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KOBELCO WELDING TODAY

Vol. 15
2012 No. 3

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

KOBELCO

PREMIARC™ DW-410NiMo: the best choice for welding hydraulic turbine components

The flux cored wire PREMIARC™ DW-410NiMo has recently been developed and launched in North American and South American markets by Kobe Steel. The classification of the wire is as shown in Table 1.

It is designed to weld 410NiMo type stainless steels, in particular in the production of hydraulic turbine components, such as CA6NM (ASTM A352, A356, A487 & A743): the corrosion resistant stainless steel casting.

DW-410NiMo shows excellent weldability with 80%Ar-20%CO₂ shielding gas in all-position welding. Let's consider the properties of the wire in more detail.

Table 1: Applicable code and classification of DW-410NiMo

Applicable code	Classification
AWS A5.22/A5.22M: 2012	E410NiMoT-4/-1
EN/ISO 17633-A: 2010	T 134 P C/M 1
EN/ISO 17633-B: 2010	TS 410NiMo - FB1

As 410NiMo type weld metal is composed of a martensitic microstructure, it is sensitive to hydrogen induced crack, therefore, heat control (i.e. preheating, interpass temperature control during welding, and post heating right after welding) is indispensable. Applying post weld heat treatment (PWHT) after the weld metal cools down to ambient temperature is also necessary to temper the weld metal as well as the heat affected zone (HAZ). The recommended heat control is shown in Table 2 and the typical properties of all weld metal of DW-410NiMo are shown in Tables 3, 4 and 5.

Table 2: Recommended heat control

Heat control	Temperature (°C)
Preheating	150 - 200
Interpass	100 - 200
Post-heating	200 - 300
PWHT	590 - 620

Table 3: Chemical compositions of all weld metal (mass %)

	C	Cr	Ni	Mo	Mn	Si	P	S	Cu
DW-410NiMo	0.015	11.6	4.3	0.55	0.52	0.34	0.024	0.004	0.03
AWS A5.22 E410NiMoTX	0.06 max	11.0-12.5	4.0-5.0	0.40-0.70	1.0 max	1.0 max	0.04 max	0.03 max	0.5 max

Table 4: Mechanical properties of all weld metal

PWHT	Tensile test (Room temperature)			Absorbed energy (J)	
	0.2%PS (N/mm ²)	TS (N/mm ²)	El (%)	-20°C	0°C
600°Cx1 hr, AC #1	846	926	17	42, 41, 40 Avg 41	46, 42, 43 Avg 41
600°Cx25 hrs, FC #2	699	855	20	51, 52, 49 Avg 51	51, 52, 55 Avg 52

Note: #1: Air cooling
#2: Furnace cooling to ambient at 40°C/hr

Table 5: Diffusible hydrogen content of all weld metal (cc/100g)

200 A	280 A
4.0, 4.7, 4.2 (Avg 4.3)	5.2, 6.4, 6.1 (Avg 5.9)

The butt joint welding results are shown below for reference. The base metal is ASTM A743 CA6NM, the welding consumable, DW-410NiMo, 1.2 mm dia., the shielding gas, 80%Ar-20%CO₂, the post heating, 250°Cx 2 hours and PWHT, 600°Cx 1 hour (AC) - 600°Cx25 hours (FC).

Tables 6 and 7 show the welding conditions and the impact test results respectively and Figures 1, 2 & 3, the weld bead appearance, the macrostructure and the hardness test result of the butt joint respectively.

Table 6: Welding conditions

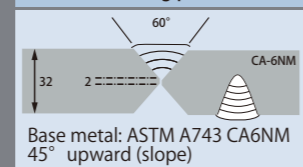
Groove shape, base metal & welding position	Side	Layer/pass	Welding current (A)	Arc voltage (V)	Interpass temp (°C)
	Face	4 layers/4 passes	240	31	150-200
	Back	6 layers/6 passes	240	31	150-200

Figure 1: Weld bead appearance



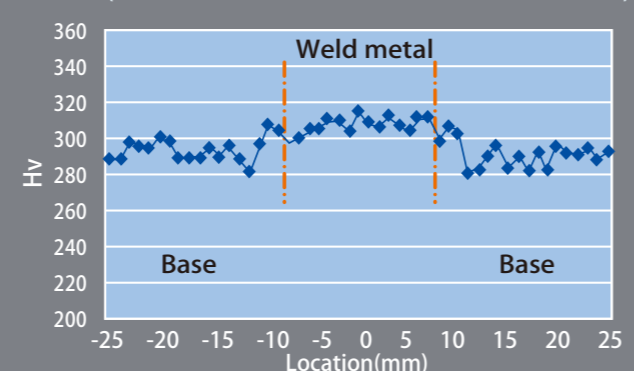
Figure 2: Macrostructure



Table 7: Impact test result at 0°C

Side	600°Cx1 hour, AC (J)	600°Cx25 hours, FC (J)
Face	39, 35, 36 (Avg 37)	51, 51, 53 (Avg 52)
Back	36, 36, 36 (Avg 36)	53, 53, 55 (Avg 53)

Figure 3: Hardness test result
(Tested location: 3 mm below the face side surface)



Close communication with customers from local channels

Dear KWT readers! We thank you so much for your continuous patronage of Kobelco welding consumables, welding systems and equipment. Firstly, we are grateful for your kind understanding of our unfortunate price revision, which was a heart-breaking decision to make. We simply could not absorb the rising prices of raw materials, and our only choice was to ask you to bear some portion. However, we will never give up endeavoring to supply our products at a fair price.

The goal of the International Sales and Marketing Section (ISMS), as we cooperate with our overseas subsidiaries, is to get as many people as possible to become fans of and continuously use Kobelco products. In order to realize this, users must first learn to feel good about having used Kobelco products and then we must continue to support their productivity and quality improvement.

We have been expanding our group's sales network so that we can maintain close communication with clients and remain aware of their needs in detail. In fact, two new Kobelco sister companies, KMWK in Korea and KWI in India were setup just last year. They will enable us to visit clients, discuss their individual needs and respond with our proposals. This community-based business activity will also help us to improve how we organize the development of welding products and procedures as well as sales and marketing (i.e. technical support, inventory, quality assurance) to meet client needs.

In communicating with customers, the role of our agents has become important. In China, for example, while KWSH, KWQ and KWT used to sell the products through their own sales channels, we have united sales and marketing in a restructured organization. We believe that the new organization will be smoother and more effective in this vast country and that the people will favor and rely on Kobelco products. During the Beijing Essen Fair in June 2012, we held a Kobelco Group Agents Association meeting in China for the first time. 32 local companies and distributors took part in it and declared they would play an active role as agents of the Kobelco Group. We will proceed in developing similar associations in other areas to further the spread of Kobelco products by enhancing the sales-agent networks.

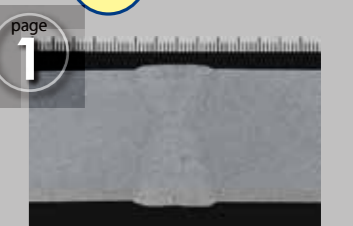
Lastly, under our ultimate goal of becoming the most reliable manufacturer in the world, we will grow our activities by grasping each user's needs and contributing to their quality improvement by presenting the best total solutions. We look forward to working with you and receiving your support.



Shinichi Tanaka
General Manager
International Sales & Marketing Section
Marketing Department
Welding Business
Kobe Steel, Ltd.

KOBELCO WELDING TODAY No.3 2012

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"Real life" in KWQ, and in China



One is never bored in Shanghai



Looking for growth at KWI and in
my first overseas assignment

KOBELCO WELDING TODAY
is published by
Marketing Department
Welding Business, Kobe Steel, Ltd.
URL: <http://www.kobelco.co.jp>
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Using ARCMAN™ Robot Welding Systems for Railroad Car and Bridge Applications



Introduction

When used in connection with SENSARC™ series arc welding power sources, Kobelco's ARCMAN™ series arc welding robots are well-suited for welding medium/thick steel plates. In the previous issue (Vol.15, No.2), the technical highlight article described how Kobelco's robot welding systems are used in the construction machinery field. In this issue we focus on two more applications involving medium/thick plate welding: railroad cars and bridge construction. This article will also describe how the user-support software "AP-SUPPORT" improves production stability and efficiency.

Features of a robot welding system for railroad car construction

The railroad car is basically composed of a chassis and a body that is supported by a chassis. Quite a few ARCMAN™ robot welding systems have been supplied to railroad car manufacturers for automating the welding processes of their chassis.

Railroad cars must by nature be reliable and safe when transporting people or objects. The robotic welding processes used in constructing them must, therefore, be of high quality as well. The main components to be welded by robots are the side beam, the horizontal beam, and the chassis frame, in which both beams are connected to each other. Figure 1 shows the chassis frame.

Chassis components have complicated shapes such as the curved welding line with a groove as shown in Figure 2. Such complex shapes require stable deep-penetration and multi-pass welding, at which Kobelco's robot welding systems are particularly adept. The robot's various sensing and multi-pass welding functions are just the ticket for medium/thick plate welding.

Figure 1: Chassis frame of railroad car

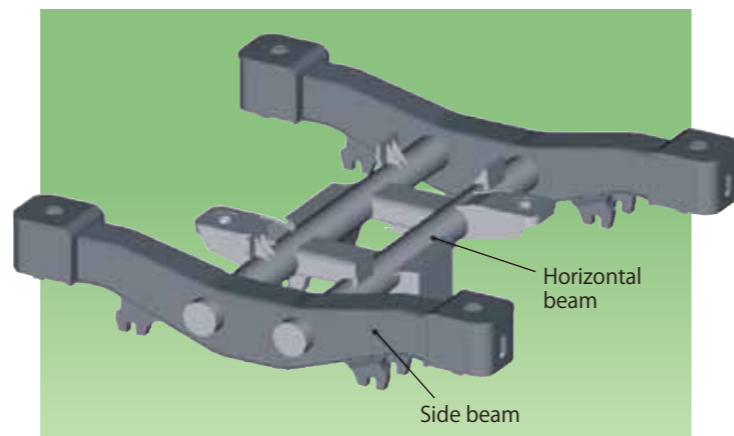


Figure 2: Chassis component with complicated welding line



(1) Hardware configuration of ARCMAN™ robot welding system

The standard robot welding system for welding the main components of railroad cars consists of the ARCMAN™ robot and peripheral equipment, a positioner and a slider.

Figure 3 is an example of the robot welding system employing a two-axis (rotation and tilt) positioner which allows the robot to synchronously conduct flat-position welding in order to secure the highest quality.

Figure 3: Robot welding system with 2-axis positioner



Figure 4: 2-3 meter long workpiece, held 1.5-2 meters above the floor level.



When a 2-3 meter long workpiece is mounted for flat position welding, it has to be tilted about 70° maximum. As a result, the tilt axis center must be positioned about 1.5-2.0 meters above the floor to prevent the workpiece from touching the floor. (See Figure 4.)

However, it can be burdensome as well as dangerous when operators are required to mount and dismount workpieces in such high positions. Therefore, Kobe Steel has provided the robot welding system with a specially-designed positioner that has an additional, up-down, axis.

(2) Efficient off-line teaching software

The teaching of the robot welding system applied to railroad car fabrication will be different for every workpiece because each one has a unique shape. The off-line teaching software, K-OTS32, is provided in order to make a more efficient teaching database for the diverse workpieces with complicated shapes.

(3) Easy plasma cutting by robot system with off-line teaching software

In side beam fabrication, both the edge preparation for the welding groove and the component cutting is

performed prior to welding. In general, steel material bent in a U shape is cut at the user's factory to make the side beam component. As three dimensional (3-D) cutting is required, an articulated cutting robot is well-suited to the task. The off-line teaching system, K-OTS32, can effectively create the teaching database of the complicated movement locus.

Furthermore, because the plasma cutting machine made by Hypertherm Inc. is connected to the ARCMAN™ robot through an exclusive interface, cutting parameters such as cutting current and speed can be taught from the teaching pendant connected to the robot. As a result the operational performance is increased. Figure 5 shows an example of plasma cutting robot system.

Figure 5: Plasma cutting robot system



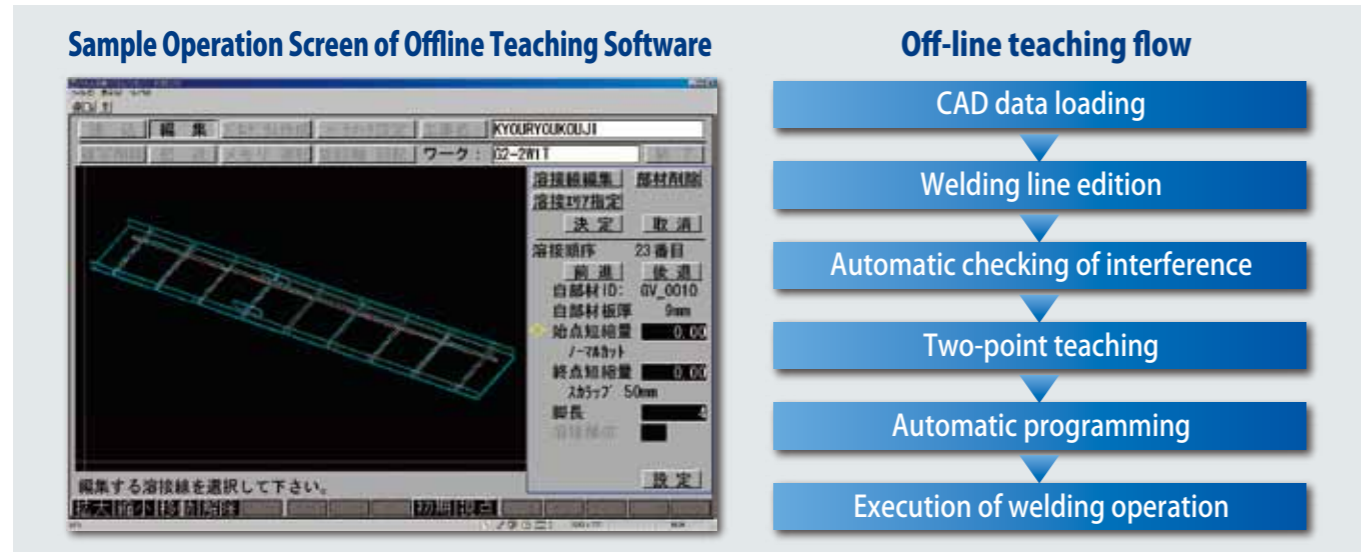
Plasma cutting robot systems from Kobe Steel are available in two configurations. One is designed exclusively for cutting, whereas the other can carry out both cutting and welding. The latter system is mounted with both welding and cutting torches that engage automatically for their particular job. In this way, the robot achieves a high operating ratio as well as significant space-saving.

Features of robot welding systems for steel bridge construction

The GT-5000, an orthogonal NC twin welding robot for bridge construction, was released in 1988; however, these days, the ARCMAN™ series welding robots are preferred as they have special features for fabricating bridge panel components.

One improvement relates to the teaching function. Because bridge panel components have diverse designs, teaching usually has to be performed each time a new workpiece is operated on, which can mean shutting down the production line and losing productivity. In Japan, the off-line teaching can now be carried out without stopping

Figure 6: Off-line teaching display



the production line by utilizing a computer program that applies CAD data designed with a full size (see Figure 6).

(1) Major systems

① Twin robot welding system

One common type of system utilizes a pair of welding robots suspended overhead and set on opposite sides of the workpiece that is mounted on a slider with an extra pivot axis. Facing each other, the robots perform horizontal fillet welding on both sides of the workpiece at the same time, thereby increasing welding efficiency. Two types of twin welding systems are available: a gantry type, as shown in Figure 7, and a cantilever type, allowing the user to match the system to his needs.

② Single robot welding system

Compared with twin robot systems, single robot welding systems take up much less space. They can carry out welding of main girders with a width of up to 3m. The ARCMAN™-XL mk II is an extremely large robot; however, when mounted on a compact, floor-type carriage with one axis instead of a conventional overhead-suspended carriage, the size of the system is reduced and the cost is lower as well. (See Figure 8.)

Figure 7: Gantry type twin welding system



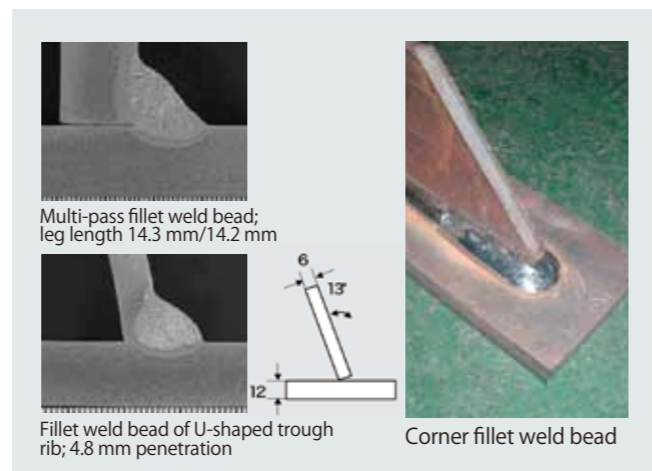
Figure 8: Compact and single robot welding system



(2) Suitable workpieces and welding functions

Many different bridge panel members such as plate girders, box girders, U-shaped trough ribs, flange panels, and diaphragms are well-suited for robotic welding. These bridge panel members usually require corner welding and multi-pass, large leg-length welding in combination with flux cored wires.

Figure 9: Multi-pass fillet weld and corner fillet weld



(3) Extending monitor-less operation time

① Memory function

These welding systems feature computer memory that can be programmed to weld multiple workpieces one after the other. Continuous welding of up to 20 workpieces is possible.

② Skip function

When short-time breakdowns occur (in which an operator can quickly resolve an issue and restart the production) during automatic operation, the robot automatically conducts a series of actions. It stops welding, shifts the nozzle to its cleaning device, cleans the nozzle, returns to the position where the welding had stopped, and then re-starts welding. This function is particularly useful for monitor-less welding during night shifts.

③ Automatic nozzle-cleaning and nozzle-changing devices

Spatter that sticks to a nozzle during welding may cause short-time breakdowns or welding defects due to the lack of shielding. In such cases, the nozzle can be replaced with a clean one by the automatic nozzle-changing device shown in Figure 10. The automatic nozzle-cleaning device then cleans the dirty nozzle up to the orifice located deep inside.

Figure 10: Automatic nozzle-changing device



④ Other functions supporting continuous operation

In addition to the functions already mentioned, the computer controlling the ARCMAN™ series welding robots is programmed to prevent “wire-stick” (when the melted wire end adheres to the weld bead), nozzle-to-workpiece contact and arc-retrying. These standard functions enable the robots to be employed in continuous operation safely and effectively.

AP-SUPPORT: User support software

In order for a robot welding system to maintain stable production, it is necessary to be able to monitor the system and promptly resolve any problems that occur.

AP-SUPPORT is a program that maintains production stability by allowing users to visualize the robot welding system. It was launched in October 2010. It allows users to monitor the daily operations of the ARCMAN™ robot welding system and to improve productivity. Specifically, AP-SUPPORT accurately processes production control data such as the arc generation rate as well as data generated from any problems that occur.

Figure 11: AP-SUPPORT network

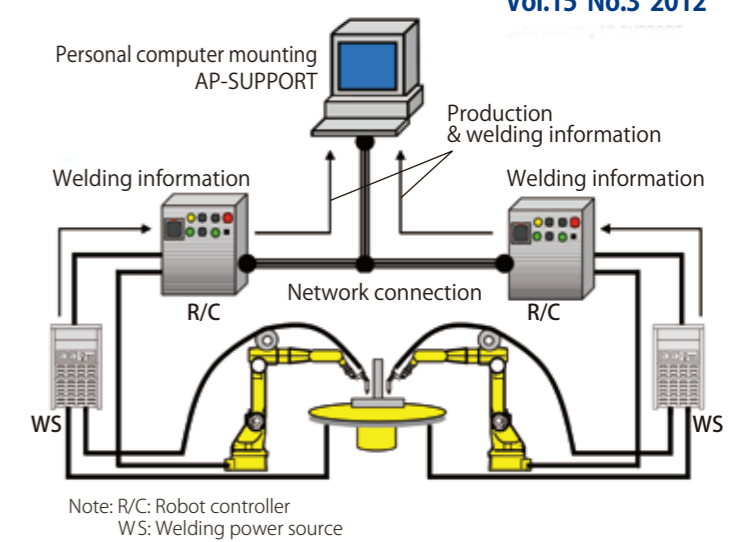


Figure 11 shows the AP-SUPPORT network. Quite a lot of welding information as well as production information are transferred from the robot controllers and the welding power sources through the network, into the personal computer.

With the AP-SUPPORT program, users can analyze production control data like the arc generation rate and data related to short-time breakdowns and welding defects and thereby improve productivity more efficiently.

To better understand how the program supports production and welding, it is worthwhile to look at the production monitor and arc monitor in more detail.

(1) Production monitor

The production monitor helps to control production and to improve the effects of short-time breakdowns.

One of the main functions of the production monitor is to produce a report of information related to production obtained from the robot controller. Production data obtained from the robot controller is analyzed, and the report provides details essential for production control (see Figure 12) as well as information that will allow users to improve performance in future short-time breakdowns (see Table 1). Figure 12 shows a bar chart detailing the daily arc time, non-arc time, and stoppage time due to errors or other reasons experienced daily as well as a line graph that shows the number of short-time breakdowns. This chart can help users understand whether the arc generation rate is maintained or not and how stoppage time either increases or decreases over time. Table 1 also shows teaching data (Program number and Step number) indicating the locations of the short-time breakdowns and provide error messages. From this output, users can easily recognize which part of teaching data requires modification.

Other functions of the production monitor include displaying the robot's present status as well as the history of changed teaching data.



Figure 12: Output of production related information

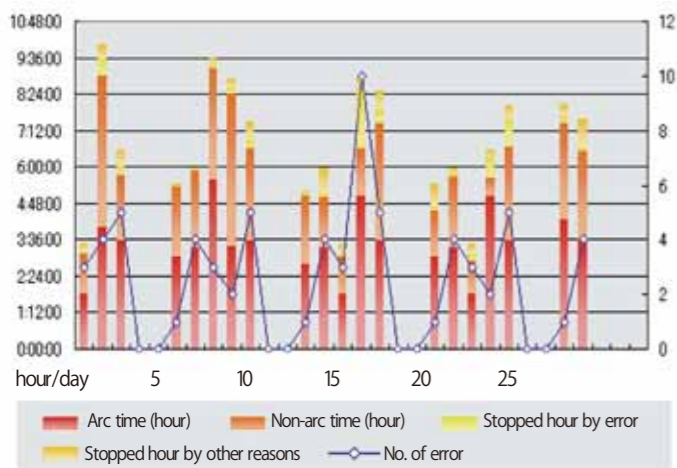


Table 1: Output of information related to short-time breakdowns

No. of times	Main program	Program no.	Step no.	Pass no.	No.	Error message
22	12	204	13	1	367	Abnormal arc occurred (during welding) 2
15	13	302	13	3	693	Abnormal arc occurred (Arc re-try)
13	22	252	13	1	367	Abnormal arc occurred (during welding) 2
22	22	255	16	1	367	Abnormal arc occurred (during welding) 1
9	13	304	13	2	693	Abnormal arc occurred (Arc re-try)
8	11	127	12	0	452	Movement of a certain distance is not enough to keep away from a wall (Touch-off)

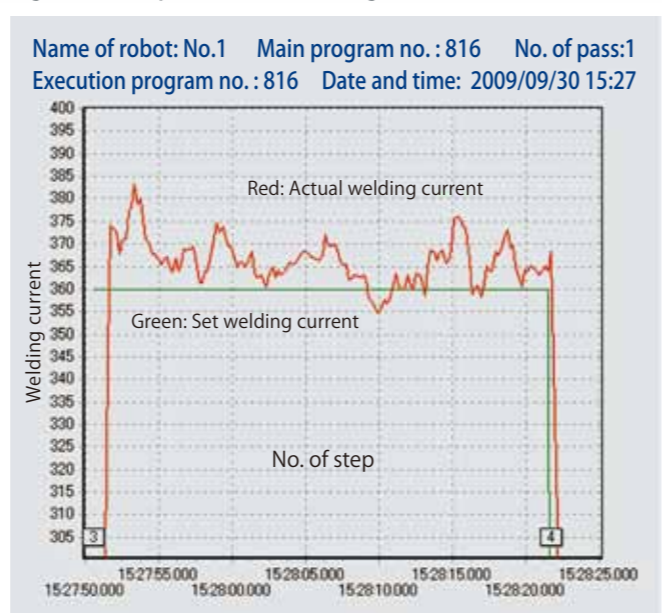
For more detailed analysis, the monitor can also report on the number of sensing actions, the number of times sensing is corrected, or waiting time due to timer setting. For example, if the output report indicates the amount of sensing corrections for the workpiece is quite small, it may be judged that the workpiece is accurate and that sensing operations can be omitted, leading to shorter takt time.

Ultimately, the production monitor's report-output function helps users to improve productivity and automation by utilizing information obtained and analyzed by operators in the past.

(2) Arc monitor

The arc monitor function helps users solve such welding problems as lack of leg length, unstable arc, and deviation of welded line. Such information related to the welding as welding current, arc voltage, welding speed, corrected amount of track-sensing, adjusted amount of arc sensing is obtained from the robot controller and displayed in the graphs on the arc monitor screen as shown in Figure 13.

Figure 13: Output of arc monitoring



Robot welding systems connected to the latest SENSARC™ AB500 power source can obtain wire feeding information (e.g. the wire feeding load) that can cause welding defects. Another function can judge the appropriateness of the set welding current against the actual welding current. The arc monitor screen displays not only present welding data in real time but also past welding data. It enables users to better investigate the causes of current welding defects as well as to trace the welding history.

Postscript

Readers of Kobelco Welding Today may have noticed that the Technical Highlight columns in 2012 have featured KOBELCO's robot welding systems three times in a row. We hope that readers by now well understand the excellent features and benefits of our robot welding systems.

KOBELCO plans to continue to enhance the product lines, functions as well as the application software of our welding systems to enable our clients to achieve more efficient and stable production. As one of the most prominent manufacturers of welding consumables in the world, Kobe Steel takes pride in presenting total solutions that combine strengths coming from the areas of welding consumables, robot welding systems and welding power sources. KOBELCO will continue to provide our clients with the ARCMAN™ robot welding systems, by making use of these advantages and strengths.

Three Kobelco sister companies strengthen their ties at the Beijing Essen Fair 2012

The 17th Beijing Essen Welding & Cutting Fair 2012 was held at the New China International Exhibition Center in Beijing from June 4 - 7, 2012. One of the largest welding-related exhibitions held in Asia, the Essen Fair in China is held annually, alternating between Beijing and Shanghai.

Kobe Steel took part in the exhibition together with three sister companies in China, Kobe Welding Tangshan (KWT), Kobe Welding Qingdao (KWQ) and Kobe Welding Shanghai (KWSH), highlighting the One Kobelco Group in the Chinese market.

Kobelco displayed several products in together with the Tangshan Group, which is based in Tangshan City near Beijing and which KWT also belongs to. In the corner dedicated to robot welding systems and welding consumables recommended to various industries, visitors could see demonstrations of welding with flux cored wires for stainless steels, other welding consumables, bead samples as well as panels explaining the products and processes. Kobe Steel was able to show itself as the total-welding-solution provider to many prospective customers not only from China but also from such places as India, the Middle East, Europe and America.

Another corner was dedicated to "business talk," where we could have fruitful communication about Kobelco's



Entrance of Beijing Essen Fair 2012

strong points with many visitors.

"Overwhelming" is the word that best describes the Beijing Essen Fair. Twice the size of this year's Japan International Welding Show, it required eight large halls in order to fit the large number of small, medium and large-sized exhibitors, including several famous global companies. This sight convinced me that the fair is surely among the largest in the world and also that worldwide companies remain keenly interested in the big Chinese market.

Clearly, Kobe Steel must strengthen its presence in this

vast Chinese market, and in order to grow stronger, we have to emphasize our technical capability as the total solution maker. We also have to support our three local group companies in China, so they can establish a firm presence as local suppliers.

On the final day of the exhibition, I came to realize that we have to make more effort to ensure that Kobelco products are welcomed by a wider range of potential customers in China. Next year, get ready as we prepare a "bigger surprise" and welcome you to the exhibition!

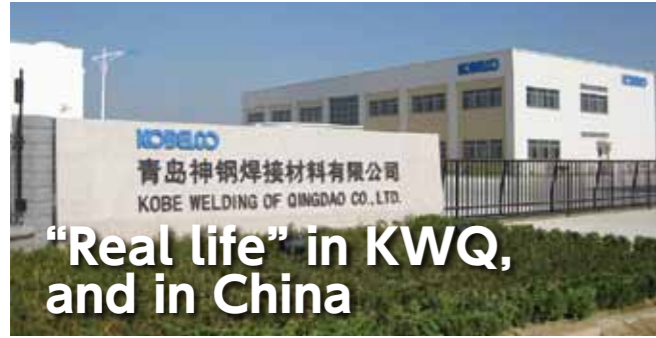
Reported by **Makoto Yamashita**
International Sales & Marketing Section
Marketing Department, Welding Business
Kobe Steel, Ltd.



Good communications with potential customers in the business talk corner



Panels and a welding robot system are displayed in the corner for robot welding systems and welding consumables



Dear readers of Kobelco Welding Today! My name is Arizono, and I've been at Kobe Welding of Qingdao Co., Ltd. (KWQ) in Qingdao City, China since April 2012.

When I joined Kobe Steel, Ltd., I was first assigned to the Hidaka Plant and then to the Fujisawa Plant in the "Welding Division" for a total of five years. But for the next twenty years, I worked in the wholesale and distribution business of welding consumables in the Japanese domestic market.

At KWQ, I've returned to wearing the blue Kobelco worker's outfit instead of a suit and tie because KWQ is a welding consumable production company. I can say, therefore, life in China seems more authentic, more "real."

Two years after KWQ began production, the company has nearly reached the point where it can sail at normal speed – especially as production has recently increased.

Chinese shipbuilders, the most productive in the world, are the biggest industrial end-users for KWQ products. At one time, the rapid progress of Kobe Steel's welding technology paralleled the development of Japanese shipbuilding. At KWQ, we hope to progress by playing a similar role for the Chinese shipbuilding industry, while extending our technology further to other industries.

While the news reports on the slowdown of the Chinese economy, in reality, it is still growing. KWQ also wants to grow and become the most reliable manufacturer and supplier of total welding solutions in China, in cooperation with our sister companies, Kobe Welding Tangshan and Kobe Welding Shanghai. We also look forward to cooperating with the newly organized Kobelco Group Agents Association in China for our mutual fruitful development.

We sincerely thank you for your kind support and look forward to seeing you soon, probably at the next Shanghai Essen Fair in 2013.



Mr Arizono, KWQ President, wearing Kobelco blue working cloth



Dear KWT readers! I am Hideaki Takauchi of Kobe Welding of Shanghai Co., Ltd. (KWSH). I have been here since February 2012.

Even though KWSH was established only two years ago, the welding consumables of our parent company, Kobe Steel (KSL), are highly reputed all over China for their quality and properties.

Although economic growth in China has been somewhat stagnant, new projects in the energy-related sector have kept our products in high demand. The welding material manufacturers in China as well as in Europe and America are aggressively promoting their products for these projects. We at KWSH will endeavor to support our customers with both smooth delivery and advanced and efficient technical support, so they will surely continue to trust Kobe Steel and the Kobelco brand products.

By the way, the most famous animal in China is certainly the "giant panda." In Japan, pandas live in glass cages and rarely move around. But you can see a



While visiting Guilin with his family, Mr Hideaki Takauchi, Manager, poses with his two children.

totally different giant panda in China. In Chinese characters, a panda is a "cat-like bear," which suggests a soft, cuddly animal. But, as "bears," when the giant pandas play together, they seem violent and bear-like. Seeing the pandas in action surely changed our image of the cuddly beasts. At the Shanghai zoo, we saw giant pandas with black and brown stripes - not black and white stripes. This was because they spent their time playing and rolling around in the dirt. My family's present goal is to visit Sichuan Province, where we might see real giant pandas in the wild.

In China, the nature is magnificent and cities can feature beautiful historical buildings. Even in Shanghai's major sight-seeing spot, "The Bund," the way modern and historical structures coexist is impressive. When I visit local districts, I enjoy the local cuisine because each region offers a different taste. All in all, I have found I never get bored in China as I have encountered innumerable pleasures. Dear KWT readers: I recommend you visit China and find your own attractive China.



Giant pandas playing with each other at Shanghai Zoo



Dear KWT readers! My name is Keitaro Sawada. I was transferred to Kobelco Welding India Pvt. Ltd. (KWI), in March 2012. I started working for Kobe Steel in 2000 and worked in domestic sales for both the wholesale and distribution business as well as sales and marketing to end users in such heavy industries as shipbuilding and energy.



Mr Keitaro Sawada Senior Manager, KWI

KWI is a very young company, established in 2011. As my first assignment abroad, I am still a little nervous but I've learned that each day I might experience something unimaginable or meet a new friend. Living in India has given me the opportunity to acquire an international business way of thinking and to help this young KWI grow.

March 8, when I arrived at my post, also happened to be the day of the great spring celebration in the Hindu religion, called the Holi Festival. Indian people celebrate the coming of spring on that day by splashing colored powder and water on friends and strangers. The people in northern India are especially enthusiastic about the festival and almost all companies and shops are closed. They celebrate the festival in their own way, taking the opportunity to cheer up their spirits for the coming year. Some say the festival plays an important role in helping people in Indian society to relieve stress. I could find the vestiges of the festival in many places on the streets for a few days after it.

I look forward to working for KWI and also seeing many people in India in the very near future.



Staff members of KWI, posing at the new office for KWI's first year celebration