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# KOBELCO WELDING TODAY

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

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# PREMIARC™ TG-Super304H: austenitic stainless steel TIG wire for coal-fired steam boilers

In the field of power generation, ultra supercritical (USC) coal-fired boilers, in which the operational temperature is increased from the conventional 550˚C to 650˚C, are increasingly seen as a way of not only increasing efficiency but of helping to mitigate the issues of global energy consumption and $CO_2$ emissions.

Because of the high temperature requirements associated with USC coal-fired boilers, the stainless steels and relevant welding consumables for the heat exchanger tubes must be austenitic rather than ferritic.

PREMIARC™ TG-Super304H, developed for welding SUPER304H®, the heat exchanger tube for USC fossil-fired boilers, provides excellent creep rupture strength, hot crack resistance as well as weldability. (SUPER304H is a trademark belonging to the former Sumitomo Metal Industries, Ltd.)

The chemistries of PREMIARC™ TG-Super304H are shown in Table1 and the mechanical properties, in Table 2.

The microstructure of PREMIARC™ TG-Super304H all weld metal is shown in Figure 1.

The creep rupture test results of PREMIARC™ TG-Super304H all weld metal are shown in Table 3 and Figure 2. The typical creep rupture characteristics of SUPER304H® steel tubes are also shown in Figure 2 for reference.

Butt joint welding was conducted with PREMIARC™ TG-Super304H wire and SUPER304H® steel tube according to the welding conditions listed in Table 4. The results showed good weldability as well as root pass welding as shown in Figures 3 and 4, respectively.

Table 1: Chemistries (weight %)

| C | Mn | Cu | Ni | Cr | Nb | W | N |
|---|---|---|---|---|---|---|---|
| 0.1 | 3 | 3 | 16 | 20 | 0.5 | 2 | 0.2 |

Table 2: Mechanical properties of all weld metal

| Tested temperature | Tensile test | | | |
|---|---|---|---|---|
| ℃ | 0.2%PS (N/mm²) | TS (N/mm²) | El (%) | RA (%) |
| 23 | 573 | 796 | 28 | 51 |
| 550 | 392 | 574 | 19 | 25 |

Welding conditions:
Welding current: 150A; Arc voltage: 12V; Welding speed: 8 cm/min
Wire feeding speed: 10 g/min; Heat input: 13.5 kJ/cm
Preheat temp: Room temp; Interpass temp: 100-150˚C

Figure 1: Microstructure of all weld metal

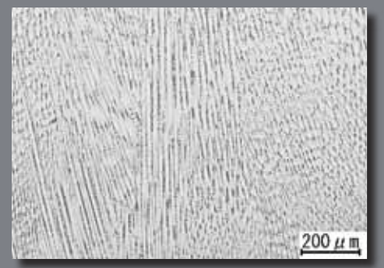
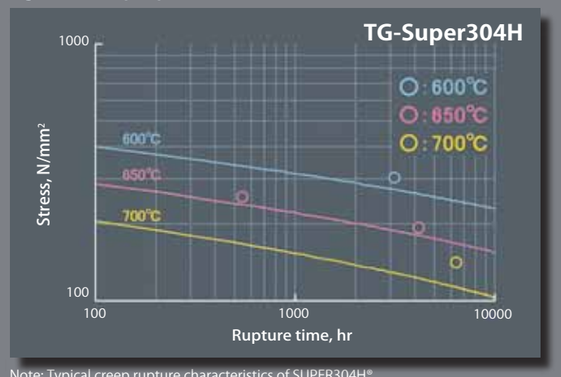



Table 3: Creep rupture test results of all weld metal

| Tested temperature (˚C) | Stress (N/mm²) | Rupture time (Hour) |
|---|---|---|
| 600 | 300 | 3172 |
| 650 | 250 | 552 |
| | 190 | 4239 |
| 700 | 140 | 6502 |

Figure 2: Creep rupture test results of all weld metal




Note: Typical creep rupture characteristics of SUPER304H® steel tube are represented by the solid lines.

Table 4: Welding conditions of butt joint welding

| Polarity | Welding position | Welding current (A) | Arc voltage (V) | Welding speed (cm/min) | Preheat temp. (°C) | Interpass temp. (°C) |
|---|---|---|---|---|---|---|
| DCEN | 1G | 90-125 | 11-12 | 8-10 | RT | 100-150 |

Figure 3: Butt joint outer appearance

Figure 4: Root pass welding

Note: Tube outer dia.: 51mm





# Customers find satisfaction with quality weld metals that provide high efficiency

I sincerely wish all KWT readers heartfelt greetings and a Happy New Year! My name is Toshihiro Nakamura, the General Manager of the Marketing Department in the Welding Business. I am honored to have this opportunity to forward my greetings at the start of the year 2013.

In pursuit of economic growth, many governments have invested heavily in improving infrastructure and rationalizing services. Companies, too, have continued to develop new products. On the other hand, a general sluggishness prevails due to imbalances in supply and demand as well as the debt problems and political turbulence that have increased in many countries.

Such circumstances force us to reconsider the true nature of the happiness that we seek.

As a person working in the welding business, I believe the answers lie in energy conservation, the development of safe living spaces, and the establishment of comfortable transportation systems. It is our mission to firmly support through welding the reliability of the structures used to create these “answers” I mentioned.

I try to remember always that what customers want is not the welding consumables or the automated welding robots, but simply the weld metal – obtained efficiently and up to the required standard. In order to meet our customers’ essential demand, we pursue quality and weldability in our welding consumables and provide customers with optimum pricing as well as total solutions that include power sources and equipment and operator training in construction methods and welding procedures. This is how we enable customers to get reliable welding results. When customers use efficient and stable products, they experience minimal welding defects, scraps, spatter losses, and fume generation, all of which ultimately helps to enhance eco-friendly welding and preserve resources.

Because we want to be conscious of the nature of the problems that customers face, we listen carefully to their requests and suggestions and respond in our daily activities. In addition, we are upgrading our computer network in English in order to provide better support and communicate with you. I recommend that readers access our network.

Last but not least, I would like to wish all of you the best of health as well as a fruitful and prosperous 2013. And I look forward to seeing you in the very near future.

**Toshihiro Nakamura**
General Manager
Marketing Department
Welding Business
Kobe Steel, Ltd.

KOBELCO WELDING TODAY No.1 2013

CONTENTS Vol.16



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KOBELCO WELDING TODAY
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# Pipeline Girth Welding: Kobe Steel's up-to-date welding consumables meet diverse requirements

## 1 Preface

Because growing populations in developing countries create ever more demand for energy, investments in mining, transportation and storage of energy resources and relevant equipment are expected to increase. Used for stable and continuous transport of crude oil and natural gas, pipelines, in small and large sizes, play a key role in energy infrastructure worldwide.

There are two major types of pipeline: on-shore, pictured in Figure 1, and subsea pipelines. Two methods of installing subsea pipelines are used. One is called the S-Lay or J-Lay method, in which pipes are girth-welded on board a ship and then lowered to the seabed. In contrast, the spooled pipe method has the pipes girth-welded into one long pipe (a few km in length). It is wound or spooled onto a bobbin and carried to a ship for installation under the seabed.

SMAW, GTAW, GMAW and SAW are the processes most often applied for welding the pipes used in pipelines. However, SAW tends to be limited to welding the longitudinal pipe seams whereas the other processes are used for circumferential girth welding. This article focuses on the up-to-date welding consumables for onsite girth welding.

## 2 Girth welding and requirements for welding consumables

The specifications required of pipelines vary, depending on materials (strength requirements), sizes (pipe diameter), construction site conditions (temperature, on-shore or seabed), and service condition (pressure). Most countries also have their own particular regulations and requirements that will influence a pipeline's specifications – and raise issues when pipelines cross borders.

Cellulose type covered electrodes, used in vertical downward position (from 12 to 6 o'clock), have been preferred for girth welding from the start of pipeline history because of their fast welding speed. Their use, however, is limited to warm areas due to their low crack resistance and that a certain degree of welding skill is necessary. More recently they are being replaced by self-shielded flux cored wires (SS-FCWs). Nevertheless, both of these welding consumables still account for 70 to 80 % of total girth welding.

Figure 1: Onshore pipeline
Photo courtesy of Pipeline Service S.r.l., Manufacturer of the Proteus FAP.

Because construction, transportation and installation of pipelines require significant investments of time and money, demand is high for the most efficient girth welding processes. As seen in Figure 2, the application of exclusive girth welding equipment with automatic GMAW has gradually been expanding and replacing covered electrodes and SS-FCWs. The use of solid wires as well as metal type FCWs that enable vertical downward welding is also rising.

Because pipe constructed with the spooled pipe method is wound on a bobbin after welding, mechanical properties like ductility and strength as well as the inspection methods of the weld metal have to be carefully considered when designing the weld metal and setting-up the welding procedures. For example, vertical downward welding by conventional GMAW with solid wires often suffers from lack-of-penetration that can increase the need for future repairs. Therefore, all-positional FCWs that enable vertical upward welding with deep and stable penetration are preferable. Furthermore, because higher strength pipe like API 5L X80 grade is being considered for actual pipeline projects, FCWs with the quality and efficiency suitable for higher strength pipes are now a must for development.

The grades of carbon steel that are suited to pipeline pipes range from API 5L X52 to X100, as shown in Tables 1 and 2. Clad pipes (Ni base) are also available from the view point of corrosion resistance.

Figure 2: MAG welding by special girth welding machine.
Photo courtesy of Pipeline Service S.r.l., Manufacturer of the Proteus FAP.

## 3 Carbon steel welding consumables suitable for girth welding

Kobe Steel has been marketing welding consumables for girth welding for decades. Table 1 shows the typical covered electrodes for girth welding while Table 2 shows the TIG and MAG wires for particular grades of steel.

## 4 Up-to-date welding consumables for girth welding

### 4.1. TRUSTARC™ LB-52NSU

When pipe root pass welding must be conducted from outside rather than inside in order to form the back bead inside the pipe, GTAW or SMAW are generally favored. Kobe Steel has long marketed FAMILIARC™ LB-52U as well as FAMILIARC™ LB-62U for this purpose, and they still serve as Kobe's most reliable, "one and only" products worldwide.

In addition to meeting the always-changing and diverse specifications of pipelines, TRUSTARC™ LB-52NSU has been developed specifically for root pass welding of pipes for low temperature service. It is a covered, low hydrogen type electrode equivalent to AWS A5.5 E7016-G. It offers superb notch toughness at -60°C and very low diffusible hydrogen content of about 3.0ml/100g. The chemistries, mechanical properties of all weld metal and diffusible hydrogen content of TRUSTARC™ LB-52NSU are shown in Tables 3, 4 and 5 respectively.

Table 1: Covered electrodes for girth welding

| API 5L pipe grade | Welding pass | Low hydrogen type | | High cellulose type |
|---|---|---|---|---|
| | | Vertical upward position | Vertical downward position | |
| X42-X52 | Root | LB-52U LB-52NSU | LB-78VS | KOBE-6010 |
| | Hot | LB-52-18 LB-52NS | | |
| | Filler & Cap | | | |
| X56-X60 | Root | LB-52U LB-52NSU | | KOBE-6010 KOBE-7010S |
| | Hot | LB-52-18 LB-52NS | | KOBE-7010S |
| | Filler & Cap | | | |
| X65 | Root | LB-52U | LB-88VS | KOBE-7010S KOBE-8010S |
| | Hot | LB-62 LB-62D | | KOBE-8010S |
| | Filler & Cap | | | |
| X70 | Root | LB-62U | | KOBE-7010S KOBE-8010S |
| | Hot | LB-62 LB-62D | | KOBE-8010S |
| | Filler & Cap | | | |
| X80 | Root | LB-62U | LB-98VS LB-108VS | —— |
| | Hot | LB-65D LB-106 | | |
| | Filler & Cap | | | |
| X100 | Root | —— | LB-118VS | —— |
| | Hot | LB-80L LB-116 | | |
| | Filler & Cap | | | |

Table 2: TIG and MAG wires for girth welding

| API 5L pipe grade | Welding pass | Temperature (°C) | | |
|---|---|---|---|---|
| | | −20 | −40 | −60 |
| X42-X56 | Root & Hot | TG-S50 MX-100T | TG-S1N MX-A55T | |
| | Filler & Cap | DW-A50 DW-A50SR | DW-A55E DW-A55ESR | DW-A55L DW-A55LSR DW-A81Ni1 |
| X60 | Root & Hot | TG-S62 | TG-S60A | |
| | Filler & Cap | DW-A55E DW-A55ESR | | DW-A55L DW-A55LSR DW-A81Ni1 |
| X65 | Root & Hot | TG-S62 | TG-S60A | |
| | Filler & Cap | DW-A55E DW-A55ESR | | DW-A55L DW-A55LSR DW-A81Ni1 |
| X70 | Root & Hot | TG-S62 | TG-S60A | |
| | Filler & Cap | DW-A70L | | DW-A55L DW-A81Ni1 |
| X80 | Root & Hot | TG-S80AM | | |
| | Filler & Cap | DW-A70L | | —— |
| X100 | Root & Hot | TG-S80AM | | |
| | Filler & Cap | DW-A80L | —— | —— |

KOBELCO WELDING TODAY
Vol.16 No.1 2013

Table 3: Chemistries of TRUSTARC™ LB-52NSU all weld metal (mass %)

| C | Si | Mn | P | S | Ni | Ti | B |
|---|---|---|---|---|---|---|---|
| 0.06 | 0.62 | 1.25 | 0.016 | 0.004 | 0.50 | 0.014 | 0.0027 |

Table 4: Mechanical properties of TRUSTARC™ LB-52NSU all weld metal

| Tensile properties | | | | Notch toughness | | | |
|---|---|---|---|---|---|---|---|
| 0.2%PS (MPa) | TS (MPa) | EI (%) | RA (%) | Absorbed energy:J (Brittle fracture: %) −80°C | −60°C | −40°C | FATT (°C) |
| 511 | 598 | 32 | 78 | 43(60)<br>55(60)<br>41(60)<br>Av.46(60) | 44(55)<br>72(55)<br>58(52)<br>Av.58(54) | 70(50)<br>137(35)<br>144(35)<br>Av.117(40) | −53 |

Table 5: Diffusible hydrogen content of TRUSTARC™ LB-52NSU (ml/100g)

| Electrode dia (mm) | 1 | 2 | 3 | 4 | Ave. |
|---|---|---|---|---|---|
| 3.2 | 2.8 | 3.3 | 3.5 | 3.0 | 3.2 |

Note: Tested method: According to AWS A4.3.(Gas chromatography)
Welding current: 120 A (DCEP)
Welding atmosphere: 21°C x RH10%

In welding a butt joint on a 25 mm thick plate, 3.2 mm dia. TRUSTARC™ LB-52NSU was used for the root pass with DC 95 amp, and 3.2 mm dia. TRUSTARC™ LB-52NS was used for the second pass onwards with DC 110 amp in the vertical upward position. The preheating and interpass temperatures were kept between 115 and 135°C. Figure 3 shows the groove shape and the pass sequence and Figure 4, the macrostructure of the weld metal. The chemistries and the tensile properties are shown in Tables 6 and 7, respectively and the notch toughness properties and the transition curve of the butt joint weld metal are shown in Table 8 and Figure 5, respectively. (Note: both TRUSTARC™ LB-52NSU and TRUSTARC™ LB-52NS are specified as AWS A5.5 E7016-G).

Figure 3: Groove shape and pass sequence of butt joint welding with TRUSTARC™ LB-52NSU(root pass only) and TRUSTARC™ LB-52NS

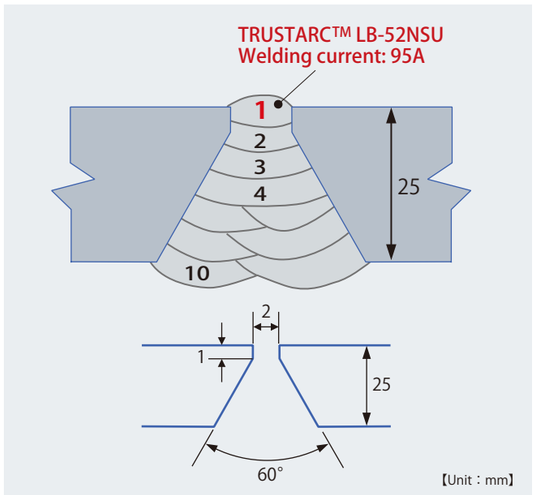



Table 6: Chemistries of butt joint weld metal (mass %)

| Location | C | Si | Mn | P | S | Ni | Ti | B |
|---|---|---|---|---|---|---|---|---|
| Face | 0.07 | 0.31 | 1.40 | 0.008 | 0.003 | 0.50 | 0.013 | 0.0022 |
| Reverse | 0.08 | 0.30 | 1.36 | 0.009 | 0.003 | 0.43 | 0.014 | 0.0023 |

Figure 4: Macrostructure of butt joint weld metal

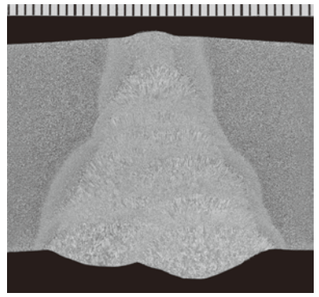


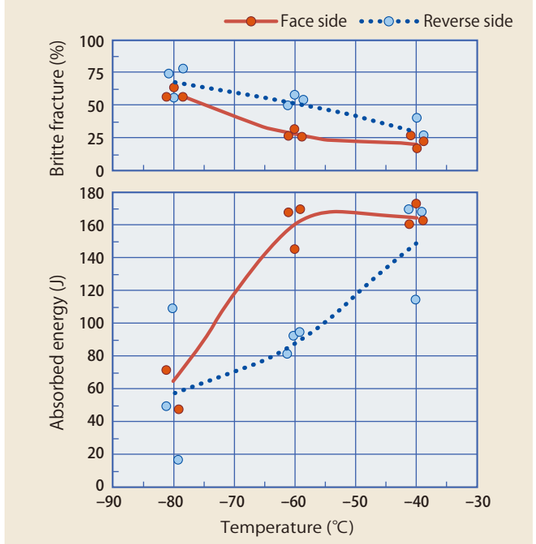
Table 7: Tensile properties of butt joint weld metal

| Location | Tensile properties | | | |
|---|---|---|---|---|
| | 0.2%PS (MPa) | TS (MPa) | EI (%) | RA (%) |
| Center | 506 | 577 | 25 | 81 |

Table 8: Notch toughness properties of butt joint weld metal

| Location | Notch toughness | | | |
|---|---|---|---|---|
| | Absorbed energy:J (Brittle fracture: %) −80°C | −60°C | −40°C | FATT (°C) |
| Face side | 47(56)<br>73(64)<br>71(55)<br>Av. 64(58) | 169(26)<br>145(30)<br>167(26)<br>Av. 160(27) | 162(22)<br>172(16)<br>160(26)<br>Av. 165(21) | −75 |
| Reverse side | 17(79)<br>108(56)<br>49(73)<br>Av. 58(69) | 93(53)<br>92(56)<br>82(50)<br>Av. 89(53) | 167(26)<br>114(40)<br>169(26)<br>Av. 150(31) | −58 |

Figure 5: Transition curve of butt joint weld metal




## 4.2. TRUSTARC™ DW-A70L

TRUSTARC™ DW-A70L was developed by Kobe Steel in order to meet the need of pipeline-constructors for high quality and efficiency in welding high strength pipes. A rutile type FCW for all position welding that was designed exclusively for pipeline girth welding. TRUSTARC™ DW-A70L is well suited for welding high strength pipes and for complying with the NACE MR0175 requirement that specifies total Ni content in the weld metal of not more than 1%. The diffusible hydrogen content of TRUSTARC™ DW-A70L all weld metal is as low as 4ml/100g.

Table 9 shows the classification of TRUSTARC™ DW-A70L and Tables 10, 11 and 12, the chemistries, the mechanical properties and the diffusible hydrogen content of TRUSTARC™ DW-A70L all weld metal, respectively.

Table 9: Classification of TRUSTARC™ DW-A70L

| Wire diameter | 1.2 mm dia. |
|---|---|
| Shielding gas | 80%Ar-20%$CO_2$ |
| Welding position | All position |
| Classification | AWS A5.29 E101T1-GM<br>ISO 18276 -A- T 62 5 Mn1NiMo P M 2 H5 |

Table 10: Chemistries of TRUSTARC™ DW-A70L all weld metal (mass %)

| C | Si | Mn | P | S | Ni | Mo |
|---|---|---|---|---|---|---|
| 0.05 | 0.36 | 1.90 | 0.008 | 0.011 | 0.97 | 0.46 |

Table 11: Mechanical properties of TRUSTARC™ DW-A70L all weld metal

| Tensile properties | | | | Notch toughness | | | |
|---|---|---|---|---|---|---|---|
| 0.2%PS (MPa) | TS (MPa) | EI (%) | RA (%) | Absorbed energy:J (Brittle fracture: %) −50°C | −40°C | −30°C | FATT (°C) |
| 663 | 739 | 21 | 63 | 75(23)<br>76(23)<br>66(30)<br>Av.72(25) | 88(23)<br>89(18)<br>84(18)<br>Av.87(20) | 95( 8 )<br>92(13)<br>92(13)<br>Av.93(11) | <−50 |

Table 12: Diffusible hydrogen content of TRUSTARC™ DW-A70L (ml/100g)

| Wire dia (mm) | 1 | 2 | 3 | 4 | Ave. |
|---|---|---|---|---|---|
| 1.2 | 3.5 | 3.7 | 3.9 | 3.6 | 3.7 |

Note: Tested method: According to AWS A4.3.(Gas chromatography)
Welding current: 200A-24V-300mm/min
Wire stick-out length: 25 mm

Using TRUSTARC™ DW-A70L FCW, API 5L X65 pipe was girth-welded with a CRC Evans M300-C welding machine (as shown in Figure 6), and successful results were obtained. Table 13 shows the tested welding conditions. The macrostructure and the bead appearance are shown in Figures 7 and 8, respectively and the chemistries, in Table 14. The mechanical properties and the transition curve of the weld metal are shown in Table 15 and Figure 9 respectively.

Figure 6: CRC Evans M300-C welding machine

Table 13: Tested welding conditions

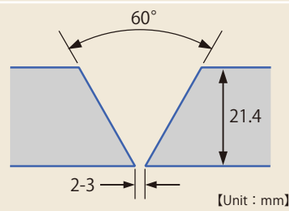
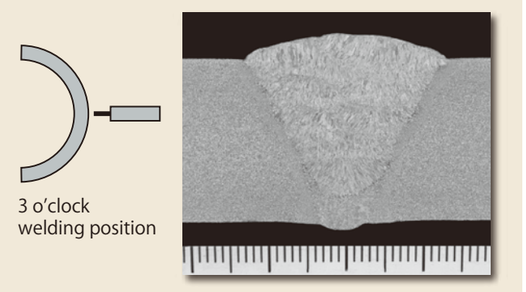
| | |
|---|---|
| Base metal | API 5L X65-PSL1<br>273.1 mm dia.× 21.4 mm wall thickness |
| Welding position | 5G (Pipe is fixed in horizontal position.) |
| Welding equipment | M-300-C External Pipe Welding System (CRC-EVANS) |
| Groove shape |  |
| Root & hot passes | TRUSTARC™ TG-S60A (2 layers)<br>Welding parameters:150 A-10 V-70 mm/min |
| Polarity | DCEP |
| Welding parameters | 200A-23.5V |
| Heat input | 1.7 kJ/mm |
| Pass sequence (FCW) | 8 passes / 5 layers |
| Preheating & Interpass temp. | 100 -130 °C |
| Shielding gas | 80%Ar-20%$CO_2$ , 25 L/min. |
| PWHT | None (As-welded) |

Figure 7: Macrostructure of the weld metal in the 3 o'clock position



KOBELCO WELDING TODAY
Vol.16 No.1 2013

Figure 8: Bead appearance of the weld metal in the 3 o'clock position

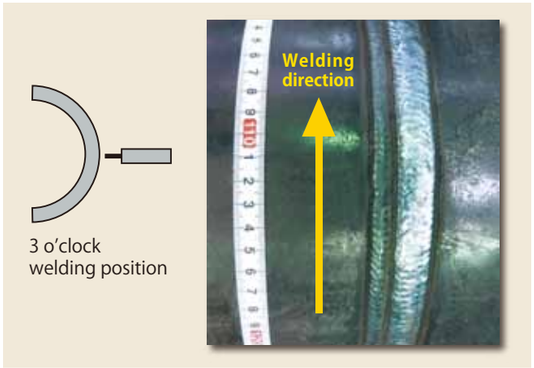


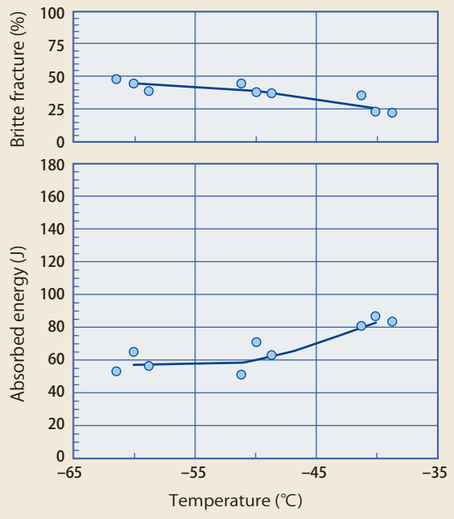

Table 14: Chemistries of weld metal (mass %)

| C | Si | Mn | P | S | Ni | Mo |
|---|---|---|---|---|---|---|
| 0.05 | 0.30 | 1.77 | 0.008 | 0.006 | 0.89 | 0.42 |

Table 15: Mechanical properties of weld metal

| Tensile properties | | | | Notch toughness | | | |
|---|---|---|---|---|---|---|---|
| 0.2%PS (MPa) | TS (MPa) | EI (%) | RA (%) | Absorbed energy:J (Brittle fracture: %) | | | FATT (°C) |
| | | | | −60°C | −50°C | −40°C | |
| 627 | 691 | 29 | 66 | 57(37)<br>63(44)<br>54(48)<br>Av.58(43) | 63(38)<br>70(37)<br>49(45)<br>Av.61(40) | 82(22)<br>86(23)<br>82(34)<br>Av.83(26) | <−60 |

Figure 9: Transition curve of weld metal




As seen in Table 14, Ni content of 0.89 % in the weld metal complies with the NACE requirement. The mechanical properties such as strength (0.2%PS as well as TS) and notch toughness as low as -60°C, are also satisfactory, thanks to the optimization of the alloying elements including minor components in the TRUSTARC™ DW-A70L flux. Finally, the amount and composition of slag in TRUSTARC™ DW-A70L flux is optimum and provides good weldability in all position welding as can be seen in Figures 7 and 8, the macrostructure of the weld metal at 3 o'clock position as well as the bead appearance.

## 4.3. PREMIARC™ DW-N625P

Depending on where it is drilled, crude oil or natural gas may sometimes contain substances that can corrode pipes. In such cases, the inner pipe has to be corrosion-resistant, so clad pipes in which the inner surface is overlay-welded are generally used. For girth welding of corrosion-resistant pipes as well as clad steel pipes, Ni-Cr-Mo 625 alloy is normally applied due to its excellent corrosion resistance. Its strength is usually designed to be equal to or better than the pipes being welded.

Until recently, an FCW with good weldability, corrosion resistance as well as appropriate mechanical properties for girth welding was not available in the market. However, Kobe Steel's newly-developed PREMIARC™ DW-N625P flux cored wire fulfills all the requirements mentioned above. Table 16 shows the classification of PREMIARC™ DW-N625P and Tables 17 and 18, the chemistries and the mechanical properties of PREMIARC™ DW-N625P all weld metal, respectively.

Table 16: Classification of PREMIARC™ DW-N625P

| Wire diameter | 1.2 mm |
|---|---|
| Shielding gas | 75-80%Ar+Bal.%$CO_2$ |
| Welding position | All position |
| Classification | AWS A5.34/A5.34M: ENiCrMo3T1-4<br>ISO 12153 T Ni 6625 P M21 2 |

Table 17: Chemistries of PREMIARC™ DW-N625P all weld metal (mass%)

| Elements | C | Si | Mn | P | S | Cu | Ni |
|---|---|---|---|---|---|---|---|
| DW-N625P | 0.031 | 0.21 | 0.02 | 0.007 | 0.004 | 0.01 | 65.2 |
| ENiCrMo3Tx-y | ≤0.10 | ≤0.50 | ≤0.50 | ≤0.02 | ≤0.015 | ≤0.50 | ≥58.0 |

| Elements | Cr | Mo | Ti | Fe | Nb+Ta | Others |
|---|---|---|---|---|---|---|
| DW-N625P | 21.3 | 8.8 | 0.17 | 2.0 | 3.23 | — |
| ENiCrMo3Tx-y | 20.0-23.0 | 8.0-10.0 | ≤0.40 | ≤5.0 | 3.15-4.15 | ≤0.50 |

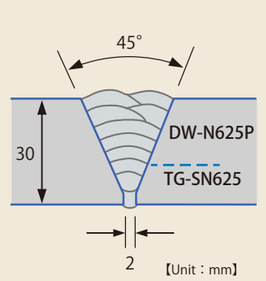
Table 18: Mechanical properties of PREMIARC™ DW-N625P all weld metal

| | Tensile properties | | | Notch toughness | | |
|---|---|---|---|---|---|---|
| | 0.2%PS (MPa) | TS (MPa) | EI (%) | Absorbed energy (J) | | |
| | | | | -196°C | -100°C | 0°C |
| DW-N625P | 479 | 765 | 45 | Av.70 | Av.78 | Av.84 |
| ENiCrMo3Tx-y | Not required | ≥690 | ≥25 | Not required | | |

Figure 10: Welding of pipe by PREMIARC™ DW-N625P and Magnatech machine.
Photograph supplied, courtesy of Magnatech International B.V.

Table 19: Welding conditions of girth welding

| Welding position | 5G (6→12 o'clock) | Pass sequence |
|---|---|---|
| Type of steel | Carbon steel* | |
| Pipe size | Wall thickness 30 mm<br>Outer diameter 267 mm | |
| Welding process | 1-3 passes: GTAW<br>4-10 passes: FCAW | |
| Wire | 1-3 passes: TG-SN625 2.4 mm dia. (AWS A5.14 ERNiCrMo3)<br>4-10 passes: DW-N625P 1.2 mm dia. | |
| Shielding gas | 1-3 passes: 100%Ar (Back purge: 100%Ar)<br>4-10 passes: 80%Ar-20%$CO_2$ (25 l/min) | |
| Wire stick-out | 4-10 passes: 15 mm (160A) | |
| Torch angle | 10° back-hand | |
| Interpass temp. | 150°C max. | |




* For checking the usability of DW-N625P only

Figure 11: Fourth-pass bead appearance

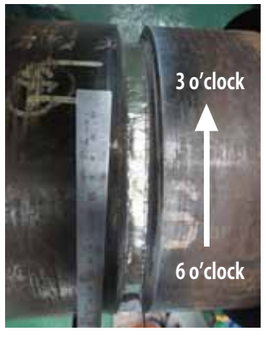



Figure 12: Cap-pass bead appearance

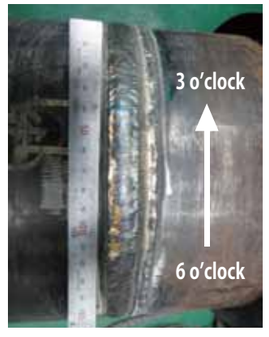



Figure 10 shows pipe being girth-welded on a Magnatech machine with PREMIARC™ DW-N625P in 5G position. GTAW and FCAW were used to conduct welding according to the welding conditions listed in Table 19. GTAW was used for the root, hot and 3rd passes (3 passes) with PREMIARC™ TG-SN625 rod, and FCAW was used from the 4th pass to the cap pass (10th pass) with PREMIARC™ DW-N625P.

The bead appearances from 6 to 3 o'clock of the 4th pass and the cap pass are shown in Figures 11 and 12, respectively. The macrostructures of 6, 4 and 3 o'clock positions are shown in Figures 13, 14 and 15, respectively. Table 20 shows the impact test results of the 3 o'clock position in the different temperatures down to -196°C.

Figure 13: Macrostructure of the weld metal in the 6 o'clock position

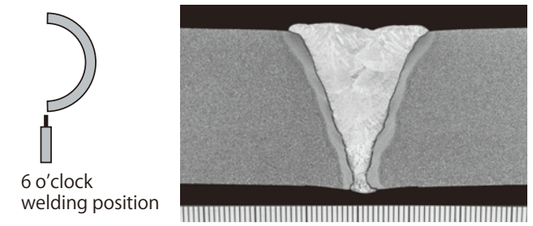



Figure 14: Macrostructure of the weld metal in the 4 o'clock position

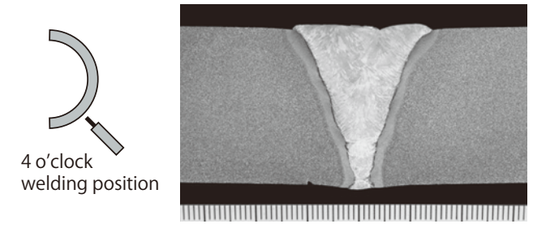



Figure 15: Macrostructure of the weld metal in the 3 o'clock position

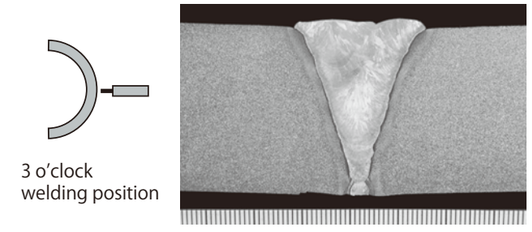



Table 20: Impact test results of girth welding

| Position | Tested temp. (°C) | Absorbed energy (J) |
|---|---|---|
| 3 o'clock | 0 | Av. 96 |
| | -30 | Av. 93 |
| | -100 | Av. 87 |
| | -196 | Av. 82 |

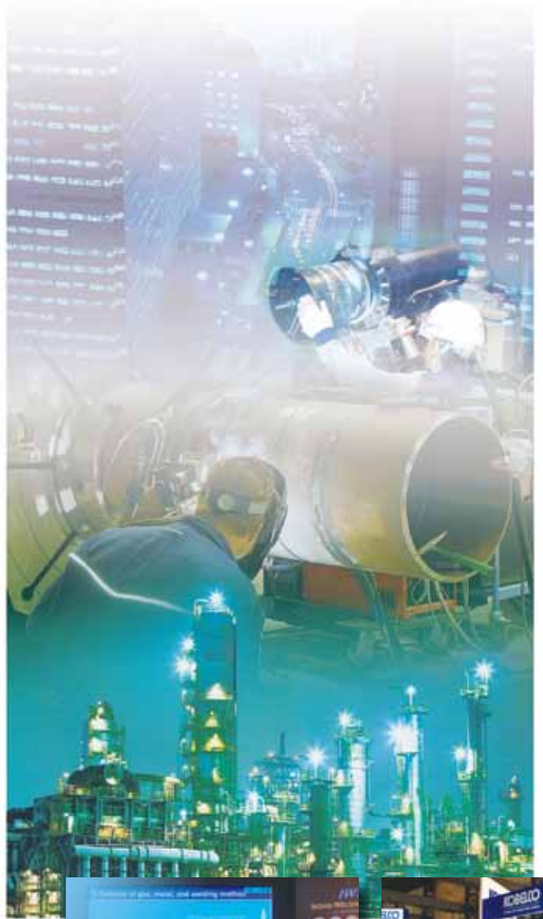
These tests show that girth welding was able to obtain excellent bead appearance at the 6, 4 and 3 o'clock positions which are the most difficult positions in which to achieve defect-free welds.

## 5 Postscript

Whereas most offshore structures are constructed according to the same specifications and, therefore, will utilize the same welding processes and consumables, pipeline projects are more likely to apply specifications set forth by the particular project owner. For this reason, one project may differ significantly in terms of welding from another. It can be assumed, however, that future pipeline projects will specify ever higher quality requirements.

Demand for more stable and more efficient welding consumables and processes shall not stop and Kobe Steel is always ready to challenge the limits of current technology.

With special thanks, photographs courtesy of:
Pipeline Service S.r.l., Manufacturer of the Proteus FAP
Magnatech International B.V.





KOBELCO WELDING TODAY
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# India Essen Fair, enhancing Kobelco's presence

India Essen Welding & Cutting 2012, the 5th International Trade Fair Joining-Cutting-Surfacing was held at the Bombay Convention & Exhibition Center in India's commercial city, Mumbai from October 30 to November 1. Kobe Steel took part in the fair together with the group company in order to enhance the Kobelco brand and expand sales in the Indian market.

It was Kobe Steel's second time to participate in the Indian exhibition, following Weld India 2011, which was held in Chennai on the east coast.

By exhibiting jointly with the group company, Kobe Steel could present the abundant Kobelco brand products as well as demonstrate that it is also a diversified manufacturer of welding products, by showing welding consumables for each industry by panels and welding bead samples. FAMILIARC™ LB-52U, the covered electrode designed for root pass welding without a backing material, was featured as a product geared toward the Indian market.

In parallel with the exhibition, the Indian Welding Society held a seminar in which three engineers from Kobe Steel gave presentations. A number of persons in attendance have already made inquiries and requested samples of the products introduced in the seminar.

In the large Indian market, we still need to emphasize our presence as well as our strength and capability. We will continue to take part in such exhibitions in order that potential Indian customers will become even more familiar with Kobe Steel.

Although the size of the India Essen Fair is nowhere near as large as the German Essen Fair or even the Chinese Essen Fair, it will continue to expand along with increasing demand for these products in the large market.


Outlook of Kobelco group exhibition booth

Reported by Akihisa Ushijima, Manager
International Sales & Marketing Section, Marketing Department

# Singapore life offers thrilling days

Dear KWT readers! My name is Hiroyuki Negoro, and I was assigned as Manager to the sales and marketing department (SMD) at Kobelco Welding Asia Pacific Pte. Ltd. (KWAP) in April, 2012.

Based in Singapore, the SMD covers a wide area, including the ASEAN countries, the Middle East, Oceania, Africa as well as Bangladesh and Hong Kong.

What has impressed me most since I arrived at my post is the change toward a faster pace in business. Clients require quick and accurate responses, and even when we are on business trips, they press us for answers to inquiries and requests. Sometimes we can't get smooth internet access or check our e-mails, causing our responses to be further delayed. Such thrilling days without a "Not yet!" wait for us almost every day.

My private life is exciting as well. You may think that Marlion is the most famous spot in Singapore. However, there are so many other attractive spots in Singapore, such as the Night Safari, Universal Studios as well as the Hotel Marina Bay Sands, which has become famous in Japan because a popular Japanese group recently made an advertisement for it. In addition, the largest aquarium in the world opened in December, 2012 and just across the border, in Johor Bahru, Malaysia, the sixth Legoland in the world has also opened. Because Singapore has such excellent access to the ASEAN countries, Oceania, even the Middle East, I plan to travel overseas with my family as much as possible in order to broaden our minds.

Because Singapore is a multi-national country, with four national languages – English, Chinese, Malay and Tamil – the local cuisine reflects the variety of cultures. If KWT readers have a chance to visit Singapore, please enjoy not only wonderful sight-seeing spots but also the many cultures and foods.

Mr Negoro, Manager, enjoying Chili-crab with his colleagues in SMD (center of the back side)

# Can advanced welding technology provide richness or happiness?

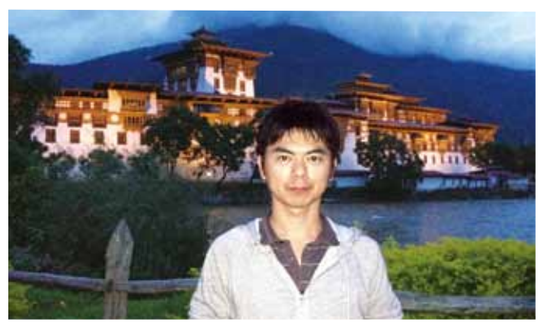
Dear all KWT readers! My name is Toshihiko Hama, General Manager of the Sales and Marketing Department at Thai-Kobe Welding Co., Ltd. (TKW) as well as Kobe Mig Wire (Thailand) Co., Ltd. (KMWT) in Thailand.

Since I was transferred to Bangkok in March, 2012, almost half a year has passed. Different from the Japanese domestic sales where I had been working since right after joining Kobe Steel, my new job here has surprised me many interesting experiences. Though bewildering sometimes at the beginning, I've gotten used to them now, and so I travel around not only Thailand but also the surrounding ASEAN countries with an expectation of not quite knowing what will happen next.

Although worldwide economic trends are unclear due to stagnant business conditions in Europe and China, economic growth of ASEAN countries is exceptionally high, and our effective and efficient performance is necessary to satisfy market demands. Our aim is to further tighten relationship with our partners in Thailand as well as other ASEAN countries, and to supply high quality welding consumables and technology to our clients through our partners.

The dry season has come to Thailand, and it's the best period for travelling as well as playing sports. It is a good time to enjoy travelling with my family who have just moved to Bangkok.

During my business trips across the region in the last half year, I would say that the most impressive country was Bhutan, which is famous worldwide because of their "Gross National Happiness" index. The Tibetan Buddhism and mountain scenery that resembles that of Japan was present everywhere and very beautiful. While there, I wondered whether advanced welding technology had brought the people "richness" – or even "happiness." Dear KWT readers, what would be your answer?
Thanks a lot and wish you a prosperous new year!



Posing in front of the old castle in Bhutan is Mr Hama