

# KOBELCO

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# KOBELCO WELDING TODAY

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



# KOBELCO





New line-up in the ARCMAN™ welding robot series



The new SAW US-29HK / PF-H55LT-N, for Offshore Wind Power Generators



The Welding Business's 115th International QC-Circle Conference

NOTIFICATION

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# New 2021 Year's greeting from the Head of the Welding Business

Dear KWT readers! I wish all KWT readers a Happy New Year! And I would like to express my sincere gratitude for your continuous patronage of KOBELCO group products.

This year, we had a different-from-usual New Year, due to the COVID-19 pandemic. In Japan, we usually enjoy a rather long holiday at the year end and beginning of the year, with many people going back to their hometowns to celebrate the New Year with their relatives and friends. However, this year started with a much calmer atmosphere than normal. I assume that your Christmas and New Year holidays were also different this time. Nevertheless, the COVID-19 pandemic will certainly end, and we will be able to enjoy a true Merry Christmas and Happy New Year in 2022!

Although the year 2020 was an extremely difficult year, I could say that it was a year of change in our lifestyle but also discovery of joy and thankfulness. How we use our time has become freer and more flexible due to tele-working through Teams or ZOOM, which became commonplace and have allowed us to participate in meeting easily, even from far away. We also discovered joy and thankfulness at the International QC-Circle Conference. It is normally held in Japan, with the participation of representatives from Welding Business Group companies from around the world. In September 2020, however, it was held as an on-line video conference via Teams. While actual QC-Circle presentations were given by representatives of domestic plants only, participants from overseas were able to broadcast video messages to the conference. We could see our colleagues' cheerful faces and confirm how deeply united we are with them. Even if we are in the midst of the COVID-19 pandemic, their messages have encouraged us to overcome it. How wonderful it has been to discover such joy and thankfulness!

The COVID-19 pandemic has caused worldwide economic activities to become stagnant. Our customers' welding environments have been so badly influenced that increasing productivity through automation is going to be expected. We, the KOBELCO group, are the only worldwide business group that owns technology and products from welding consumables to robots, power sources, IoT and AI. We have been developing new technologies and will continue to do so in order to respond to market expectations.

On the other hand, the welding solutions that we aim for are not limited to automation by robots; rather, we aim to solve issues related to our clients' welding. In other words, we help our customers to utilize our KOBELCO products safely and with relief as well as contribute to their Monozukuri. We are determined to dedicate our efforts toward strengthening the merchandising strategy, the business plan and the marketing force in each market. Thus, we want to contribute to develop each enterprise, each region and each country, while responding to our customers' needs while further developing welding and joining technologies.

The Welding Business Group will keep on acting under the slogan of being "the most reliable welding solutions company in the world" while cherishing the ties we form around the world. I am quite sure that the pandemic will come to an end sooner or later. And we will be ready to provide our customers with the solutions as soon as their activities resume. In the meantime, we would be more than happy if you could send us your comments, needs or requests at any time.

In the last, I do hope you and your family have a happy and prosperous 2021!

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



# New line-up in the ARCMAN™ welding robot series



For over forty years, the ARCMAN™ welding robot series has been a part of KOBELCO's robotic welding systems that have been marketed to a range of industries that utilize steel materials of middle to heavy plate thickness, such as construction machinery, steel structures, bridges and railway vehicles. In 2020, the mid-sized ARCMAN™ A60 and the small-sized ARCMAN™ A40 were added to the line that includes the large ARCMAN™ A80 and the extremely compact ARCMAN™ A30/A30S. This complete line-up will extend the series to new applications, such as automation for which demand is expected to grow in the near future. Let's take a closer look at each member of the now-complete series of ARCMAN™ robots.



	ARCMAN A80	ARCMAN A60	ARCMAN A40	ARCMAN A30/A30S
Load capacity	10 kg	10 kg	8 kg	5 kg
Max. reach	2735 mm	1646 mm	1258 mm	858 mm

Figure 1: The new line-up of ARCMAN™ welding robots

## 1 The large-sized ARCMAN™ A80

A modified version of the ARCMAN™ XLmk II that is one of the KOBELCO's most successful welding robots, the A80 is stiffer, lighter in weight, and features a longer reach. In addition, because the A80's peripheral axis has been reduced and its cable treatment simplified, welding systems adopting the A80 robot can be simplified as well.



Figure 2: ARCMAN™ A80 is applied in the production of a construction machine

KOBELCO Welding Industries

## 2 The mid-sized ARCMAN™ A60

An advanced version of the standard ARCMAN™ MP, the A60 offers better space saving and reduces interference with workpieces because of optimized cable treatment, with all cables designed to go through the S1 axis. (Welding cables go through it when a wire feeder is mounted on the robot, and a torch cable goes through it when the wire feeder is not mounted.) As the A60 is compatible with the MP, all peripheral equipment associated with the MP can be used with the A60.

## 3 The small-sized ARCMAN™ A40

The details of how the A40 updates the ARCMAN™ SR have been discussed in the Product Spotlight of KOBELCO WELDING TODAY, Vol. 23, No. 1, 2020. Generally, small-sized robots are advantageous in overhead welding systems that approach workpieces from above, which is a means of saving space and reducing a system's height. The A40 can minimize interference with workpieces because the torch cable goes through the S1 axis and features a reverse elbow posture that allows the S3 axis to bend to the back side of the robot, making it especially suitable for an overhead welding system. Furthermore, the A40's improved load capacity enables it to utilize a heavy torch exclusively designed for the Ultra-High-Current GMAW Process, which increases its application range even more.

## 4 The extremely compact ARCMAN™ A30/A30S welding robots

The new ARCMAN™ A30 and A30S robots are designed for cramped work areas. Due to the robot's small size and light weight, all cables for the drive system are installed inside the robot in order to minimize interference from the robot's uneven shape on the torch cables. The robots feature high speed sensing as well as highly efficient arc sensing functions.



Figure 3: Welding carried out by the ARCMAN™ A30S in the shipbuilding hull assembly

KOBELCO Shipbuilding



# The new SAW FAMILIARC™ US-29HK / TRUSTARC™ PF-H55LT-N, for Offshore Wind Power Generators



## 1 Preface

Submerged arc welding (SAW) is a common arc welding process, and in Japan about 11% of welding consumables are applied to SAW. It is mostly used for long straight welding lines in the fields of steel tubes and pipes, steel frames and bridges, shipbuilding and chemical engineering/machines.

As for SAW consumables, just three industries account for more than half of total consumption: steel tubing and piping, steel structure/bridge construction and shipbuilding. However, among those three, the steel structure/bridge construction and shipbuilding industries account for a higher share of SAW consumption than the steel tubing/piping industry.

Since 2000, interest in alternative methods of power generation that feature reduced CO<sub>2</sub> emissions has steadily grown worldwide in response to environmental issues such as global warming. For example, many countries have accelerated the introduction of power generators that utilize renewable wind power and solar

energy. Especially in Europe, where conditions for wind power are excellent, installation of wind power generators has been widespread; moreover, large size generators that further increase the electrical generation capacity of off-shore wind power generators have recently drawn attention.

Many off-shore wind power generators are supported by a mono pile, a large-sized steel cylinder driven deep into the sea bed that serves as the foundation for the tower and windmill. On these pipes, the highly efficient SAW process is mainly applied, especially the SAW method utilizing a narrow groove, which is both highly efficient and labor saving.



KOBELCO now offers the newly-developed combination of **US-29HK** wire and **PF-H55LT-N** flux as the SAW consumables most suitable for narrow

groove, seam welding and/or circumferential welding of steel tubes and pipes as well as for low temperature service.

## 2 Properties of the **US-29HK** wire and **PF-H55LT-N** flux combination

As shown in Table 1, the SAW flux **PF-H55LT-N** is a fluoride-basic type of bonded flux and has excellent usability even in a narrow groove due to its superb

optimization of flux components. In combination with the SAW wire **US-29HK**, it provides extremely stable notch toughness down to -60 °C and is applicable to both alternating current (AC) and direct current, electrode positive (DCEP). It is also recommended to use in the as-welded condition.

Table 1: Properties of **US-29HK** and **PF-H55LT-N** combination

Flux type of <b>PF-H55LT-N</b>	Fluoride-basic type
Electrode-Flux classification	AWS A5.23 F8A8-EH12K
Applicable base metal grade	• Up to YP460 MPa grade steel (e.g.: DNV-GL F460)
Features	<ul style="list-style-type: none"> <li>• Excellent slag removal, bead shape and good resistance of various welding defect for narrow groove</li> <li>• High strength(up to YP460 MPa) and excellent impact value at low temperature down to -60°C</li> <li>• Applicable for DCEP and AC polarity</li> </ul>

Note. DNV-GL: Det Norske Veritas-Germanischer Lloyd

### 2-1. Properties of the deposited metal

Tables 2 and 3 show the chemical composition and the mechanical properties in the as-welded condition by both DCEP and AC, based on AWS requirements. Figure 1 exhibits the notch toughness property in the

as-welded condition and Figure 2, bead appearance.

The diffusible hydrogen content of the deposited metal welded by the combination of **US-29HK** / **PF-H55LT-N** with DCEP is shown in Table 4. It indicates an extremely low level of about 3 mL/100 g, below H5.

Table 2: Chemical composition of the deposited metal (mass%)

	Polarity	C	Si	Mn	P	S
<b>US-29HK</b> / <b>PF-H55LT-N</b>	DCEP	0.07	0.29	1.85	0.013	0.002
	AC	0.08	0.27	1.73	0.013	0.002

Note. Welding condition: 550 A-30 V-42 cpm; Ext.=30 mm; 4.0 mm wire dia.

Table 3: Mechanical properties of the deposited metal

	PWHT condition	Polarity	0.2%OS (MPa)	TS (MPa)	EI (%)
<b>US-29HK</b> / <b>PF-H55LT-N</b>	As-welded	DCEP	514	603	28
		AC	534	618	29
AWS Specification (As-welded only)			Min 469	552-690	Min 22

Note. Welding condition: 550 A-30 V-42 cpm; Ext.=30 mm; 4.0 mm wire dia.

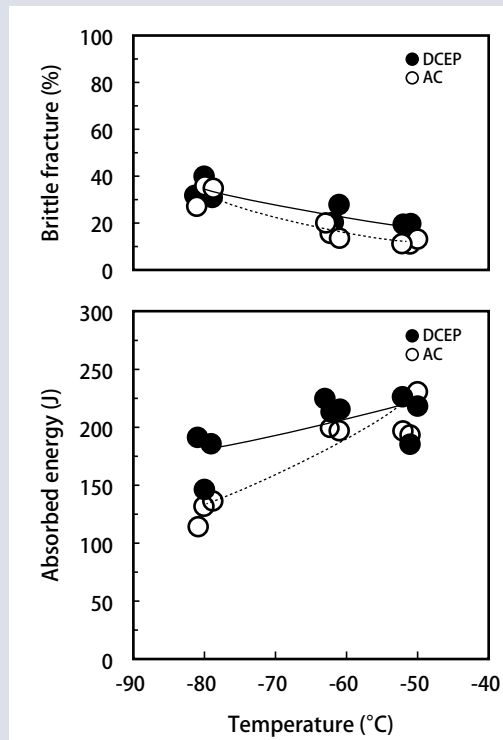


Figure 1: Transition curve of notch toughness in the as welded condition



Figure 2: Bead appearance

Table 4: Diffusible hydrogen content

	Polarity	Diffusible hydrogen content (mL/100g)				Classification of shipping approval
		N-1	N-2	N-3	Avg.	
US-29HK / PF-H55LT-N	DCEP	3.2	3.3	3.3	3.3	H5

Note. \*1. Welding condition: 500 A-30 V-40 cpm; Ext.=30 mm; 4.0 mm wire dia.  
\*2. Test method: According to JIS Z 3118 (Gas chromatography), equivalent to AWS A4.3 Standards Methods for Determination of the Diffusible Hydrogen Content of Martensitic, Bainitic, and Ferritic Steel Weld Metal Produced by Arc Welding.

## 2-2. Both side butt joint welding test in a narrow groove

A both side butt joint welding test in a narrow groove was performed with the combination of US-29HK / PF-H55LT-N under the welding condition and welding parameters shown in Tables 5 and 6, respectively. In this test, the base metal was an 80 mm thick steel plate with a 60° V-groove on the first side, a 40° V-groove on the second side, and a 10 mm root face in-between, as shown in Figure 4. The first side was welded in 8 passes. After the welding, the second side was machined into a U-shaped (8 mm radius), 16° groove to a depth of 58 mm from the second side surface, as shown in Figure 5. The second side welding was carried out in 21 passes by the tandem welding process: a 4.0 mm dia. wire for the leading electrode (DCEP) and two 2.4 mm dia. wires for the trailing electrodes (AC) in order to increase the deposition rate, as shown in Figure 3. The two trailing electrodes were connected to one power source only but through two contact tips.

In actual welding, however, a different welding procedure to the one above, including edge preparation, can be applied. For the first side welding, a single Y-groove can be prepared instead of a double V-groove, and after the first side welding, the U-shape groove can be machined. Both applications are recommended.

Regarding the actual application of the trailing electrode, while the method of two wires going through one contact tip was adopted, the method of two wires going through two respective contact tips with one power source is recommended. When two wires are used in one contact tip, a problem like a welding wire adhering to a contact tip will require the whole special contact tip to be changed, increasing down time for the operator, as well as the consumption of special contact tips.

Tables 5 and 6 show the test condition and the welding parameters. Figure 3, 4 and 5 also exhibit the location of electrodes at tandem welding and the pass sequences in both the first and second side grooves, respectively.

Table 5: Test condition of both side butt joint welding

Electrode	US-29HK Leading electrode (L): 4.0 mm dia. Trailing electrode (T): 2.4 mm dia. x 2 wires
Flux	PF-H55LT-N
Base metal	JIS G 3106 SM490A, 80 mm thick

Table 6: Welding parameters for both side butt joint welding

	No. of passes	Welding parameter	Heat Input (kJ/mm)	Preheat and interpass temperature
1st side	1	Single, DCEP, 600 A-30 V-600 mm/min	1.8	100-147 °C
	2	Single, DCEP, 650 A-30 V-600 mm/min	2.0	
	3-8	Tandem, L: DCEP, 650 A-30 V T: AC, 600 A-32 V-700 mm/min	3.3	
2nd side	1	Single, DCEP, 600 A-30 V-600 mm/min	1.8	
	2-21	Tandem, L: DCEP, 650 A-30 V T: AC, 600 A-32 V-700 mm/min	3.3	

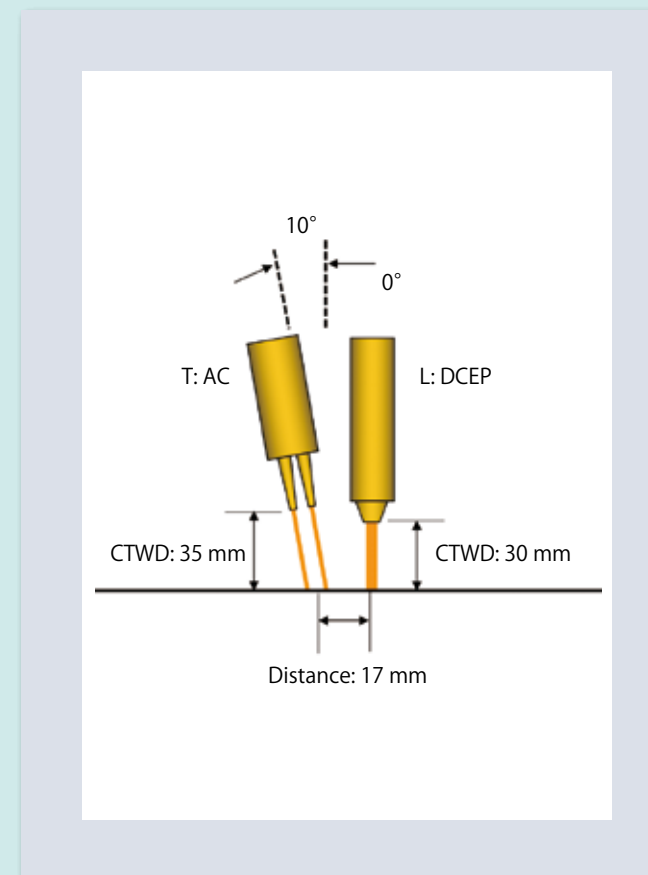


Figure 3: Location of electrodes at tandem welding

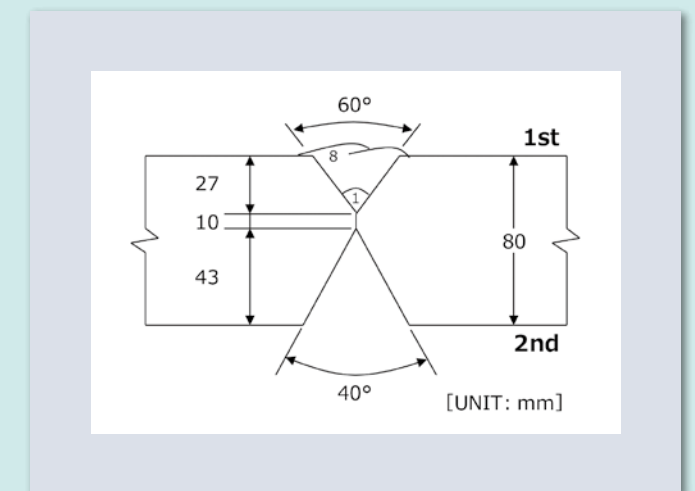


Figure 4: Groove configuration and pass sequences for the 1st side welding

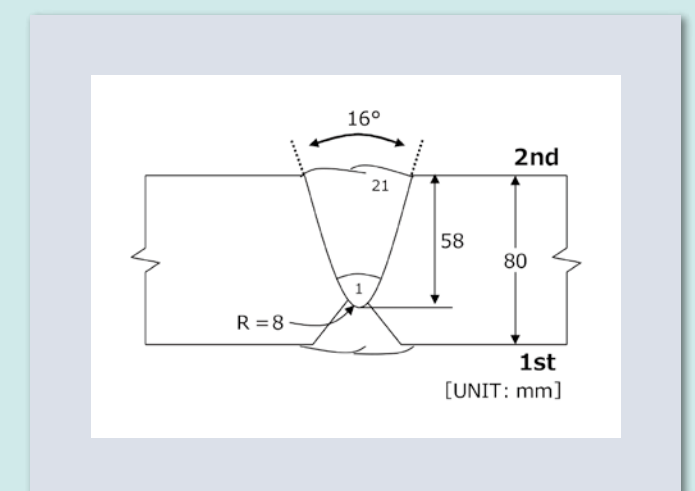


Figure 5: Groove configuration and pass sequences for the 2nd side welding



In welding this butt joint, excellent results were obtained. Figure 6 shows a macroscopic section and Tables 7 and 8, the chemical compositions and mechanical properties of the butt joint weld metal, respectively.

Overall, the properties of the welded butt joint can be evaluated as excellent, due to maintenance of high strength, the securing of sufficient notch toughness at -60 °C, and the transition temperature being held below -60 °C.



Figure 6: Macroscopic section of both side butt joint welding

Table 7: Chemical composition of weld metal (mass%)

C	Si	Mn	P	S
0.09	0.30	1.78	0.014	0.003

Note. Location of chemical test specimen: Center of plate thickness

Table 8: Mechanical properties of weld metal

PWHT condition	Location of specimen	0.2%OS (MPa)	TS (MPa)	El (%)	vE-60°C (J)	vE-40°C (J)	
As-welded	7 mm beneath the surface on the 2nd side	496	618	33	112	161	
					123	Avg. 121	156
					127		147
	40 mm beneath the surface on the 2nd side	580	634	28	162	194	
					181	Avg. 165	196
					152		196
	73 mm beneath the surface on the 2nd side	591	664	28	128	184	
					130	Avg. 146	185
					179		183

### 3 Notes on usage

- It is advised to note the following points:
- (1) The combination of **■** US-29HK wire and **■** PF-H55LT-N flux is most suitable for multi-pass and multi-layer welding; however, it is not recommended for high heat input welding like both side, one pass welding.
  - (2) PWHT is not recommended because the combination is designed to obtain excellent mechanical properties in the as-welded condition.
  - (3) It is also recommended to re-dry the flux one or two hour(s) before welding at 300-350 °C in order to avoid cold cracking.

### 4 Postscript

The combination of **■** US-29HK wire and **■** PF-H55LT-N flux can be utilized to weld in seam and/or circumferential direction(s) of the steel tubes and pipes with narrow and U-shape grooves (groove angles from 15 to 16 degrees and root gaps from 5 to 10 mm). It provides for stable weld metal properties, including low diffusible hydrogen content.

For these reasons, it is expected to become more widespread in industrial fields requiring sound and reliable weld joints in the near future.

## The Welding Business's 115th International QC-Circle Conference



Figure 1: Participants in a plant in Japan



Figure 2: Participants in an overseas plant

The 115th International QC Circle Conference, one of the biggest events in the Welding Business, was held via on-line video conference, in response to the COVID-19 pandemic, on September 11, 2020. Under normal circumstances, representatives of Welding Business Group companies from around the world would have gathered in a location in Japan and held presentations on the achievements of their circle activities related to improving quality, increasing productivity, or cutting costs over the previous year. This year there were eight presentations by representatives of domestic plants that were discussed by a record number of participants: 201 from Japan and 116 from overseas.

Learning how the QC Circles achieved success through trial and error, the participants, especially those from overseas bases, were eager to absorb as much knowledge as possible, even under the challenging circumstances of a remote online conference and listening to foreign languages.

Due to the difficulties associated with remote online presentations, the QC circle activities in the overseas bases were not reported; however, video messages from all overseas sales offices and plants were broadcast so that the tradition of the QC circle conference would not die out, and unity between domestic and overseas bases, as members of the KOBE STEEL Group, would continue to be enhanced. Some video messages reported on the progress of QC activities, while others described treatments for COVID-19 or sent out a greeting to the entire KOBE STEEL Group. Here are some of the video messages that were received:

Figures 3 & 4: THAI KOBELCO WELDING (Thailand and Vietnam)

From Thailand: We're beside you.  
From Vietnam: We trust KOBELCO products will bring you the best value. Therefore, we always feel proud whenever we introduce KOBELCO products to our customers.



Figure 3: THAI KOBELCO WELDING (Thailand)



Figure 4: THAI KOBELCO WELDING, Vietnam Office (Vietnam)



Figure 5: KOBELCO MIG WIRE (THAILAND) (Thailand)

Thanks to the International QC Circle Conference, we have had great opportunities to share our presentations there.



Figure 5: KOBELCO MIG WIRE (THAILAND) (Thailand)

Figure 6: KOBELCO WELDING OF KOREA (Korea)

The Education Program is one of our QC Circles.



Figure 6: KOBELCO WELDING OF KOREA (Korea)

Figures 7, 8 & 9: KOBELCO WELDING OF SHANGHAI, KOBELCO WELDING OF TANGSHAN AND KOBELCO WELDING OF QINGDAO (China)

We would like to take this opportunity to say “thank you all” from our hearts.



Figure 7: KOBELCO WELDING OF SHANGHAI (China)



Figure 8: KOBELCO WELDING OF TANGSHAN (China)



Figure 9: KOBELCO WELDING OF QINGDAO (China)

Figures 10 & 11: KOBELCO WELDING ASIA PACIFIC (Singapore) and KOBELCO WELDING MALAYSIA (Malaysia)

From Singapore: We pray that the spirit of this QC Circle will lead KWAP to further success.  
From Malaysia: Factory Disinfection is carried out daily at the Malaysia factory.



Figure 10: KOBELCO WELDING ASIA PACIFIC (Singapore)



Figure 11: KOBELCO WELDING MALAYSIA (Malaysia)

Figure 12: P.T. INTAN PERTIWI INDUSTRI (Indonesia)

The message from Mr Smarno, President: And hopefully the pandemic COVID-19 can end soon.



Figure 12: P.T. INTAN PERTIWI INDUSTRI (Indonesia)

Figure 13: KOBELCO WELDING INDIA (India)

The message from Ms Regina Francis, Manager, Mr Rahul Raj, Administration and Ms Manisha Mehra, Administration: We look forward to seeing worldwide growth and additional KOBELCO factories.



Figure 13: KOBELCO WELDING INDIA (India)

Figure 14: KOBELCO WELDING OF EUROPE (Netherlands)

Tele-working, the best of corona measures.



Figure 14: KOBELCO WELDING OF EUROPE (Netherlands)

Figure 15: KOBELCO WELDING OF AMERICA (USA)



Figure 15: KOBELCO WELDING OF AMERICA (USA)

Although the remote on-line QC Circle conference was our first experience, it has allowed all of us to feel a real atmosphere about the QC Circle conference and to promote it further; otherwise, only a few participants visiting Japan could have found this feeling.

This year’s Gold Prizes were awarded to three plants: Ibaraki, Fujisawa and Saijo. Those circles have already started improving upon their achievements, and other circles who did not win this time have also started their activities for the next year.

KOBELCO will always contribute to our customers and their Monodzukuri, as well as to society and the environment in Japan and overseas through welding, while aiming to be the most reliable welding solutions company and to enhance the power of Monodzukuri and our belief in quality.

Reported by **Ryota Kobayashi**,  
Global Operation and Marketing Department,  
Marketing Center, Welding Business