it will be evaluated and verified further in welding of actual work pieces and put into practical use in the very near future.

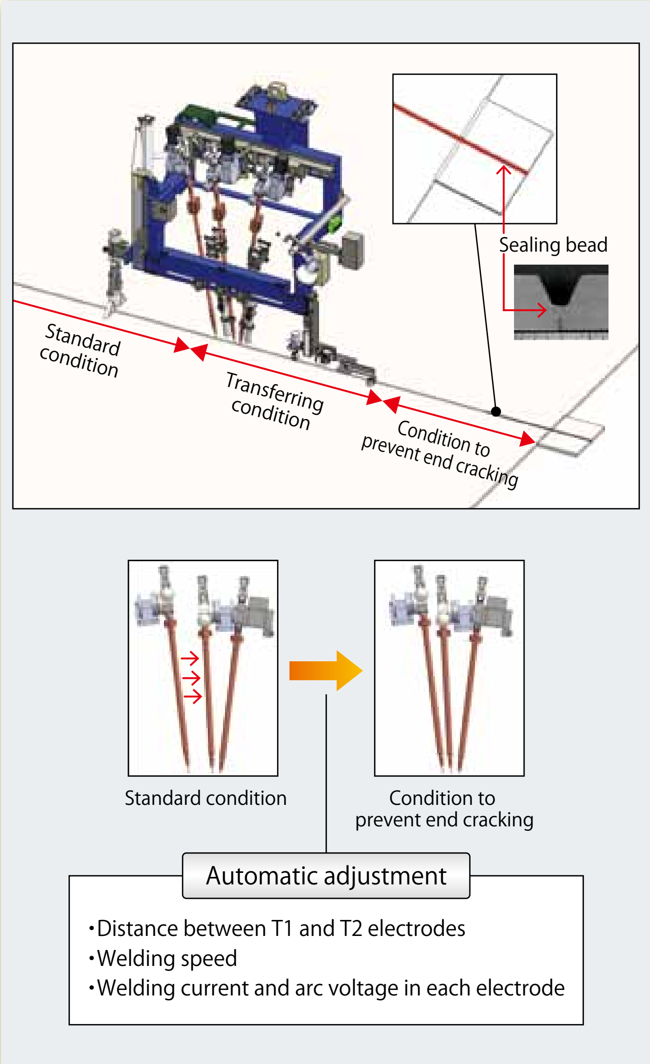


Figure 9: Schematic diagram of one-side SAW process and equipment with functions installed to prevent end cracking

Reported by
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A great KOBELCO event combining the ASEAN Shin-Yo-Kai meeting with the celebration of KWAP's 40th anniversary

On June 13, 2019, two occasions were organized and held as a joint event in Singapore: the 12th annual meeting of the ASEAN Shin-Yo-Kai, KOBELCO's welding distribution network, and the 40th anniversary of KOBELCO WELDING ASIA PACIFIC PTE. LTD. (KWAP).

The Japanese Association, Singapore (JAS) served as the location for this meeting/celebration, and 103 ASEAN Shin-Yo-Kai members from 16 ASEAN and neighboring countries attended. Although the JAS recently moved into a new facility, it has served as a base for Japanese people living in Singapore since it was established in 1915. I believe that the event provided an excellent opportunity for representatives of agents in different countries to experience the atmosphere of an organization that has embodied the strong ties that have been built and cultivated by our predecessors for more than 100 years.

The daytime meeting opened with Mr Akira Yamamoto, the Head of the Welding Business, giving a welcome speech. He was followed by Mr Toshihiko Hama, Sales director of KWAP who introduced ASEAN market trends, and by Mr Tetsunao Ikeda, Technical director of KWAP who presented on the development of welding consumables for the ASEAN market. Finally, Mr Hiroyuki Shimizu, the Head of the Technical Center, presented on the latest welding technologies in Japan and the developed world. (As for ASEAN, where covered electrodes remain dominant, it might be next generation technology.) Mr Shimizu's talk caused a sensation among local representatives, who might have been seeing their near future. I am sure that they could understand well how KOBE STEEL has foreseen the future market.

In the evening, the members commemorated the ASEAN Shin-Yo-Kai meeting and KWAP's anniversary at a dinner party. It was opened by the Kagami-nuki, or breaking of a sake cask with wooden hammers and following with a toast. The party was filled with joy all at once.

Mr Yamamoto's welcome speech at ASEAN Shin-Yo-Kai Meeting held in an auditorium in JAS

Kagami-nuki ceremony

At the dinner party, guests clap their hands in a big circle at the success of the joint anniversary celebration and meeting.

During the chatting time, photos of KWAP, from the past until present time, were projected on the screen, and I could see many people became emotional while thinking about KWAP's long history.

This year, some agents from India took part in the ASEAN Shin-Yo-Kai meeting for the first time, and they seemed especially impressed by the Thai Shin-Yo-Kai's strong unity. I also noticed positive conversations between representatives from different areas who might otherwise have had difficulty to interact easily. Seeing these things made me feel how useful the ASEAN Shin-Yo-Kai meeting is and how it may lead to prosperity.

At the end of the party, I could hear people asking "where will it be held next time?" With such uplifting feelings of the participants spreading in the party room, I felt certain that this get-together party would give everyone positive motivation to lead in the promotion of sales in their regions.

Reported by
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Beijing Essen Welding & Cutting Fair 2019, focused on robotic welding and IoT related technology

Sponsored by Chinese Mechanical Engineering Society, the 24th Beijing Essen Welding & Cutting Fair 2019 was held from 25 to 28 June, 2019, at the Shanghai New International Exhibition Center. As the largest welding exhibition in Asia, it attracted about 1,000 exhibitors and, over four days, 29,000 visitors from all over the world. Because China is the largest welding consumable market in the world, competition is fierce, among local manufacturers as well as welding consumable makers from around the world. The KOBELCO group participated in the exhibition in order to develop KOBELCO's brand presence in such a huge welding consumable market.

At the exhibition, our booth featured the slogan, "Technology will make KOBELCO develop, and quality will build KOBELCO's future!" We also displayed panels, products and bead samples by industries and presented live demonstrations of the Ultra High Current GMAW welding process and semi-auto welding with stainless steel flux cored wires and SE solid wires (no-copper coated solid wires). One of the bead samples from a one-meter-diameter line pipe (see photo) drew much attention and interest from visitors.

Throughout the exhibition, visitors from China and all over the world continuously visited the KOBELCO booth, engaging in long discussions with and asking questions of the KOBELCO attendants.

Looking around the exhibition, I realized that robotic welding systems were displayed by many exhibitors, including Chinese, Japanese and European and American manufacturers. Also displayed were a device for installing a laser sensor, a cloud system technology for monitoring welded parts and operation rates, and IoT-related technologies such as a welding machine with a wireless system. Additionally, a Chinese welding consumable maker displayed its high level of quality control with a video of its production process. I could understand the fierce competition in the Chinese market from this experience.

Under such a competitive Chinese market that is only growing in severity, three KOBELCO group companies in China - KOBE WELDING OF TANGSHAN CO., LTD., KOBE WELDING OF QINGDAO CO., LTD. and KOBE WELDING OF SHANGHAI CO., LTD. – have been incorporated together to develop their mutual presence. They will build up their position as a reliable welding solutions partner who can provide customers with optimum welding procedures, systems and consumables.

The Beijing Essen Fair has renewed my belief that I have to beat the competition and expand the business while performing useful services to customers.

Reported by
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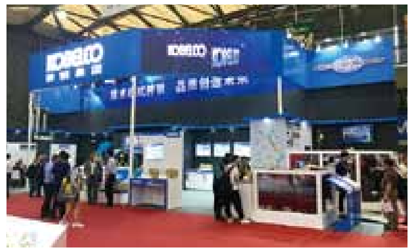
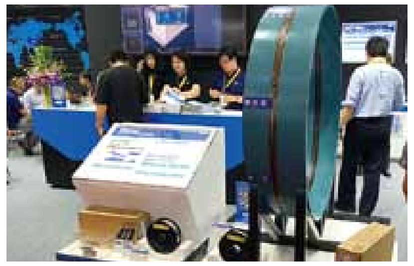


The KOBELCO booth welcomed a constant stream of visitors.



Bead sample display featuring a 1-m-dia. line pipe

KOBELCO booth participants posing in front of the KOBELCO booth

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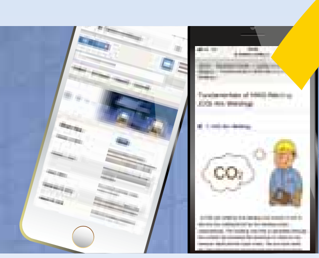

KOBELCO Global Website is smartphone friendly now

KOBELCO Global Website that started in 2012 in four languages - English, Spanish, Portuguese and Russian - has become smartphone friendly since June 3, 2019. Furthermore, the retrieval function of KOBELCO Welding Handbook has become even more user-friendly. I will explain the main media content of the KOBELCO Global Website, and I hope KWT readers will use it for retrieving educational data and products, confirming approval certificates, or for downloading Safety Data Sheets (SDS).

<Products>

1. Welding Handbook Quick View (English only)
   A user can search for a product under product names, type of steel, welding methods or AWS specifications and obtain data on mechanical properties, chemical compositions, recommended welding current for each welding position and approved shipping classifications.

2. Certification
   Approval certificates of shipping classifications or NAKS (National Agency of Welding Control/Russia) can be downloaded.

3. SDS (English only)
   SDS by each product name can be downloaded. However, customers in the USA and the EU are kindly requested to retrieve them from the homepage of KOBELCO WELDING OF AMERICA INC. and KOBELCO WELDING OF EUROPE B.V., respectively.

4. Technical Highlight and Product Quick View & Highlights
   The Technical Highlight reported in every issue of Kobelco Welding Today is published in four languages. And in Product Quick View & Highlights, suitable welding consumables are described briefly in the respective booklets of Heat-Resistant Steel, Stainless Steel or Low Temperature Steel. (For detailed information, please contact your local KOBELCO offices or agents.)

<Education Center> (available in four languages)

1. The ABC's of Arc Welding
   This explains welding defects and provides notes on usage and technical terms. It is the most popular media content in the KOBELCO Global Website.

2. Fundamentals of CO_2 Arc Welding
   This section discusses principles, features, procedures, notes on usage and defects and countermeasures related to CO_2 arc welding, which is in the mainstream in gas metal arc welding (GMAW) around the world. As media content, it is also very popular.

3. Welding of Medium/High Carbon Steels and Special Steels and Welding of Stainless Steels
   This section, formerly a textbook, gives pointers on the welding of medium and high carbon steels, in which defects like crack are common, and explains how to apply stainless steel welding. These welding procedures receive the largest number of technical inquiries in Japan.

4. Welding References
   Users can also study up on technical terms used in welding, welding symbols and how to estimate/calculate the consumption of welding consumables.

<Events>

The website also publishes the KOBELCO group's planned exhibitions as well as past displays together with photos.

<Library> (English only)

Five welding textbooks and a booklet on an overview of the KOBELCO group business (in four languages) can be downloaded.

All issues of KOBELCO WELDING TODAY from the first publication in 1998 until the latest, including SPECIAL EDITIONs which introduce welding consumables for specific kinds of steels can be viewed. Please search as below:

Kobelco Welding Today

Global site

Kobelco Welding Today

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