# KOBELCO WELDING TODAY

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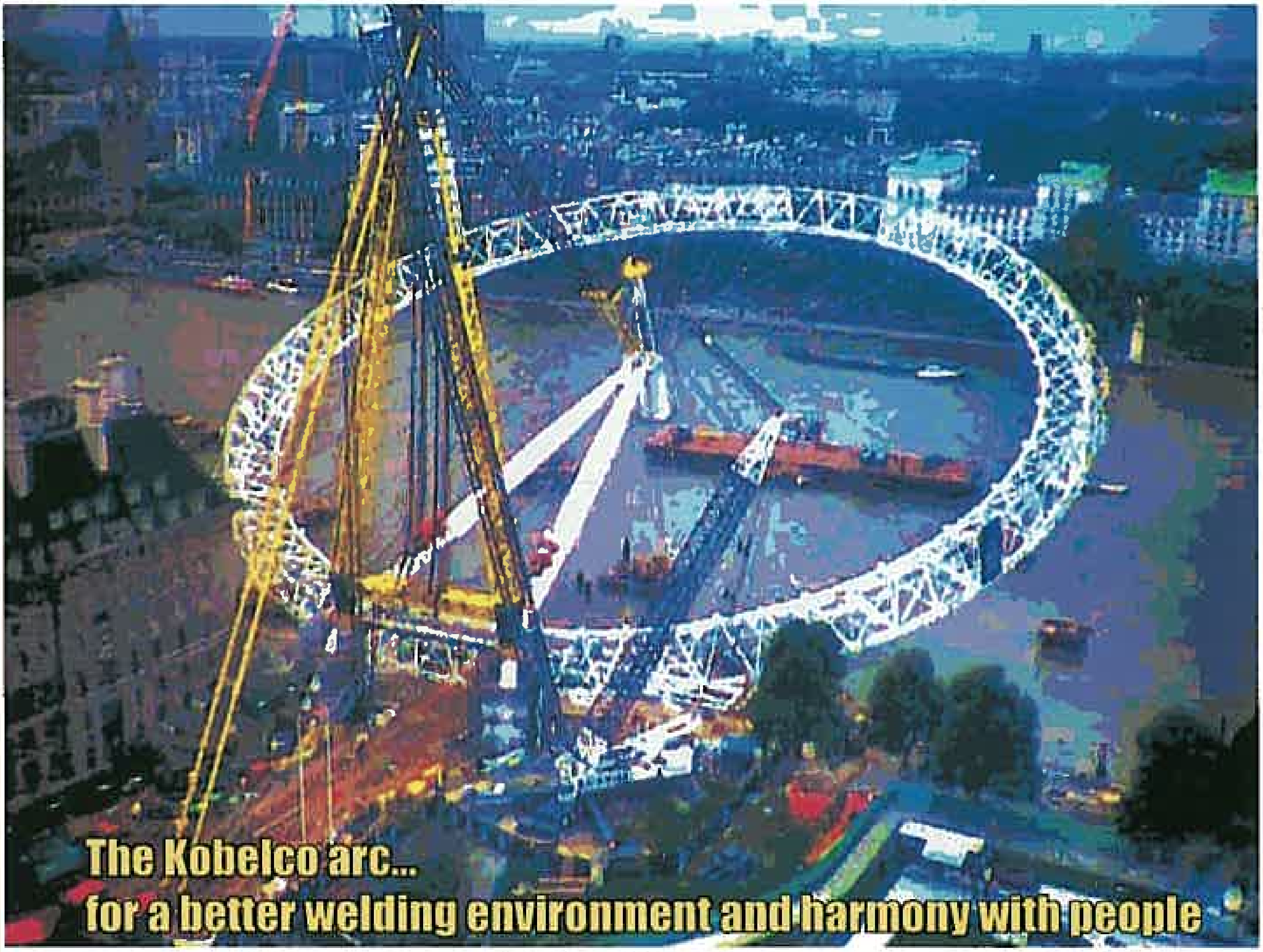
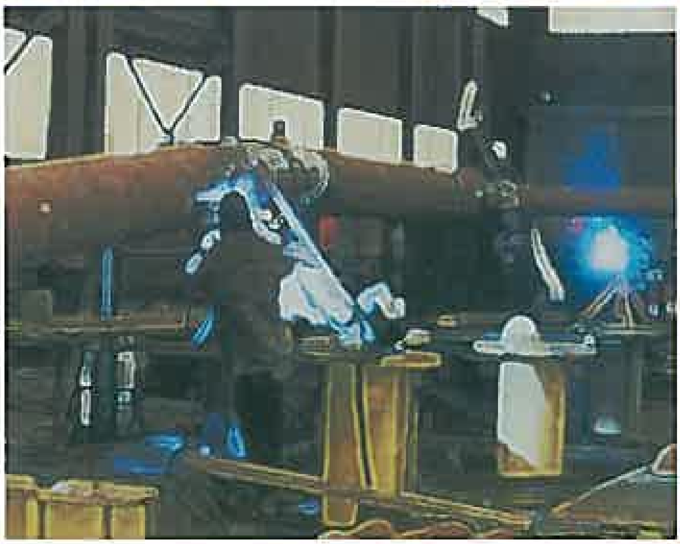


## Dear readers of Kobelco Welding Today

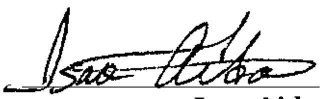
I took office as the new president of the Welding Company of KOBE STEEL, LTD. on April 1, 2004. The former president, Mr. Hiroo Shimada, is now the president of Kobelco Construction Machinery Co., Ltd.

As the new president, I have made a business slogan to represent the Welding Company for this year. "Let us boost our presence," Yes, let us demonstrate and strengthen KOBELCO's presence domestically and globally through our quality and technology. By offering welding products and services, supported by a high level of quality and technology, to customers all over the world, we will follow the KOBELCO WAY. I sincerely wish to make the Welding Company such a company that everybody in the world will say, "Their KOBELCO WAY is good!"

By enhancing "Technological Capabilities, Profitability and Globalization" as the primary targets for this year, we will strive to build solid foundations for the continuous reproduction of our presence for the future. The aggregate of the vitality of each and every member of the company forms the vitality of the whole company. With this in mind, I will share the targets with the employees and further vitalize our activities, by which the Welding Company may go forward on the KOBELCO WAY.

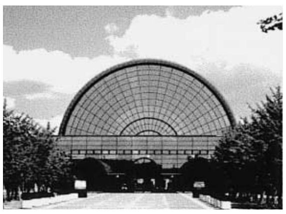
We have now eight overseas subsidiaries as manufacturing and sales bases, starting with Thai-Kobe Welding established in 1968 to Kobe Welding of Tangshan that commenced production last year. In Japan, we established KOBE-JFE Welding, a joint venture with JFE Steel, a manufacturer of solid wires. All these are investments to heighten customer satisfaction by responding to our customers' desires in terms of welding products and services.

I am firmly determined to "boost our presence" in every country and in every area with each overseas subsidiary serving as the core of activities, so that the KOBELCO WAY may receive hailing recognition globally and domestically.



**Isao Aida**
President
Welding Company
Kobe Steel, Ltd..

## Scheduled International Welding Shows in 2004



A bird's-eye view of a Japan's largest international exhibition center, IntexOsaka (left), having a 70,000-m² exhibition area, and the main gate (right) to the exhibition area

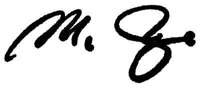
An every-two-year welding event, the Japan International Welding Show, is scheduled to open at IntexOsaka in Osaka on 14-17, July. Subsequently, China will open the Beijing Essen Welding and Cutting Fair at China International Exhibition Centre in Beijing from 10 to 13, November. This is planned as an annual event. Kobe Steel will be an exhibiter at both welding shows, and we welcome you at our booths.

## The rapid increase of raw material prices is my headache

Spring has come in Japan. The new president of KOBELCO Welding Company, Mr. Isao Aida, has assumed his duties from April 1st. He was promoted from his previous position as vice president of our Welding Company.

Today, we are facing a serious shortage of and price increases for such raw materials as wire rods, nickels, and lubricants. In particular, the price increase for wire rods and the steel hoops for the sheath of flux-cored wires is our biggest issue. However, even under these circumstances, we are determined to keep supplying KOBELCO welding consumables to our customers and to cut the production costs as much as we can. However the situation of price increases is getting worse day by day. In tandem with the rapid economic growth in China, there have been big increases in demand for almost all kinds of products, especially steels, oil, coal, paper and chemical products. Frankly, I have no particular outlook about when this situation will cease. This is similar to the situation during the "Oil Crisis" in the early 70's.

The most important issue for us this year is how we will ensure sufficient materials for manufacturing our products. However, I believe we will be able to overcome this difficult situation somehow as we did in the past with your full cooperation.



**Masakazu Tojo**
General Manager
International Operations Dept.
Welding Company
Kobe Steel, Ltd.

### Canteen in the Tokyo Head Office

To give you a different look at our company, we plan to introduce the canteens of our related companies in turn in this new column. The first one offered for your perusal is the canteen of the Tokyo Head Office of Kobe Steel. The workers of all the divisional companies in the Tokyo Head Office enjoy lunch in the canteen on the second floor. The menu offers plenty of variety, with seven choices including curry and rice and a daily lunch special every day. The price is very reasonable ranging from 280 yen to 550 yen. After office hours in the evening, the canteen will turn into a pub where you can enjoy a drink with your colleagues.

A view of canteen (left) and a regular menu of curry and rice (right)

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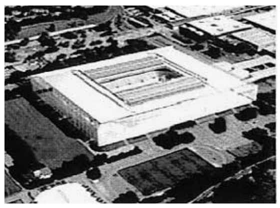

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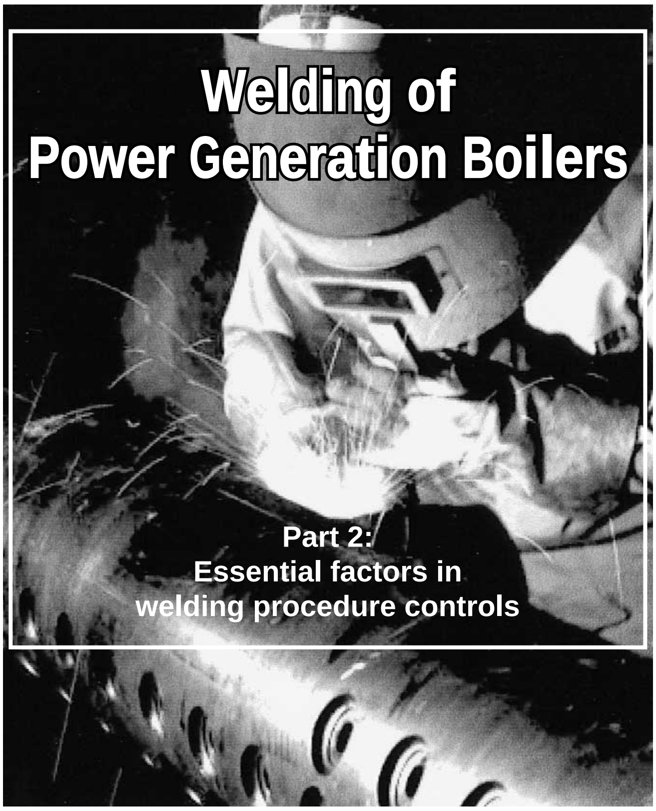


# Welding of Power Generation Boilers

## Part 2: Essential factors in welding procedure controls

Fossil-fuel-fired power generation boilers are typically water-tube boilers that can generate high pressure steam and superheated steam. The welded components of water-tube boilers are mainly tubes, drums and headers. Because a steam power station contains many thousands of welds, the failure of just one can result in a shutdown, so good weld quality is of great importance. This article discusses the essential factors in welding procedure controls in the fabrication of water-tube boilers.

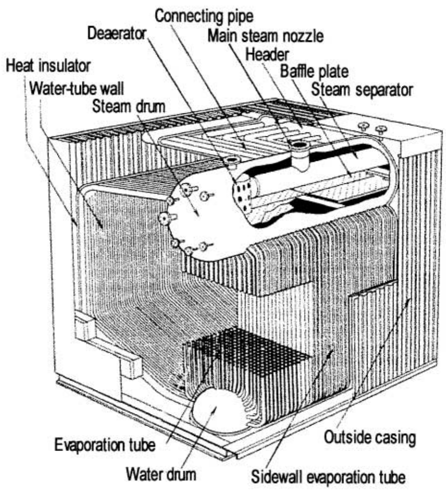



**Figure 1.** Schematic view of a saturated steam water-tube boiler, consisting of tubes, drums and headers. (Source: K. Nagumo, Basic Knowledge of Boilers, Ohmsha)

## Water-tube boilers are characterized by tube bundle structures

**Figure 1** shows how the bulk of the tubing in a water-tube boiler is used. The tubing includes water-tube walls in the combustion chamber, evaporation tubes that connect the water drum and steam drum, superheater tubes, and reheater tubes. Such tubes have exterior diameters generally range from 38-65 mm. Water-tube walls (**Fig. 2**) are typically fabricated by means of submerged arc fin welding, gas metal arc fin welding, and submerged arc fusion welding on the longitudinal joints, the principles of which are shown in **Fig. 3**. 1Cr-0.5Mo, 1.25Cr-0.5Mo or carbon steel is selected according to the service temperature of the water tube walls.

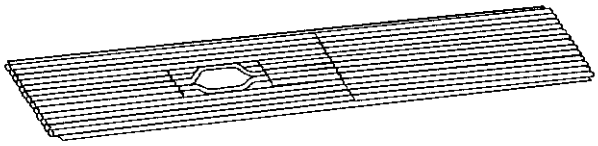


**Figure 2.** A water-tube wall segment assembled by tube-to-tube longitudinal and butt welding.

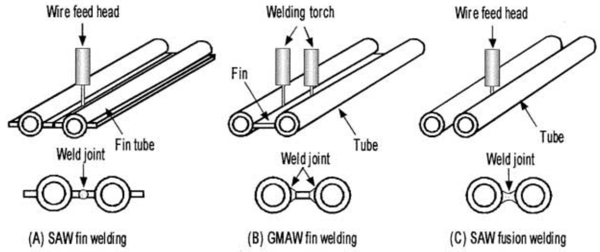



**Figure 3.** Assemblage of water-tube walls by submerged arc or gas metal arc fin welding and submerged arc fusion welding on tube-to-tube longitudinal joints.

The tube bundle structures of evaporators, superheaters and reheaters are fabricated with tube-to-tube butt weld joints by automatic (**Photo 1**) and manual gas tungsten arc welding and shielded metal arc welding. The type of steel for evaporators varies—0.5Mo, 1.25Cr-0.5Mo or 2.25Cr-1Mo—according to the service temperature. Superheaters and reheaters have traditionally been made from 0.5Mo, 1.25Cr-0.5Mo, 2.25Cr-1Mo, 9Cr-1Mo and austenitic stainless steel, which is selected according to the specified service temperature; however, in recent years, 9Cr-1Mo-V-Nb, W-enhanced 9-12Cr and enhanced austenitic stainless steels are also employed extensively as the steam temperature increases.

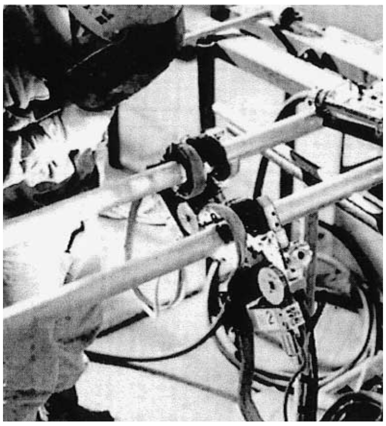


**Photo 1.** Automatic gas tungsten arc welding of tube-to-tube butt joints. (Source: Kobelco Welding Technical Guide, 1997, 10, No. 330)

## Thick-wall, large diameter components: drums, headers, and main steam pipes

The drum of a power boiler consists of a water drum and steam drum that are connected by a bundle of evaporating tubes. The steam drum supplies steam to the superheater, in which the steam is heated further to increase its thermal efficiency. The superheated steam is driven to the turbine via the main steam pipe and the header. Such thick-wall, large diameter components are fabricated by submerged arc welding, gas metal arc welding, shielded metal arc welding and gas tungsten arc welding. Mechanized and robotized gas metal arc and gas tungsten arc welding processes are often employed.

Boiler drums have been made from 0.5Mo, 1.25Cr-0.5Mo, or carbon steel, and recently enhanced 0.5Mo steel micro-alloyed with Cr, V and B. Headers and main steam pipes (**Photo 2**), are fabricated with 2.25Cr-1Mo, 2.25Cr-W-V-Nb, 9Cr-1Mo-V-Nb or W-enhanced 9-12Cr steel according to the steam temperature.

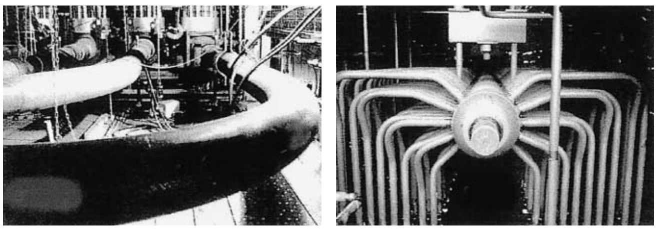


**Photo 2.** Main steam pipes (left) and a header (right) in position, connected with a bundle of tubes. (Source: Mitsubishi Heavy Industries, Ltd. and National Institute of Materials Science, Japan)

## Prevention of cold cracking is basic to welding Cr-Mo steels

Cold cracking, which can occur in welds of heat-resistant low-allow steel, is caused by the combined effects of low weld ductility, residual stresses and diffusible hydrogen in the weld. It generally occurs at temperatures below 200℃ immediately upon cooling, or after a period of several hours or days (also known as delayed cracking).

Cold cracking in welds can be prevented by using low-hydrogen type welding consumables to minimize diffusible hydrogen, preheating and postweld heating to remove the diffusible hydrogen and proper welding procedures to minimize stress concentration. **Figure 4** shows the results of y-groove restraint cracking laboratory tests of various steel welds, in which root pass welds were laid and investigated for cold cracking after 48 hours of exposure at room temperature. It clearly shows that preheating can prevent cold cracking, and Cr-Mo steel welds need higher preheating temperatures than other types of steel; e.g. 2.25Cr-1Mo (0.15C) steel requires 300℃ or higher preheating without postweld heating to prevent cold cracking.

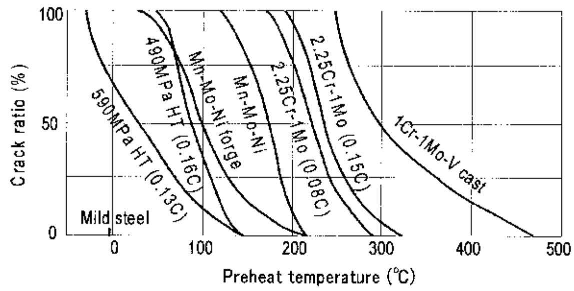



**Figure 4.** Effect of preheat temperature on cold crack susceptibility of various steel welds. (Source: H. IKAWA. The Complete Book of Welding, Series 4, 1978. Sanpo)

The use of high preheat temperatures safely prevents cold cracking but inconveniences welders and welding operators. Therefore, in production welding of heat-resistant low-alloy steels, a lower temperature preheat is often used—provided that immediate postweld heating (IPWH) is applied, thereby decreasing diffusible hydrogen to a safe level to prevent cold cracking even when the weldment is cooled down to room temperature. **Figure 5** shows the effect of IPWH on preventing cold cracking and also suggests that lower preheating temperatures than those obtained in Fig. 4 can be used, provided IPWH is combined; that is, 2.25Cr-1Mo

(0.15C) steel can successfully be welded without cold cracking with the combined use of 150℃ preheat and 300℃×0.5hr IPWH.

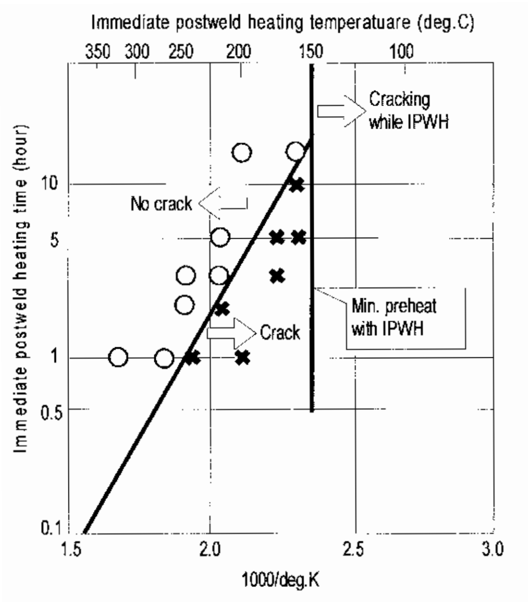



**Figure 5.** **Effects of immediate postweld heating (IPWH) temperature and time on cold cracking of 2.25Cr-1Mo (0.15C) steel weld in relation to preheating temperature. (Source: H. IKAWA. The Complete Book of Welding, Series 4, 1978. Sanpo)**

The need for and the temperature of preheat are also dependent on material thickness; that is, thicker material causes higher restraint in the parts being joined and faster cooling speeds, thereby causing higher crack susceptibility. **Figure 6** shows cold crack test results of restrained 2.25Cr-1Mo steel welds by submerged arc welding as a function of plate thickness, which illustrates the need for higher preheat temperatures with thicker materials.

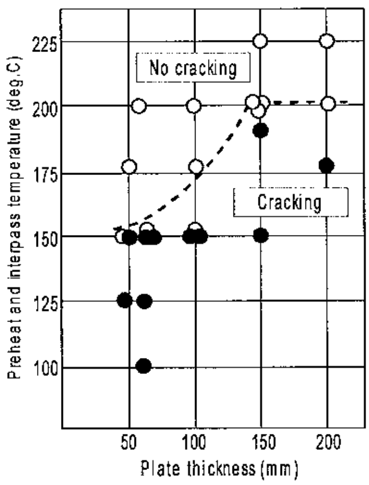



**Figure 6.** **Cold crack test results of restrained 2.25Cr-1Mo steel welds by submerged arc welding. (Source: H. IKAWA. The Complete Book of Welding, Series 4, 1978. Sanpo)**

Kobe Steel recommends the following preheat and interpass temperatures (**Table 1**) with Kobelco brands of welding consumables (refer to Kobelco Welding Today, Vol. 7, No. 1) for general applications, unless in conflict with particular job specifications.

**Table 1.** **Kobe Steel's recommendations for preheat and interpass temperature for welding heat-resistant low-alloy steels.**

| Type of steel | Kobe Steel's recommendation (1) |
|---|---|
| 0.5Mo | 100-200℃ |
| 0.5Cr-0.5Mo | 150-250℃ |
| 1-1.25Cr-0.5Mo | 150-300℃ |
| 2.25Cr-1Mo | 200-350℃ |
| Low-C 2.25Cr-W-V-Nb | 100-250℃ |
| 5Cr-0.5Mo | 250-350℃ |
| 9Cr-1Mo | 250-350℃ |
| 9Cr-1Mo-Nb-V | 250-350℃ |
| 9Cr-W-V-Nb | 250-350℃ |
| 12Cr-W-V-Nb | 250-350℃ |

**Note:**
**(1) An exact temperature for each material depends on the welding process, plate thickness and immediate postweld heating to be used.**

Most of Kobelco SMAW covered electrodes and SAW bonded fluxes for heat-resistant low-alloy steels are designed to be low or extra-low in hydrogen in the as-produced condition in order to provide better cold crack resistance. Welding consumables, however, can pick up moisture at fast or slow speeds in the atmosphere. If such a moistened welding consumable is used as it is, the moisture can be converted to diffusible hydrogen, thereby degrading the cold crack resistance of the weld metal. Therefore, redrying of welding consumables before use is quite important for successful welding. **Table 2** shows Kobe Steel's recommendation for redrying temperature and time.

**Table 2.** **Recommended redrying temperature and time for Kobelco SMAW electrodes and SAW fluxes**

| Category of welding consumable | Redrying temperature (℃) | Redrying time (hr) |
|---|---|---|
| SMAW electrode | 325-375 | 1 |
| SAW bonded flux | 200-300 | 1 |
| SAW fused flux | 150-350 | 1 |

Solid wires for SAW, GMAW and GTAW and flux-cored wires should not be heated for redrying. They should be stored in a well ventilated, low humidity room to prevent moisture deposition before use. When some remain after partial use, they should be taken back to the store room to prevent moisture deposition.

## Control of weld shape and heat input is essential to prevent hot cracking

Hot cracks can occur at temperatures near the completion of weld solidification. Carbon, sulfur, phosphorous and boron are believed to increase the susceptibility to hot cracking. Commercial Cr-Mo steels and welding consumables contain minimized amounts of such impurity elements as S, P and B; however, thick Cr-Mo steels and the matching welding consumables contain C at a reasonably high percent to ensure strength. Therefore, welding of thick-wall constructions can experience hot cracking more often.

Hot cracking is avoidable by controlling weld shape and heat input. **Figure 7** shows that controlling the width-to-depth ratio of weld metal to larger than 1.0 with appropriate groove sizes can prevent hot cracking of the weld metal. With this technique, the formation of a crack-sensitive, pear-shaped bead can be avoided because the dendritic columnar structures can be directed upwards during solidification. High heat input also tends to cause pear-shaped beads, thereby inducing hot cracking in the weld metal. This can be verified with the test results shown in **Figure 8**, which suggests that the permissible maximum heat input in submerged arc welding of 1.25Cr-0.5Mo and 2.25Cr-1Mo steel is 60 kJ/cm and 50 kJ/cm, respectively.

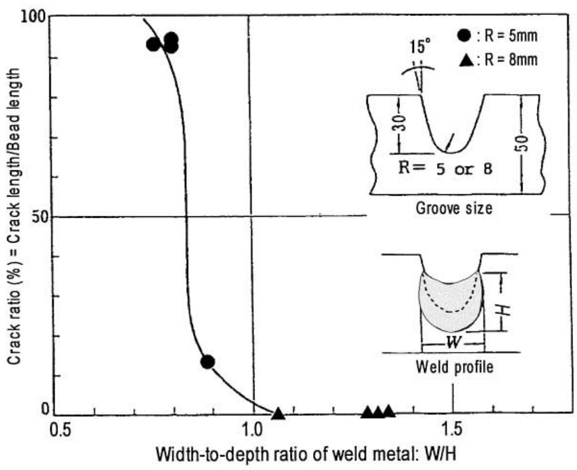



**Figure 7. The effect of width-to-depth ratio (W/H) of weld metal on hot cracking of submerged arc 2.25Cr-1Mo steel weld. (wire: 4.8 mmΦ, flux: fused type, welding current: 650-700A, arc voltage: 30V, carriage speed: 30 cm/min)**

In addition to weld shape and heat input controls, the groove faces of a thick section should be inspected by magnetic particle testing to confirm no sulfur segregation in the surfaces because it initiates hot cracking in the weld.

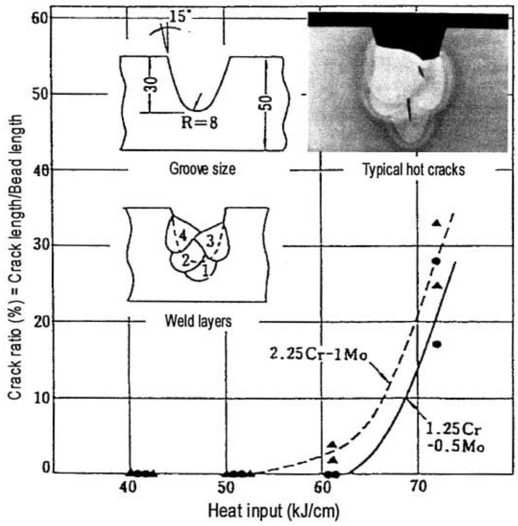



**Figure 8 The effect of heat input on hot cracking of submerged arc 1.25Cr-0.5Mo and 2.25Cr-1Mo steel welds.**
**(wire: 4.8 mmΦ, flux: fused type, welding current: 600-1000A, arc voltage: 35V, carriage speed: 30 cm/min)**

## PWHT determines weld qualities

Heat-resistant low-alloy steels are generally subject to postweld heat treatment (PWHT) to remove residual stresses and improve the mechanical properties of the weld. PWHT should be carried out soon after welding is finished while the specified preheat and interpass temperatures are still maintained in the weldment to prevent delayed cracking. In case it is difficult to follow this procedure, the aforementioned IPWH should be applied on the weldment before it cools down to room temperature to prevent delayed cracking. If PWHT is conducted in an inappropriate manner, it will cause stress relief (SR) cracking, ferrite band precipitation and poor mechanical properties.

Cracks that may occur in heat-resistant low-alloy steel welds during PWHT and high temperature operations are known as "SR cracking" and "reheat cracking." The factors that can cause SR cracking are considered to be stress concentration, precipitation hardening and coarse microstructure. The coarse grain boundaries of the base metal heat-affected zone at the vicinity of the weld toes are believed to be more sensitive to SR cracking. **Figure 9** shows the SR cracking susceptibility of a particular type of Cr-Mo steel as a function of PWHT temperature and micro-alloyed elements that have strong precipitation hardening effects. This figure suggests that PWHT at temperatures around 600℃ and micro-alloying with vanadium have the highest possibility of SR cracking.

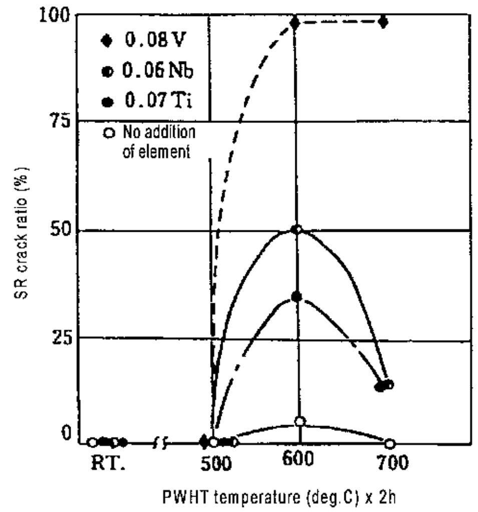



**Figure 9.** SR cracking susceptibility of 1Cr-0.5Mo steel as a function of PWHT temperature and micro-alloying elements obtained in y-groove restraint cracking test. (Source: H. IKAWA. The Complete Book of Welding, Series 4, 1978. Sanpo)

The joints of nozzle necks on vessel walls are believed to be most susceptible to SR cracking because of higher stress concentration; therefore, such welds are commonly finished by grinding to form gradual transitions to the base metal to prevent stress risers at the weld toes, thereby preventing SR cracking.

PWHT determines the mechanical properties (tensile strength, impact toughness, hardness, and creep rupture strength) of weld metals. As shown in **Fig. 10**, there is an almost linear decrease of tensile strength and yield strength with an increase of temper parameter. Impact toughness increases as temper parameter increases to a certain level, but excessive PWHT causes adverse effects as shown in **Fig. 11**. These adverse effects are attributed to precipitation of ferrite bands.

**Table 3** shows Kobe Steel's recommendation for PWHT with Kobelco welding consumables (refer to Kobelco Welding Today, Vol. 7, No. 1) for general applications. This table also contains PWHT requirements of the international code, ASME Section 1 (Rules for construction of power boilers).

In the case of dissimilar metal joints between ferritic steels, e.g. 2.25Cr-1Mo steel and 9Cr-1Mo-V-Nb steel, PWHT temperature should be high enough to suit the higher-alloyed steel, but not so high that it damages the lower-alloyed steel.

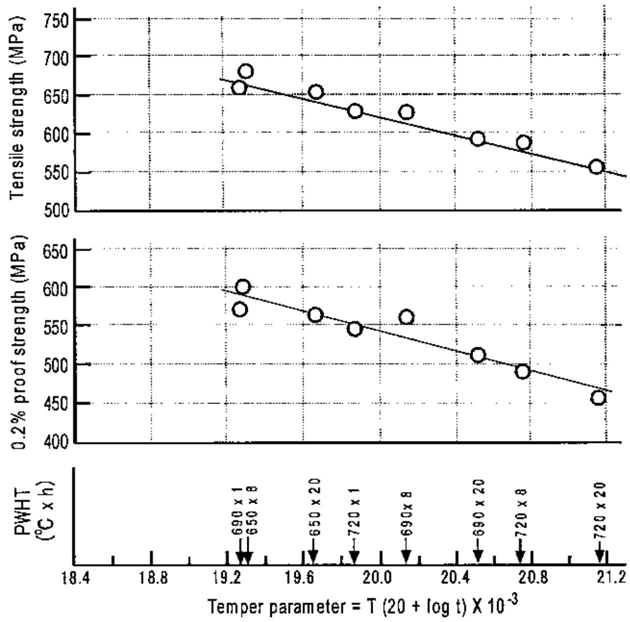



**Figure 10.** Tensile properties of 1.25Cr-0.5Mo SMAW weld metal vs. temper parameter (T: temperature in deg. K, t: soaking time in hours).

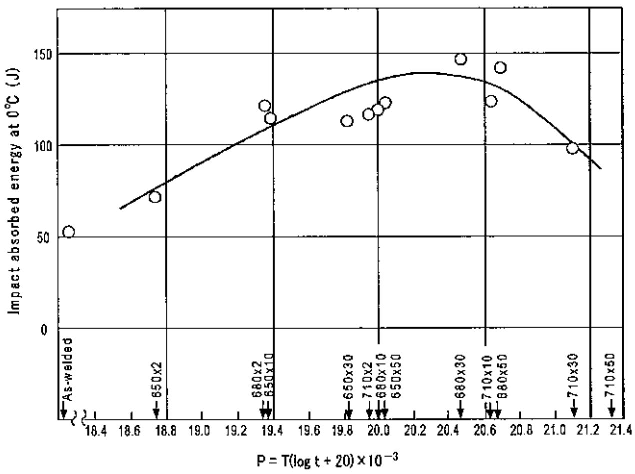
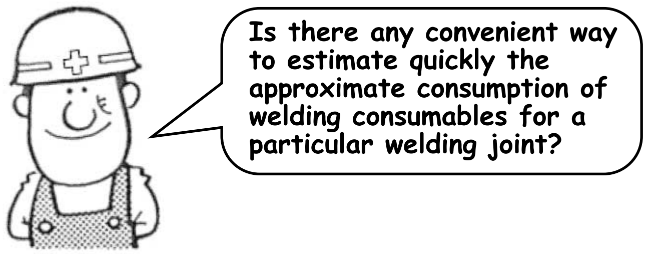



**Figure 11.** Transition of Charpy impact absorbed energy of 1.25Cr-0.5Mo SMAW weld metal vs. temper parameter (T: temperature in deg. K, t: soaking time in hours).

**Table 3.** Kobe Steel's recommendations and the ASME Sec. 1 requirements for PWHT temperature

| Type of steel | Kobe Steel's recommendation | ASME Sec. 1 requirement |
|---|---|---|
| 0.5Mo | 620-680℃ | 593℃ min. |
| 0.5Cr-0.5Mo | 620-680℃ | 593℃ min. |
| 1-1.25Cr-0.5Mo | 650-700℃ | 593℃ min. |
| 2.25Cr-1Mo | 680-730℃ | 677℃ min. |
| Low-C 2.25Cr-W-V-Nb | 680-730℃ | — |
| 5Cr-0.5Mo | 710-780℃ | 677℃ min. |
| 9Cr-1Mo | 710-780℃ | 677℃ min. |
| 9Cr-1Mo-V-Nb | 720-760℃ | 704℃ min. |
| 9Cr-W-V-Nb | 720-760℃ | — |
| 12Cr-W-V-Nb | 720-760℃ | — |




**We recommend you to use the following diagrams for a quick estimation of the consumption of welding consumables for welding ferritic steel butt joints and fillet joints respectively. Please follow the examples indicated by gray arrows in the figures.**

**Figure 2** shows the calculated consumption of welding consumables as a function of plate thickness, welding process, groove angle, and root opening for butt joints. With respect to fillet joints, **Fig. 3** shows the calculated consumption of welding consumables as a function of fillet size, welding process, and reinforcement size. These diagrams were developed using the calculations obtained by the following equation for both groove and fillet welding joints under the prerequisites given below.

$$C = [(A_1 + A_2) \times L \times G / E] \times 1/10$$

Where

C: Consumption of welding consumables (kg)

$A_1$: Area of Section $A_1$ weld metal ($mm^2$) (**Fig. 1**)

$A_2$: Area of Section $A_2$ reinforcement ($mm^2$) (**Fig. 1**)

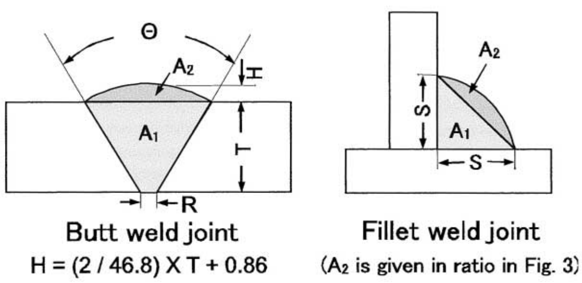



**Figure 1.** Weld sizes (Θ in deg., H, R, S and T in mm)

L: Weld length (m)

G: Specific gravity of weld metal (7.85 $g/cm^3$)

E: Deposition Efficiency (%)—

SMAW covered electrodes: 55%

GMAW solid/metal-cored wires: 95%

FCAW flux-cored wires: 90%

SAW solid wires: 100%

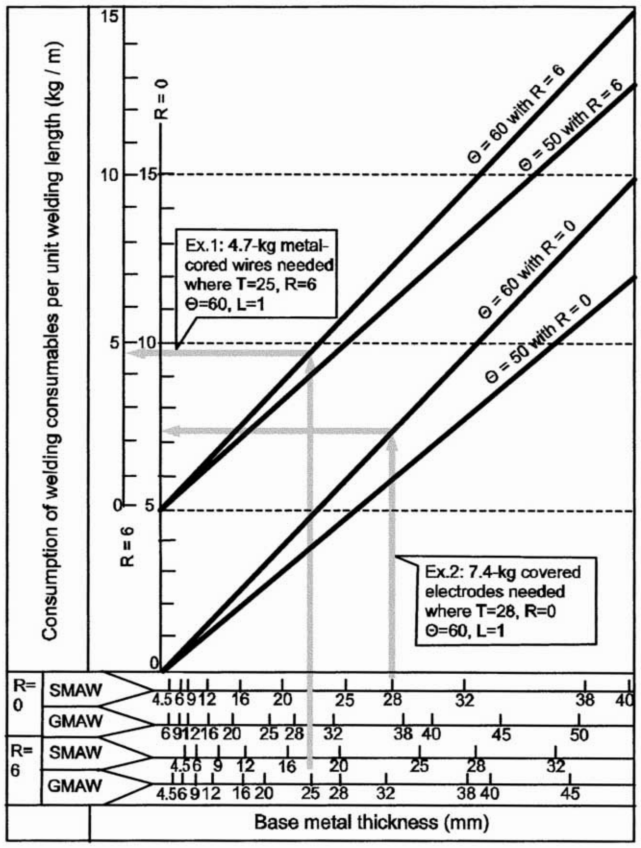



**Figure 2.** Consumption of covered electrodes in SMAW and solid/metal-cored wires in GMAW of butt joints

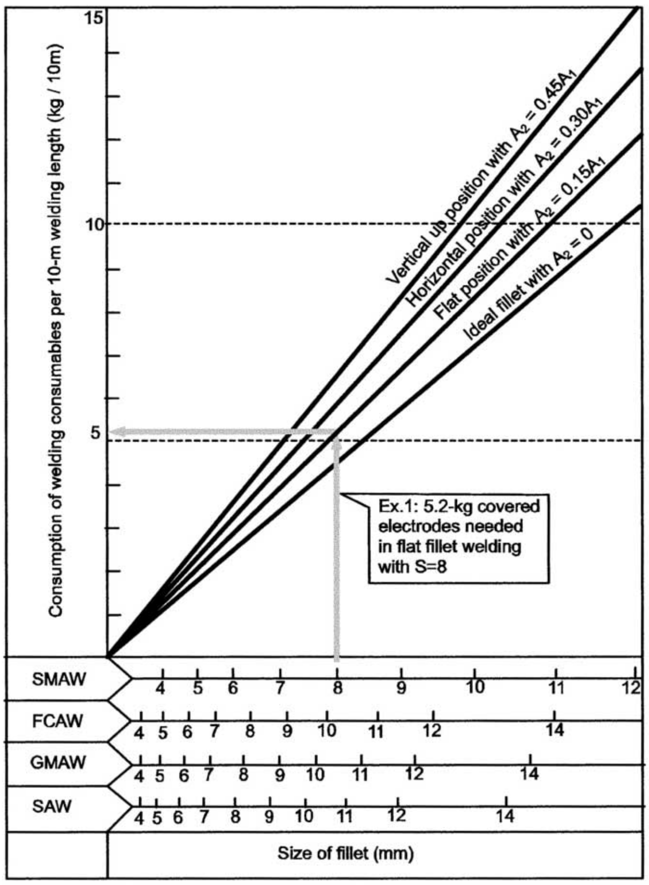



**Figure 3.** Consumption of covered electrodes in SMAW, flux-cored wires in FCAW, solid/metal-cored wires in GMAW, and solid wires in SAW of fillet joints

## Excellent Tack Welding Performances in All Positions

A tack weld is a weld made to hold the parts of a weldment in proper alignment until the final welds are made. A tack weld is generally a short weld made at intermittent points; thus the covered electrode's capability to restart the arc in shielded metal arc welding (SMAW) is key in ensuring better usability and productivity. This is why tack welding is generally carried out using high titanium type and ilmenite type electrodes, such as E6013 and E6019, which offer good arc restarting and bead appearance, unless the job requires a different type of the electrode.

However, tacking thick mild steel sections and high strength steel components generally requires low-hydrogen type electrodes such as E7016, E7018, and E7048 to prevent cold cracking; e.g. the Technical Recommendations for Steel Construction for Buildings of the Japanese Architectural Standard Specification (JASS 6) requires that SMAW tacking of 25-mm or thicker mild steels and high strength steels with 490-MPa or higher tensile strengths be conducted by using low-hydrogen electrodes.

Low-hydrogen type electrodes offer superior crack resistance. On the other hand, poor arc restarting is an inherent disadvantage for conventional low-hydrogen electrodes. **LB-52T** (AWS E7048), one of Kobe Steel's specific low-hydrogen electrodes, offers excellent arc restarting capability (**Table 1**) and better slag removal in out-of-position (incl. vertical-down) tacking with the same amperage as for a certain electrode size.

**Table 1.** Arc restarting capability of LB-52T and a conventional low-hydrogen type

| Size (mm) | Electrode | Number of restarted arcs out of 10 electrode samples | | | | | |
|---|---|---|---|---|---|---|---|
| | | At 5 sec. of arc-cut | | | At 30 sec. of arc-cut | | |
| | | Without VRD | With VRD | | Without VRD | With VRD | |
| | | | Low CR | High CR | | Low CR | High CR |
| 3.2 | LB-52T | 10 | 8 | 7 | 10 | 8 | 5 |
| | Conv. type | 1 | 0 | 0 | 0 | 0 | 0 |
| 4.0 | LB-52T | 10 | 10 | 8 | 10 | 8 | 5 |
| | Conv. type | 1 | 0 | 0 | 0 | 0 | 0 |

Note: VRD: Voltage reducing device
CR: Circuit resistance to the current for arc starting
Amperage: 150A for 3.2-mm dia. and 200A for 4.0-mm dia.

In this arc restarting test, first, 50 millimeters of a 350-mm (3.2ϕ) or 400-mm (4.0ϕ) electrode sample were consumed. Then, the arc was cut and left for five or thirty seconds, after which the electrode was struck onto the base metal for restarting the arc. As shown in Table 1, the arc restarting ratio of **LB-52T** was 100%, while that of the conventional type was 0% and 10% with an AC power source having no voltage reducing device. When the AC power source included the voltage reducing device circuit, the arc restarting ratio with **LB-52T** ranged from 100% to 50%, depending on the circuit resistance, while that of the conventional electrode was 0%, regardless of the circuit resistance.

**LB-52T** features an extra-low hydrogen covering that exhibits better weld metal crack resistance. In addition, because the coating flux is moisture-resistant, **LB-52T** picks up moisture at a lower rate in comparison with conventional low-hydrogen electrodes (**Fig. 1**).

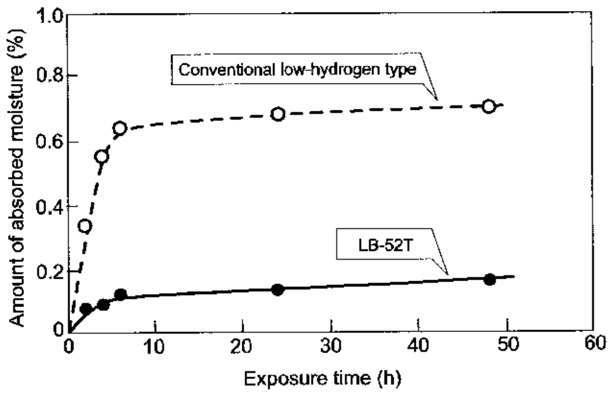



**Figure 1.** Moisture absorption rates of LB-52T (4.0ϕ) and a conventional low-hydrogen electrode (4.0ϕ) as a function of exposure time in the conditioned atmosphere (30℃ × 80%RH)

The typical chemical composition and mechanical properties of **LB-52T** weld metal in the as-welded condition, available electrode sizes and proper welding currents are shown in **Table 2**.

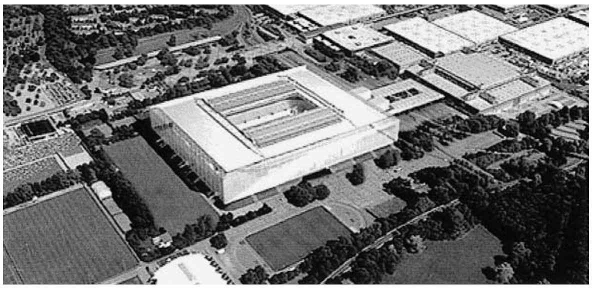
**Table 2.** Typical chemical and mechanical properties of LB-52T weld metal (as-welded) and available sizes

| C | Si | Mn | P | S |
|---|---|---|---|---|
| 0.08 | 0.47 | 0.94 | 0.012 | 0.007 |
| Yield point (MPa) | Tensile strength (MPa) | Elongation (%) | Impact absorbed energy at −29℃ | |
| 450 | 540 | 32 | 110 | |
| Electrode size (mmϕ) | | 3.2 | 4.0 | 5.0 |
| Electrode length (mm) | | 350 | 400 | 450 |
| Proper current in all positions (A) | | 110-160 | 160-220 | 200-260 |

**LB-52T** shines in tack welding in architectural steel structures, hulls, and bridges.

## Extensive use of DWA-55L flux- cored wire for the construction of a spectacular retractable truss roof

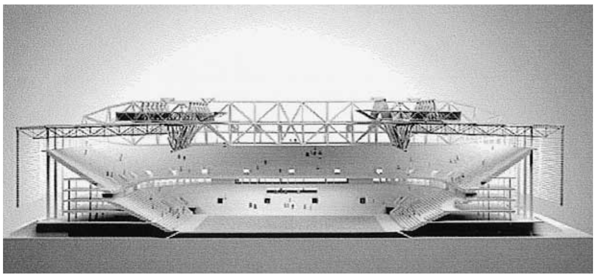
Since Summer 2002, a new multifunctional arena with over 51,000 seats under cover has been under construction on the site of the old Düsseldorf Rheinstadion.



The new multifunctional arena in Düsseldorf, Germany

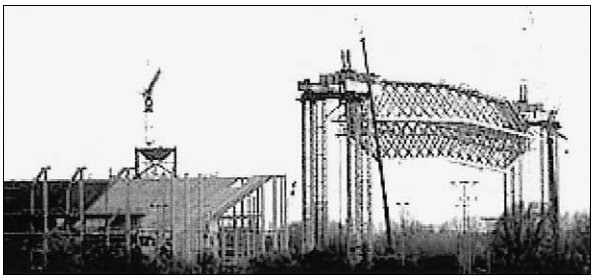
From 2004, the multifunctional arena will be used for both soccer and American football matches and major cultural and sports events, concerts and trade exhibitions. The multifunctional stadium forms an integral part of the trade exhibition area. The total costs will amount to approximately EUR 218 million (US$ 277 million).

Hollandia-Bailey Technogroup, a member of the Dutch S3C group of companies, was chosen by the German contractors Walter Bau-AG, DYWIDAG and ABB, in order to do structural engineering and construction of the retractable truss roof.



Cross-section retractable roof

The roof was first prefabricated into lengths of 40 meters. After transport by ship from Krimpen a/d IJssel near Rotterdam to Düsseldorf, the two main roof frames were assembled locally out of 100 parts to a total length of over 180 meters, a height of 18 meters and a weight of 1600 tonnes. In order to lift the two main frames to a height of 45 meters, the company Mammoet had to use a special lifting method that had previously been used for lifting the Russian nuclear submarine, Kursk, and the so-called London-Eye attraction. These main frames will support the rest of the retractable roof. The total roof measures 235 by 201 meters and has a total weight of around 8000 tonnes.



Cranes lifting one of the main frames

The steel types used for the roof construction are S355J0, S355J2, and S355ML. The wall thicknesses, from 60 up to 100 mm, are subject to impact testing at minus 50℃. For the smaller thicknesses up to 40 mm, impact testing is required at minus 40℃.

Elga has already represented Kobelco flux cored wires for more than 15 years. These wires are recognised for their high quality and productivity and have proven records in offshore structures and shipbuilding. We are very proud that Hollandia chose ELGACORE DWA-55L and MXA-100 for this ambitious project because of its excellent operational ability, outstanding low temperature properties and low hydrogen content, thus ensuring high integrity welding.

Düsseldorf with its new multifunctional arena will surely also apply for the World Cup football games in 2006. For sure this stadium will help to win the contest and the retractable truss roof will allow for the right atmosphere at every moment.

Reported by Henk van Zijl, Managing Director
Elga/ITW Welding Products, The Netherlands

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