

Sembawang Shipyard - A World-Class Shipyard for Shiprepair and Conversion

At the gateway between the Indian Ocean and the South China Sea, straddling the great maritime routes of Europe, the Middle East, and Asia lies Singapore. Naturally endowed with deep sheltered waters and a strategic geographical location, the small island nation of Singapore has grown into a successful global maritime hub in the past thirty years. Today, Singapore is one of the world's busiest ports and a leader in global shiprepair and conversions.

Sembawang Shipyard, a subsidiary of SembCorp Marine Ltd, is a significant contributor to Singapore's maritime success. Their expertise in shiprepairing and conversion business spans several decades. Today, Sembawang Shipyard, is a world-class shipyard offering an optimal combination of facilities and expertise. With four dry docks totaling 740,000 dwt in capacity (400,000 dwt, 150,000 dwt, 100,000 dwt, 60,000 dwt), almost 4 km of continuous deep and sheltered berthage up to 14 meters in depth and a host of comprehensive facilities, Sembawang Shipyard offers one of the largest integrated shiprepair facilities in a single location in South East Asia.

In addition to their proven expertise in the traditional sectors of tankers, bulk carriers and container / cargo vessels, Sembawang Shipyard is also a recognised specialist in niche markets such as passenger liner

conversions / upgrading, FPSO conversions, damage repairs, chemical tankers, liquified gas carriers, dredgers and navy ships repairs. They repair an average of 200 vessels annually from more than 35 countries. The fact that more than 85% of their business comes from repeat customers, alliance partners and long term customers testifies to their international reputation, which is based on their commitment to innovative solutions, HSE (Health, Safety and Environment) management, total reliability, timely deliveries and expert project management.

Since Kobe Welding Singapore (KWS) started its production line in 1979, we have been supplying to Sembawang Shipyard, our products such as LB-52, LB-52U, B-14 and RB-26, together with special materials - imported from the other Kobelco group companies - such as LB-52NS and DW-55E for low temperature applications and NC series stainless steel electrodes to meet their stringent quality requirements and tight schedules of the projects.

From the beginning of KWS's operation, Kobelco has consistently provided Sembawang Shipyard with support in terms of quality products, responsible and prompt customer service, and welding technical know-how. This cooperation has led to a successful long-term relationship between us. We would endeavour to add-value and be a useful supplier to Sembawang Shipyard by maintaining unmatched technical and commercial services.

Reported by K. Harada, KWS



Sembawang Shipyard covers diversified types of shiprepair and conversion, as the leader of this field

Message from the Editor

Having lived long in the USA while working with KWAI, the disastrous incident that happened on September 11, 2001 was shocking and saddening. Who could have imagined this kind of disaster? I wish the world would be more peaceful. I wish all of us living around the globe could find a more tranquil way to solve a lot of the global problems, and overcome the political and ethnic difficulties.

Even though we are in such a difficult global circumstance, the KOBELCO group will make our best effort to satisfy our customers by supplying quality products, unmatched technical services, and quicker delivery.

In Japan, the SHINYOKAI (literally, Kobe Steel Welding Products Supply Association), or the sales network (consisting of 342 companies) for Kobe Steel Welding Company, celebrated its 50th anniversary in Kobe City in October 2001. In Thailand, too, THAI-SHINYOKAI, the integrated distribution network (comprised of 40 companies) for Thai-Kobe Welding and Kobe MIG Wire, commemorated its 10th anniversary in Bangkok in October 2001. I would like to express sincere appreciation to all the members of both SHINYOKAIs for their excellent work, providing their services for their customers.

I will make an effort to make Kobelco Welding Today more useful and enjoyable to you, by supplying new, attractive articles in the future.

Last but not least, let me wish all of you and your families a happy 2002.



Masakazu Tojo
Editorial Chairman



General Manager

**International
Operations
Department**

**Welding Company
Kobe Steel, Ltd.**

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Letter from Tokyo



Weehow Tan
Asst. Manager
Welding Company
Kobe Steel, Ltd.

Hello, dear readers of Kobelco Welding Today! I am engaged in the US, Russian and Brazilian market. Due to my particular concern with the USA, I cannot help paying my condolences for the totally unimaginable disaster that attacked the World Trade Center Twin Towers in New York on September 11, 2001. Who could have thought these huge towers would ever be totally destroyed involving thousands of people engaged in routine business?

The world's most powerful nation was suddenly placed in a politically and economically difficult situation involving other nations. With the slowing down of the US economy reducing consumer spending, our sales in the US market may ultimately be affected, too.

However, I believe our high quality welding consumables will stand us in good stead through the rough times ahead with a solid reputation from the customers and thereby, we will be able to overcome the dull economy with the aid of the vigorous distribution networks that we have established.

Technical Report

When it Comes to Welding 2.25Cr-1Mo Steels, CMA-106 (AWS E9016-B3) Is the Most Reliable Stick Electrode with its 48-Year Industrial Experience

Among Cr-Mo steels, 2.25Cr-1Mo steel is widely used in the petroleum industry and in steam power generating equipment. In particular, heavy-wall pressure vessels are often constructed from this type of Cr-Mo steel because of its excellent high-temperature strength, corrosion resistibility, and resistance to high-temperature hydrogen attack. CMA-106 covered electrode was developed in 1953. Since its inception, it has been used for various applications of 2.25Cr-1Mo steel and has earned a high reputation due to Kobe Steel's persistent control of quality for long years.



Fig. 1. 2.25Cr-1Mo steel is a must in a coal-fired power plant (A Kobe Steel's power plant under construction)

2.25Cr-1Mo steel products include plates, tubes/pipes, and forgings. Table 1 shows typical 2.25Cr-1Mo grades for which CMA-106 electrodes are often used due to its unsurpassed quality, by both Japanese and international fabricators, in the construction of equipment such as power boilers, reactor vessels and plant pipelines.

Postweld heat treatment (PWHT) is normally required before 2.25Cr-1Mo steel welds can be placed in service. This is to reduce hardness and to increase ductility and impact notch toughness. As shown in Fig. 2, CMA-106 deposited metal exhibits sufficient notch toughness after PWHT.

Table 1. Typical grades of 2.25Cr-1Mo steel by product type

Product	ASTM	JIS
Plate	A387Gr.22 Cl.1, 2	SCMV4
	A542Type B Cl.4	SCMQ4E
Tube/Pipe	A199Gr.T22	STBA24
	A213Gr.T22	STPA24
	A250Gr.T22	
	A335Gr.P22	
Forging	A182Gr.F22 Cl.1, 3	SFVAF22A
	A336Gr.F22 Cl.1, 3	SFVAF22B
	A508Gr.22 Cl.3	SFVCMF22B
	A541Gr.22 Cl.3	

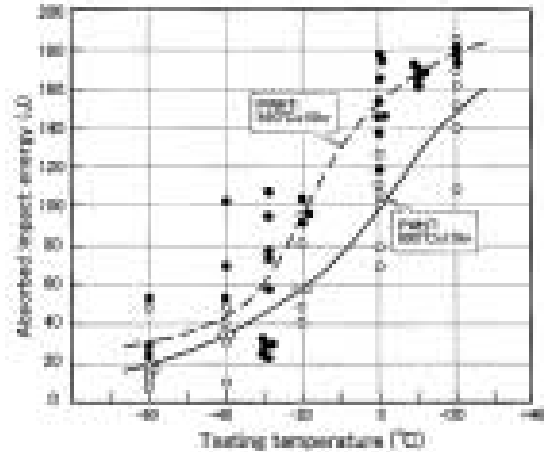


Fig. 2. Charpy impact test results of CMA-106 (5.0) deposited metal by AC welding in flat position

In contrast, PWHT reduces strength due to the tempering effect; therefore, it is essential to control the temper parameter. CMA-106 ensures high tensile strength and yield strength of weld metal even when temper parameter is high, as shown in Fig. 3.

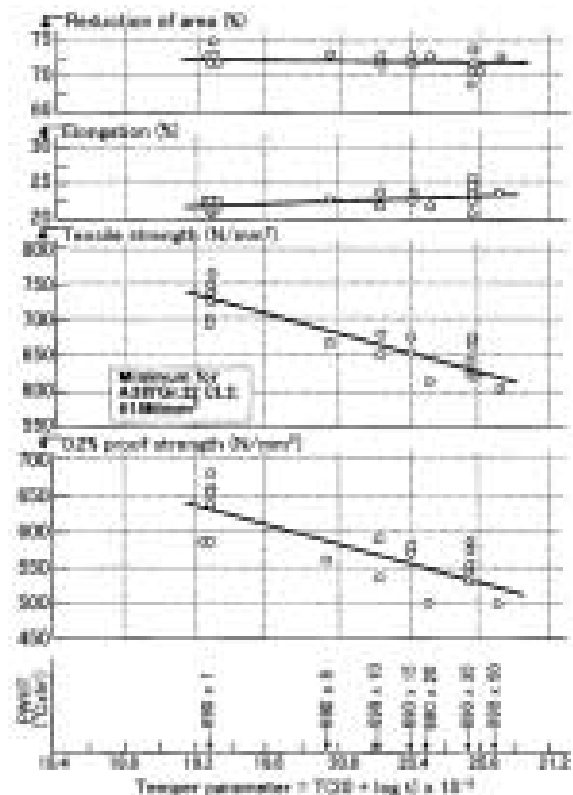


Fig. 3. Tensile properties of CMA-106 (5.0) deposited metal vs. temper parameter (T : temperature in deg K; t : soaking time in hour) by AC welding in flat position

Where Temper Embrittlement Resistance Is Strictly Required, CMA-106N (AWS E9016-B3) Is an Unbeatable Covered Electrode

Temper embrittlement, which occurs in low-alloy steels, such as Cr-Mo steels, is a decrease in impact toughness (or an increase in the ductile-to-brittle transition temperature) after long service at high temperatures in the 371 to 593 °C range. Temper embrittlement is a primary concern in the fabrication of 2.25Cr-1Mo steel pressure vessels that are operated at about 454 °C, a temperature at which temper embrittlement is most likely to occur.



Fig. 1. Hydro-desulfurization reactor is a typical pressure vessel for which temper embrittlement resistance is strictly required.

In principal, this form of brittleness is believed to occur due to the segregation of phosphorous (P), antimony (Sb), tin (Sn), and arsenic (As) at the grain boundaries of the steel and weld metal. Manganese (Mn) and silicon (Si) are also believed to be involved.

Based on these common theories on the causes of embrittlement, Kobe Steel has researched extensively to develop CMA-106N that fulfills the strict requirement for heavy-wall pressure vessels. Table 1 shows the typical chemical composition of CMA-106N deposited metal designed to minimize embrittlement.

Table 1. Typical chemical composition of CMA-106N (5 mm) deposited metal by AC welding in flat position (wt%)

C	Si	Mn	P	S	Ni	Cr
0.11	0.27	0.79	0.008	0.006	0.19	2.42
Mo	Sb	Sn	As	\bar{X}	J	
1.03	0.002	0.003	0.002	10	117	

$$\bar{X} = (10P + 5Sb + 4Sn + As)/100 \text{ (ppm)}$$

$$J = (Mn + Si)(P + Sn) \times 10^4$$

In addition to the chemical elements, the microstructure of the weld metal is an essential factor in temper embrittlement. CMA-106N is designed so as to possess a fine microstructure in the weld metal after postweld heat treatment to minimize temper embrittlement - Photo 1.

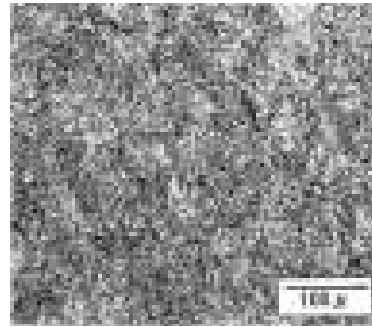


Photo 1. A very fine bainitic microstructure of CMA-106N (4.0 mm) weld metal after PWHT

The susceptibility to temper embrittlement is evaluated with a step-cooling test using cyclical thermal aging as shown in Fig. 2. Typical test results are shown in Fig. 3, revealing excellent notch toughness with a very little shift of impact energy between the as-SR and SR+SC conditions.

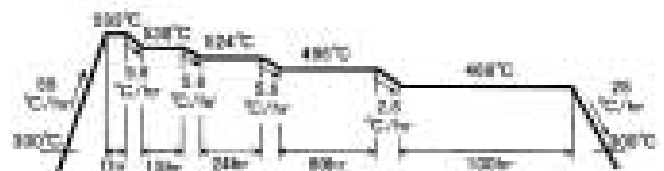


Fig. 2. A typical step cooling cycle for detecting the susceptibility to temper embrittlement

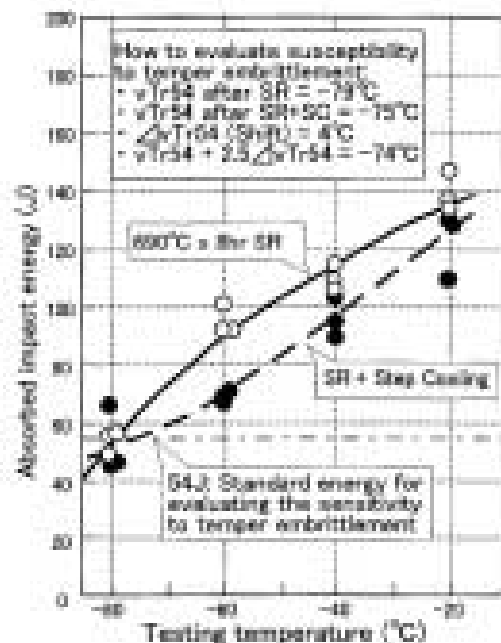


Fig. 3. Temper embrittlement test results of CMA-106N (5 mm) weld metal by Charpy impact test (AC current, flat welding position)

Technical Report

Just a Solid Filler Wire: But, TGS-2CM (AWS ER90S-G) Has Earned a Solid Reputation in TIG Welding of 2.25Cr-1Mo Tubes and Pipes

Unlike conventional 2.25Cr-1Mo TIG filler rods classified as AWS A5.28 ER90S-B3, TGS-2CM is classified necessarily as ER90S-G due to its unique chemical composition. As shown in Table 1, TGS-2CM deposited metal contains comparatively less silicon (Si) compared with the conventional ER90S-B3. In addition, TGS-2CM restricts phosphorous (P), antimony (Sb), tin (Sn), and arsenic (As). This elaborate chemical composition minimizes temper embrittlement (Fig. 1) and improves resistance to hot cracking that is likely to occur in root-pass welding of tubes and pipes.

Table 1. Typical chemical composition (wt%) of TGS-2CM deposited metal by GTAW with pure argon gas shielding

C	Si	Mn	P	S	Cr
0.10	0.26	0.70	0.009	0.008	2.31
Mo	Sb	Sn	As	\bar{X}	J
1.04	0.004	0.003	0.003	12	115

$$\bar{X} = (10P + 5Sb + 4Sn + As)/100 \text{ (ppm)}$$

$$J = (Mn + Si)(P + Sn) \times 10^4$$

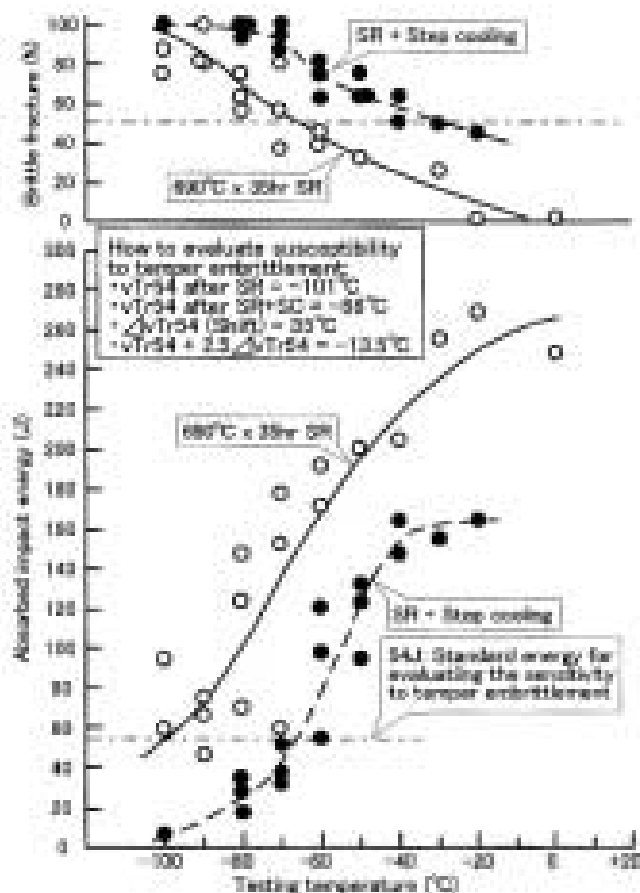
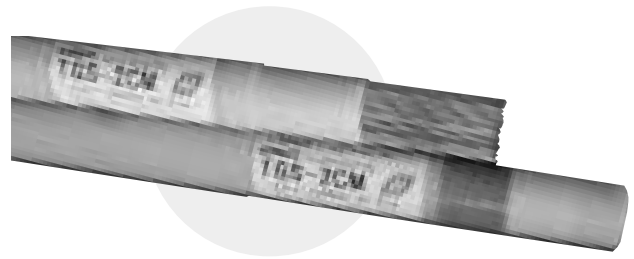


Fig. 1. Temper embrittlement test results of TGS-2CM deposited metal by Charpy impact test



TGS-2CM is available in both cut rod and spooled wire. The spooled wire is for mechanized gas tungsten arc welding. Bend-to-flange joints of reactors, Tube-to-tubesheet joints of heat exchangers and pipe-to-pipe joints of process piping are typical applications for the automatic GTAW.

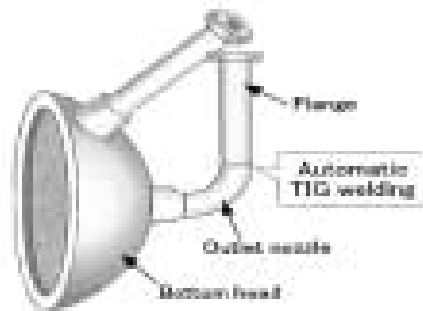


Fig. 2. An example of automatic GTAW application for joining the 90-degree bend and flange extended from the bottom head of a reactor pressure vessel.

Tips for Welding with TGS-2CM

- (1) Back shielding with argon gas is indispensable to provide a smooth root-pass bead with regular penetration. The torch shielding gas flow rate should be 10-15 liter/min. In apparent ambient wind over 1m/sec, use a windscreen to protect the molten pool from the wind, or the wind may cause porosity.
- (2) In mechanized TIG welding, the welding procedure should be determined in consideration of the quality requirements for the weld beforehand. This is because, with a high feeding rate of filler wire - thus a high deposition rate - in automatic TIG welding, notch toughness of the weld tends to decrease because of coarser crystal grains.
- (3) Preheat and interpass temperature should be 200-250 to decrease the cooling speed and thereby minimize hardness of the weld and prevent cold cracking.
- (4) Postweld heat treatment temperature should be 680-730 to remove residual welding stresses, decrease hardness and improve the mechanical properties of the weld.
- (5) Heat input should properly be controlled to prevent hot cracking and ensure mechanical properties of the weldment.

Where Preheat and Postweld Heat Treatment Are Limited, TGS-2CML (AWS ER80S-G) Is More Suitable

In comparison with TGS-2CM, classified as AWS ER90S-G (T.S. 90ksi), TGS-2CML features lower tensile strength, which is made clear by its classification, ER80S-G (T.S. 80ksi). The lower tensile strength results from the low carbon content of TGS-2CML - Table 1.

Table 1. Typical chemical composition (wt%) of TGS-2CML deposited metal by GTAW with pure argon gas shielding

C	Si	Mn	P	S	Cr	Mo
0.031	0.48	1.08	0.009	0.010	2.25	1.10

The low carbon content decreases hardness resulting in high ductility and is effective to prevent hot cracking and cold cracking. The high ductility enables the use of lower preheat temperature and removes the need for postweld heat treatment. As shown in Table 2, TGS-2CML deposited metal exhibits high ductility and impact energy with moderate hardness even in the as-welded condition.

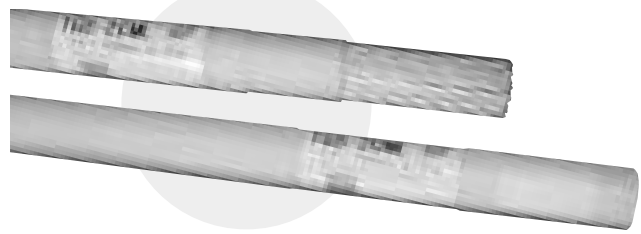
Table 2. Mechanical properties of TGS-2CML deposited metal by GTAW with pure argon gas shielding

PWHT	0.2% PS (N/mm ²)	TS (N/mm ²)	EI (%)	RA (%)	IV ₀ (J)	Hv
As-weld	722	826	27	75	186	307
690 x 1hr	548	647	28	80	202	226
710 x 1hr	501	609	30	78	181	210

Note:

- (1) Impact values are the average of 5 specimens.
- (2) Vickers hardness numbers are of the average of 5 measuring points on the weld surface.
- (3) Testing temperature for tensile test and hardness test is room temperature.

Provided a proper preheat is used during welding, postweld heat treatment sometimes may be omitted for low-carbon welds in thin sections of 2.25Cr-1Mo steel, unless otherwise required due to the presence of certain corrosives. As per ASME Sec VIII Div. 1, for example, circumferential butt welds in 2.25Cr-1Mo steel pipe or tubing having a diameter of 102 mm or less and a wall thickness under 15.8 mm can be placed in service as-welded when the weld is preheated at temperatures of 149 or higher. However, the welding procedure specification must be qualified without postweld heat treatment.



Typical applications for TGS-2CML are pipe-to-pipe joints, and tube-to-tubesheet joints. In addition, this filler wire is suitable for repair welding on the welds of equipment in service where preheat and postweld heat treatment are generally limited to avoid adverse effects of the heats to the equipment.



Fig. 1. TGS-2CML is more suitable for welding process-piping joints subject to short-time postweld heat treatment - thus lower temper parameter.

Spooled TGS-2CML is available in addition to cut rod. The spooled wire is suitable for automatic gas tungsten arc welding. Tube-to-tubesheet joints of heat exchangers and tube-to-tube and tube-to-bend joints of steam boilers are typical applications for the automatic GTAW.



Fig. 2. An automatic TIG welding process of tube-to-tube butt joints

Hot Crack: How It Occurs and How It Can Be Prevented

Hot crack can be defined as cracking formed at high temperatures near the solidus of the metal, where the metal has coherence but is completely brittle. It can occur in weld metals and the heat-affected zone. Almost all metals (such as carbon steel, low-alloy steel, austenitic stainless steel, nickel alloy, and aluminum alloy) may, on any scale, suffer this defect.

The lack of ductility at high temperatures causing the brittle condition near the solidus is usually due to the formation of an intergranular liquid film of an impurity, notably sulfur and phosphorous in metal. Both these impurities combine with the matrix elements to form low-melting-point (lower than that of the matrix) compounds, thereby reducing intergranular cohesion. The lack of cohesion between grain boundaries, in turn, initiates cracks aided by tensile stresses resulting from the contraction of the weld. Hot cracking is also known as "solidification cracking," which occurs in weld metals when a molten weld metal freezes, and "liquation cracking," which occurs in the heat-affected zones of the mother metal and weld metal in solid, affected by the heat of the arc.

Hot cracking usually occurs longitudinally along the weld axis, occurring at the middle of the weld, however it can also take place across the weld axis affected by the direction of tensile stress. Figure 1 shows a longitudinal hot crack appearing on the surface of a weld. Another hot crack, shown in Figure 2 is a longitudinal hot crack that occurred inside the weld metal.



Fig. 1
A longitudinal hot crack appearing on the surface of a weld metal by SMAW (left)

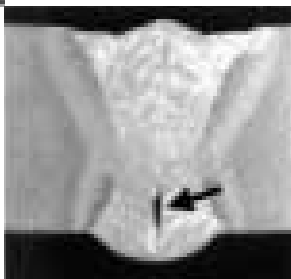
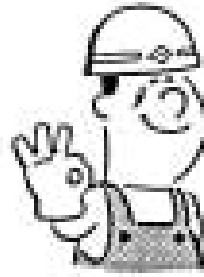


Fig. 2
A longitudinal hot crack appearing in the cross section of a weld metal by SAW (right)



In welding austenitic stainless steels and nickel alloys, minimize the interpass temperature below 150 to prevent hot cracking.

Hot cracking can be prevented by employing adequate precautions as discussed below, except for some alloys that are inherently very susceptible to hot cracking in arc welding.

- (1) Use lower heat input
The use of lower heat input increases the cooling speed of the weld metal, which minimizes the time spent in the brittle temperature range. It also increases the width-to-depth ratio of weld metal, thereby decreasing the susceptibility to hot cracking.
- (2) Use larger groove radius
The use of welding joints with a larger groove radius increases the width-to-depth ratio of weld metal, which prevents hot cracking - Fig. 3.

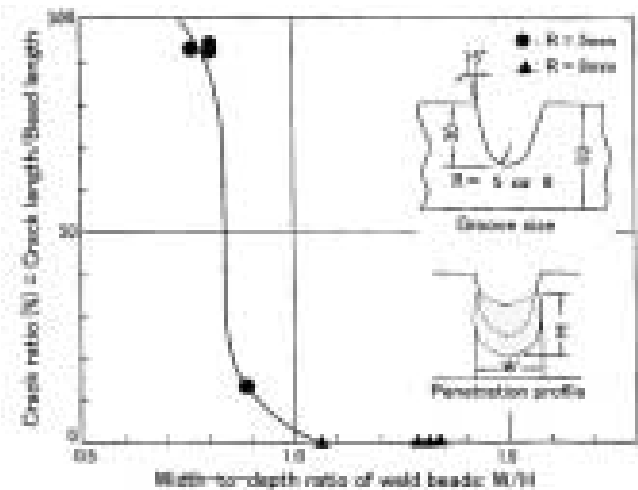
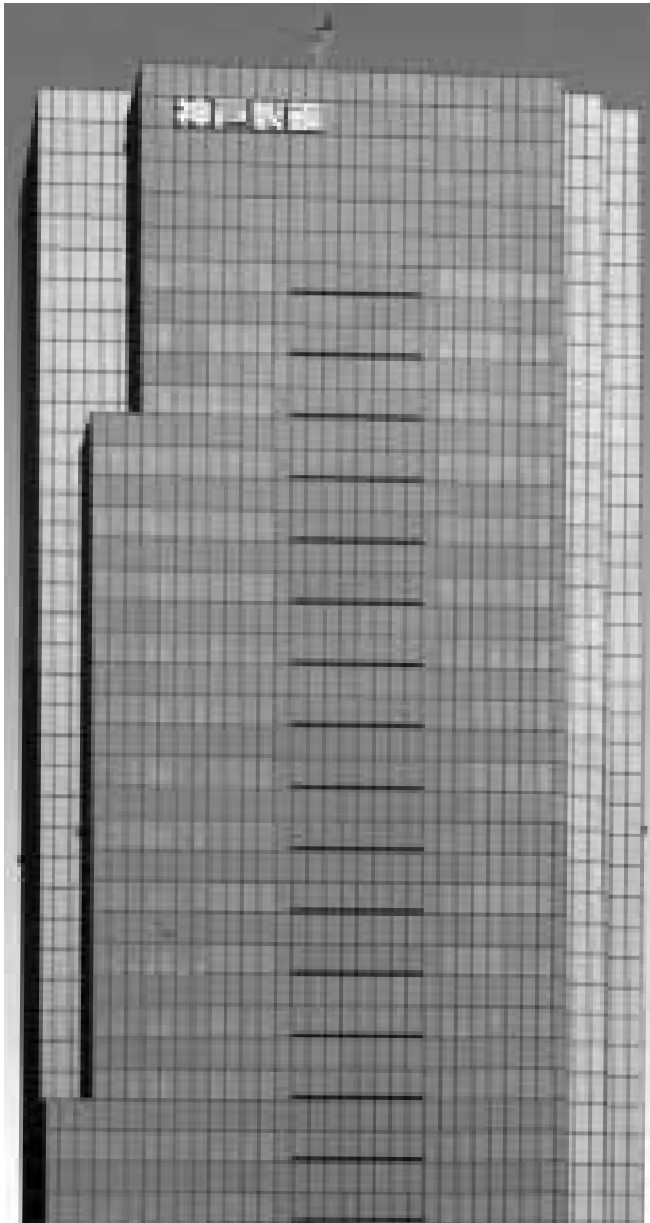


Fig. 3. The effect of width-to-depth ratio (W/H) of weld metal on hot crack susceptibility of 2.25Cr-1Mo steel welds by submerged arc welding

- (3) Use ferrite-controlled filler metals
When welding austenitic stainless steels, use filler metals containing ferrite (normally 3-10% in weld metal) in the austenitic matrix. For special purposes (e.g. cryogenic temperature uses) where a fully austenitic weld metal is required, use a filler metal containing low sulfur and phosphorus with increased manganese content.

To Be Happy with KOBELCO

Dear readers of Kobelco Welding Today: All the staff of the International Operations Department in Tokyo wish to heartily bid you "A Happy New Year," and herald our aspirations at the start of the New Year. In each issue, the article, "Letter from Tokyo" introduces one of our staff. While many of you have had the chance to meet us over the years, we realize that you tend to communicate on a daily basis with our colleagues stationed overseas as staff in our affiliated companies and business partners in your region. Therefore, we wish to take this opportunity to tell you a little more about the aims of the International Operations Department.



KOBELCO head office in Tokyo: The International Operations Department of the Welding Company is on the 6th floor



A happy new year to our dearest readers of Kobelco Welding Today from all the staff of the International Operations Department

In brief, the International Operations Department is an organization that thinks and acts, in collaboration with our reliable overseas colleagues, on the front and sometimes behind the lines as needed to provide the best services to you. Therefore, our mind is always directed toward the market even if we cannot see you directly. Our constant aim is for you 'to be happy' by using or selling KOBELCO welding products with confidence, which leads us, KOBELCO, also 'to be happy.' Even though the usual difficulties besetting any business may conspire to prevent us from being happy at the same time, we make an effort to achieve mutual satisfaction through business.

Suppose, for instance, we receive a quotation for a big contract for a welding fabrication project that is technically and economically difficult. We both think hard to find a solution. We would be happy with a smooth solution. At times, however, we may not be able to reach a mutually acceptable conclusion even after heated discussions. On such occasions, we KOBELCO think in this way: "Making a promise easily and later regretting that it can not be fulfilled, customers, dealers and KOBELCO all will be unhappy. Our wish is that you will be really convinced in the end that you were right and happy to choose KOBELCO."

There are innumerable conditions for all of us to be happy and we do not think that all these conditions can be satisfied easily. Still, we are determined to continue to make efforts so that you and we will be happy in as many ways as possible and to as much extent as possible. If you feel unhappy about us in anything, please feel free to contact your nearest KOBELCO dealers or the International Operations Dept. directly.

Finally, may the year 2002 turn out to be a happy year for all of you and for us!

"The Olympics of Welding Technology" Essen Fair 2001

"Schweissen & Schneiden", which is the No. 1 show for welding, engineering, joining, cutting and surfacing, was held in Essen, Germany from September 12th to September 18th. In spite of the terrorist attacks in the USA, the number of visitors during the seven days was stable. More than 1,000 exhibitors from over 90 countries in 18 fair halls welcomed as many as 93,000 visitors.



The KOBELCO booth attracted many visitors, with a variety of products and an interesting quiz

Like the last Essen Fair in 1997, Kobe Steel Ltd. (KSL) and Kobelco Welding of Europe b.v. (KWE) joined forces. But while KSL has exhibited 10 times, this was KWE's second time to participate. With a team of approximately 20 commercial and technical employees from KSL and KWE, we welcomed our visitors from all over the world in a booth of 200 m². For this fair, on a trial basis, we decided not to include any welding demonstrations.

After introducing the Kobelco brands, as done during previous years, for this fair we accented our continual production of quality products with the slogan: **"Top quality, our commitment"**. Of course the Kobelco Group's international slogan, "QTQ" (Quality products, Technical support and Quick delivery), was also displayed. We introduced not only a wide range of flux cored wires (FCWs) currently sold in Europe but also newly developed products, such as FCWs for Ni-based alloys and Cr-Mo steels. In addition, we exhibited our environment-friendly products such as the carton drum package, non-Cu-coated CO₂ solid wire, and low fume type FCW.

Furthermore we had a Bobbin Quiz, in which visitors enjoyed guessing how many kilograms of FCW were remaining on the displayed factory bobbin. The correct weight was 262 kg and the 10 closest guesses received a prize. Out of 568 answers the best one was "260kg".



Top: A Dutch-Japanese joint venture quiz was fun

Right: Just a bobbin of wire but a cheerful entertainer

Bottom: Hello, from the reporters of this article



Since our priority for the coming years is to increase consumer awareness of the Kobelco Brand, we created an open stand so that visitors would feel free to enter our area. As a result we received 2800 visitors from all over the world. We received much more interest from Eastern Europe & Russia than last time, due not only to the famous LB-52U (as in the past), but now also FCWs. Maybe next time we will re-introduce the performances of Kobelco FCWs by means of welding demonstrations to cater to the increasing customer's interest in FCWs.

During the fair, we received a huge number of inquiries and we had a lot of commercial and technical discussions. We can already conclude that we could achieve a big success thanks to the excellent teamwork between the employees of KSL and KWE. We will see you at next Essen Fair from September 12th to 18th 2005.

Written by Dutch Fair attendants:
Pascal Douma,
Tanja Bronneberg-Wirtz,
Lydia Gorissen, and
Bianca Meijers

KOBELCO Attracts Over 400 Visitors at FABTECH 2001

North America's largest annual metal forming and fabricating event, FABTECH which marked its 20th anniversary, was held at McCormick Place in Chicago on November 11-14, 2001. In total, 840 exhibiting companies from around the world occupied the exposition site of over 400,000 net square-feet to show the latest industrial fabrication technologies in such fields as automation/robotics, cutting, lasers, material handling, punching, safety equipment, software, tube/pipe technology in addition to welding. The featured technologies in the welding field included arc welding, consumables, laser/plasma welding, resistance welding, and robotic welding.



McCormick Place, America's premier convention facility, was the venue for FABTECH 2001
(Source: www.Mccormickplace.com)

This year's FABTECH was somewhat special. It was held under strict security conditions due to the disastrous events of September 11th, the anthrax scares, and the shutdown of New York Airports due to a crash of a passenger plane in New York City on the second day of the show. However, there were still 11,769 people (19,685 people including the exhibitors) who visited the

show to explore the industry's latest technologies.

In the welding pavilion, Kobelco Welding of America (KWA) exhibited Kobelco's world's best quality stainless steel flux-cored wire (DW series), the newly developed low-fume mild steel flux-cored wire, DW-50 (AWS A5.20 E71T-1/-1M) and high-efficiency welding mild steel metal-cored wire, MXA-70C6 (AWS A5.18 E70C-6M). We also conducted welding demonstrations to show off the unsurpassed performances of the FCWs.



Left: A variety of flux-cored wires, the core of the display



Right: Skillful demonstration and excellent performances of the flux-cored wires attracted over 400 visitors

FABTECH is well known for its characteristic way of soliciting end users of welding consumables by telemarketing. KOBELCO counted over 400 visitors who came to the booth, and 50 of them turned into solid leads for further business contacts including product demonstrations at their manufacturing sites. We hope these customers will turn into new KOBELCO fans.

KOBELCO will exhibit at FABTECH 2002 in Cleveland, Ohio at the I-X Center (Booth No. 16007)

Reported by A. Sawada, KWA

Editorial Postscript

Thanks to your eager reading, *Kobelco Welding Today* has entered its fifth year since the first issue of this periodical was published. We will publish a technical report centering on Cr-Mo filler metals this year. We will continue to introduce Kobelco users, too.

Because you may have much concern about Kobelco Group's activities, we will report on them. Your opinions or requests are welcomed. Send them to E-MAIL : iod@melts.Kobelco.co.jp. Welding exhibitions are scheduled in Japan and USA this year. We will welcome your visit to our booths, too.

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