KOBELCO WELDING TODAY

October 2006 Vol.9 (No.4)

The KOBELCO Arc: Your Total Solution in Manual, Semi-Automatic and Automatic Welding

The Best for SAW of Thin Steels

G-50 / US-36

A More Versatile SAW Flux/Wire

G-60 / US-36

G-50 is a fused flux for submerged arc welding (SAW) that is classified as AWS A5.17 F7A2-EH14 in combination with US-36. US-36 is a SAW solid wire of the high manganese type, which is classified as AWS A5.17 EH14. This flux and wire combination offers excellent performance at high travel speeds in sheet metals of mild and 490-MPa high tensile strength steel. Specifically, 2-mm thick steel can be welded at 300 cm/min.

On the other hand, G-60, a fused flux for SAW with the same AWS classification as G-50, is a better choice for thin and medium-thick steels when used in combination with US-36. G-60 offers stronger porosity resistance against rust, metal scales, oil, and other contaminants that adhere on the welding surfaces. G-60's low amount of flux consumed to obtain a unit amount of deposited metal also gives it an economical advantage over G-50.

G-50 / US-36 offers a glossy bead appearance (Figure 1) and smooth (hence large flank angle) weld toes (Figure 2) in sheet metal welds.

Figure 1: Bead appearance of G-50 / US-36 in a double-side single-pass weld (6-mm thick mild steel base metal; I-butt joint; 4-mmØ wire; 450A-33V-650 mm/min for 1st pass; 550A-33V-700 mm/min for 2nd pass).

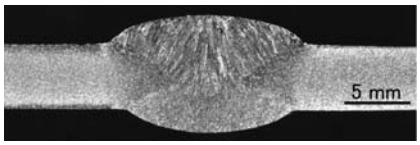


Figure 2: Macroscopic profiles of G-50 / US-36 in a double-side single-pass weld (6-mm thick mild steel base metal; I-butt joint; 4-mmØ wire; 450A-33V-650 mm/min for 1st pass; 550A-33V-700 mm/min for 2nd pass).

G-60 / US-36 is suitable for welding thicker steels due to deeper joint penetration. Figures 3 and 4 show typical macroscopic structure of the welds made by using 12- and 20-mm thick base metals with the groove preparation shown in the figure, respectively.

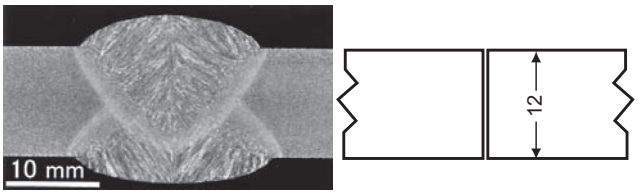


Figure 3: Macroscopic profiles of G-60 / US-36 in a double-side single-pass weld (12-mm thick mild steel base metal; I-butt joint; 4.8-mmØ wire; 700A-36V-550 mm/min. for 1st pass; 800A-38V-550 mm/min. for 2nd pass).

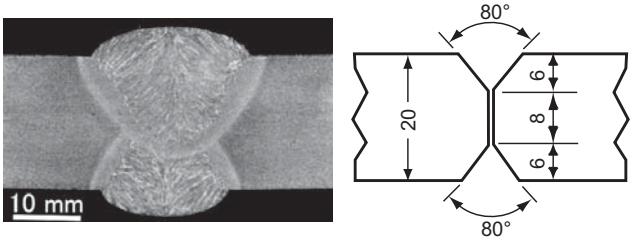


Figure 4: Macroscopic profiles of G-60 / US-36 in a double-side single-pass weld (20-mm thick mild steel base metal; Double-V joint; 4.8-mmØ wire; 750A-33V-400 mm/min. for 1st pass; 900A-38V-350 mm/min. for 2nd pass).

Table 1 shows typical chemical and mechanical properties of G-50 / US-36 and G-60 / US-36 weld metals as per AWS A5.17.

Table 1: Typical chemical and mechanical properties of G-50 / US-36 and G-60 / US-36 weld metals as per AWS A5.17.

Flux	C%	Si%	Mn%	P%	S%
G-50	0.12	0.20	1.36	0.013	0.013
G-60	0.10	0.27	1.34	0.016	0.015
Flux	**0.2%OS (MPa)**	**TS (MPa)**	**El (%)**	**2vE-29°C (J)**	**PWHT**
G-50	440	540	29	40	AW
G-60	460	560	27	40	AW

Evolution: The life of Nature, Science, and KOBELCO

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

I like this season, autumn, best in Japan. In autumn, mountains, woods, and streets become colorful as the leaves of many trees change from green to red or yellow, while some trees stay green throughout the year. It is so beautiful that a lot of people go out specifically for viewing the autumn colors. The fact there are four distinct seasons in Japan is one of my favorite things. But in cold winter, I sometimes want to escape from Japan to lands of everlasting summer like Hawaii or Bali.

In August, The International Astronomical Union dramatically altered the status of a planet under historic, new astronomical guidelines. Pluto, the ninth planet since 1930, got the boot because it does not fit the new definition that says a planet must not only orbit the sun and be large enough to assume a nearly round shape but must "clear the neighborhood around its orbit." The Union has disqualified Pluto whose oblong orbit overlaps Neptune's, downsizing the solar system to eight planets from the traditional nine. This is very surprising for me because Pluto has been a very familial planet for a long time. Although we have to accept that we have now eight planets instead of nine, Pluto is there even after it lost its status as a planet. "Science is an evolving subject and always will be," somebody said.

We, KOBELCO, will evolve our products, and we will never stop evolving the quality of our products, production system, sales system, and system for technical support.

Hope Long Lust Steady Economic Growth

Toshiyuki Okuzumi
General Manager
International Operations Dept.
Welding Company
Kobe Steel, Ltd.

This summer was very hot. On one of the hot days, I went to an exhibition of dinosaurs from around the world. Ever since I had seen the movie Jurassic Park, I have wanted to see real dinosaurs, or, rather their skeletons. The most impressive one in the exhibition was the real skeleton of a giant dinosaur that overwhelmed me by its length of 22 m. It is believed that this giant dinosaur was only 45 cm in length immediately after hatching but grew to 21 m or even bigger in 10 years. It ate as much as 500 kg of food a day and it could live more than 100 years. This tremendous speed of growth of 2 m in a year brings up in my mind the image of China's rapid economic growth.

Today, it seems to me that China is not only symbol of rapid growth with its brisk business in energy development and shipbuilding, for there is simultaneous economic expansion in every country and in most industrial fields in the world. Just as a giant dinosaur had a long life, may this global economic expansion continue stably for a long time!

There is just one similarity between a giant dinosaur and small human beings. The walking speed of a giant dinosaur was only about 4.5 km per hour! When I found this out, I had a sort friendly feeling toward a giant dinosaur. Let me suggest that you, too, visit the exhibition. You may find out some other new things.

CONTENTS

SMAW ELECTRODE COVERINGS

— Varieties and Functions —

Varieties and Classifications of Covered Electrodes

Covered electrodes for shielded metal arc welding consist of a core rod coated with a covering (flux) as shown in Figure 1.

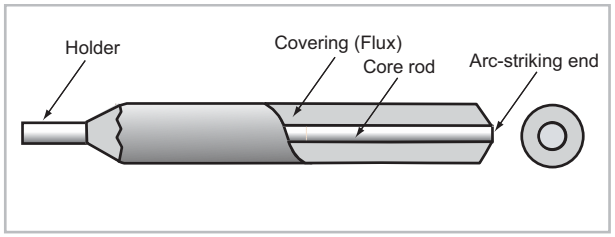


Figure 1: The structure of covered electrodes consisting of a core rod and covering flux.

A wide variety of covered electrodes are available in the world's markets. They are usually designed to suit a particular application: mild steel, high tensile strength steel, atmospheric corrosion-resistant steel, low-temperature steel, heat-resistant low-alloy steel, stainless steel, nickel and nickel alloy, copper and copper alloy, cast iron, and hardfacing. KOBELCO, for instance, produces and supplies around 130 types of covered electrodes for overseas markets to respond to the variety of customer requirements and applications.

The core rods are made of a variety of steels and alloys: mild steel, low-alloy steel, high-alloy steel (incl. stainless steel), nickel/nickel alloy, copper/copper alloy, and cast iron, and are coated with a variety of coverings according to the intended application. Covered electrodes are typically classified by the type of the covering for mild steel electrodes, by tensile strength for high tensile strength electrodes, and by chemical composition for low-alloy steel, stainless steel, nickel/nickel alloy, copper/copper alloy, and cast iron electrodes. Table 1 shows how mild steel electrodes are classified in accordance with JIS Z 3211-2000 (Covered Electrodes for Mild Steel). This JIS standard resembles the AWS Specification A5.1-2004 (Carbon Steel Electrodes for Shielded Metal Arc Welding) in that mild steel covered electrodes are classified according to the type of coverings, but differs in that this AWS specification includes 490-MPa high tensile strength electrodes (Table 2).

Table 1: Classification of mild steel covered electrodes (Extracted from JIS Z 3211-2000)

Classification	Type of coverings	Applicable welding positions	Applicable electric polarities
D4301	Ilmenite	F, V. O, H	AC, DCEP, DCEN
D4303	Lime titania	F, V. O, H	AC, DCEP, DCEN
D4311	High cellulose	F, V. O, H	AC, DCEP, DCEN
D4313	High titania oxide	F, V. O, H	AC or DCEN
D4316	Low hydrogen	F, V. O, H	AC or DCEP
D4324	Iron powder, titania oxide	F, H	AC, DCEP, DCEN
D4326	Iron powder, low hydrogen	F, H	AC or DCEP
D4327	Iron powder, iron oxide	F H	AC, DCEP, DCEN AC, DCEN
D4340	Other coverings	F, V, O, H, or any position	AC, DCEP, DCEN

Table 2: Classification of carbon steel covered electrodes (Extracted from AWS A5.1-2004)

Classification	Type of coverings	Applicable welding positions	Applicable electric polarities
E6010	High cellulose sodium	F, V, OH, H-fillet	DCEP
E6013	High titania potassium	F, V, OH, H-fillet	AC, DCEP, DCEN
E6019	Iron oxide, titania	F, V, OH, H-fillet	AC, DCEP, DCEN
E6027	High iron oxide, iron powder	H-fillet F	AC, DCEN AC, DCEP, DCEN
E7016	Low hydrogen potassium	F, V, OH, H-fillet	AC, DCEP
E7018	Low hydrogen potassium, iron powder	F, V, OH, H-fillet	AC, DCEP
E7024	Iron powder, titania	H-fillet, F	AC, DCEP, DCEN

Varieties and Functions of Electrode Covering Ingredients

The flux covering of an electrode is an essential part of the technology. If electrode's core rod were used in manual arc welding without a covering, an arc would not generate smoothly and, even if it did, it would be interrupted frequently. Consequently, the molten metal could not be continuously deposited on the base metal, and the resulting deposited metal would contain much porosity caused by nitrogen and oxygen in the air. Thus, the main functions of electrode coverings are as follows:

(1) to make a stable, concentrated arc
(2) to shield the arc and weld pool with such generated gases as CO, CO_2, H_2, and H_2O
(3) to produce slag to cover the weld metal, thereby obtaining a smooth weld bead geometry and preventing sudden cooling of the weld metal
(4) to refine the weld metal by reducing oxygen, nitrogen, sulfur, and phosphorous
(5) to add alloying elements into the weld metal
(6) to add iron powder, which proves higher deposition rates
(7) to provide electrical insulation

Approximately 100 different kings of powdered raw materials can be used for electrode coverings, including oxides, carbonates, silicates, organic substances, fluorides, and iron alloys. The covering is therefore a mixture of raw materials, combined at specified ratios. The most frequently used powdered raw materials and their functions are listed in Table 3.

Mild steel covered electrodes (except for the low hydrogen type electrode) are identified by the main ingredient in the covering — e.g. D4301 (an ilmenite type) is high in ilmenite, whereas the main ingredient in D4313 (a high titania type) is rutile (titania) — as shown in Table 4. Low hydrogen electrodes are identified as such because the covering contains a lesser amount of water and organic substances such as starch and cellulose, which in turn allows the resulting weld metal to contain lower hydrogen.

Table 3: Ingredients of coverings and their functions

Flux ingredient	Typical component	Primary function	Secondary function
Cellulose	$(C_6H_{10}O_5)_n$	Gas generation	• Deoxidation, • Strengthening of coverings
Clay	SiO_2, Al_2O_3	Slag formation	—
Talc	SiO_2, MgO	Slag formation	—
Titanium oxide	TiO_2	• Arc stability • Slag formation	—
Ilmenite	FeO, Fe_2O_3, TiO_2	• Slag formation	• Arc stability
Iron oxide	FeO, Fe_2O_3	• Slag formation • Oxidation	Arc stability
Lime carbonate	$CaCO_3$	• Gas generation	• Oxidation • Arc stability • Slag formation
Ferro-manganese	Fe-Mn	• Alloying • Deoxidation	• Slag formation
Manganese dioxide	MnO_2	• Oxidation	• Slag formation
Silica sand	SiO_2	Slag formation	—
Potassium silicate	K_2O, SiO_2	• Binding of coverings • Arc stability • Slag formation	—
Sodium silicate	Na_2O, SiO_2	• Binding of coverings • Arc stability • Slag formation	—

Table 4: Typical proportions of ingredients in coverings

Classification	D4301	D4303	D4313
Type of covering	Ilmenite	Lime titania	High titanium oxide
Ilmenite	35	—	—
Lime carbonate	6	—	4
Med-C ferromanganese	15	—	13
Manganese dioxide	5	—	—
Silica sand	10	10	—
Potash feldspar	16	—	—
Starch	5	4	2
Talc	8	—	12
Rutile	—	34	45
Dolomite	—	32	—
Feldspar	—	10	20
Mica	—	6	—
Ferromanganes	—	10	—
Cellulose	—	—	5

Table 4 (cont.): Typical proportions of ingredients in coverings

Classification	D4316	D4324	D4327
Type of covering	Low hydrogen	Iron power, titanium oxide	Iron power, iron oxide
Lime carbonate	50	2	—
Fluorite	20	—	—
Ferrosilicon	10	—	—
Med-C ferromanganese	2	—	16
Iron powder	10	60	50
Mica	7	10	—
Rutile	—	17	—
Silica sand	—	4	20
Ferromanganese	—	8	—
Starch	—	3	—
Cellulose	—	—	3
Talc	—	—	10
Potash feldspar	—	—	10
Iron ore	—	—	30

Coverings Determine the Performance of Electrodes

The following paragraphs describe the features and intended use of the major covered electrodes in each AWS classification, even though brands with the same classification may exhibit different characteristics due to the particular designs of the electrode coverings.

E6010 electrodes: These are characterized by a deeply penetrating, forceful, spray-type arc and readily removable, thin, friable slag. The coverings are high in cellulose, usually exceeding 30% by weight. These electrodes are recommended for all welding positions, particularly with multiple pass applications in the vertical and overhead welding positions. They frequently are selected for joining pipe and generally are capable of welding in the vertical-down position.

E6013 electrodes: Their flux covering makes slag removal easy and allows smooth arc transfer. This permits satisfactory operation with lower open-circuit AC voltage. The arc action tends to be quieter and the bead surface smoother with a fine ripple. The coverings are high in rutile. These electrodes are designed specifically for light sheet metal work, providing a low penetration arc. Some brands are recommended for sheet metal applications where their ability to weld satisfactorily in the vertical welding position with downward progression is an advantage. A low-fume electrode of this type is available (ZERODE-44), which emits about 30% less fumes than conventional ones.

E6019 electrodes: This type of electrode was originally developed around 1940 by using raw materials available in Japan. About one-third of the weight of the coating flux consists of ilmenite ores. These electrodes, with a fluid slag system, offer deep penetration due to a strong, spray arc and good usability in all positions. In addition, they provide good X-ray soundness, superior mechanical properties, and excellent crack resistibility. These electrodes are suitable for multi-pass welding of up to 25-mm thick steels. A low-fume electrode of this type is available (ZERODE-1), which emits about 30% less fumes than conventional ones.

E6027 electrodes: Their thick coverings contain a large amount of iron powder and account for about 50% of the weight of the electrode. These electrodes have a spray-type arc and can operate at high travel speeds. Arc penetration is medium and spatter loss is low. They produce a heavy slag that is honeycombed on the underside, friable and easily removed. The welds have a flat to slightly concave weld face with a smooth, fine, even ripple, and good wetting along the sides of the joint. This type of electrode is designed, in particular, for fillet welds with usually a 5- to 10-mm leg length single pass in the flat and horizontal welding positions. These electrodes, therefore, are also known as “fillet welding electrodes.” They are used in contact welding in which highly efficient semi-automatic welding techniques such as “gravity” and “auto-contact” are applied. When one welding operator uses three sets of the gravity devices, the welding speed can be 1 m a minute. A low-fume electrode of this type is available (ZERODE-27), which emits about 50% less fumes than conventional ones.

E7016 electrodes: These electrodes are also known as “low-hydrogen type electrodes” due to the low amounts of diffusible hydrogen contained in the weld metals. Figure 2 shows a comparison of

the diffusible hydrogen content in the weld metals of several types of covered electrodes. The low-hydrogen type electrodes are made with inorganic coverings that contain minimal moisture. The main raw material employed in the covering of this type of electrode is lime carbonate. The slag, therefore, is chemically basic. The slag is heavy, friable, and easy to remove. The arc is moderately penetrating. The weld face is convex. In addition to their use on mild steel, E7016 electrodes are also used for 490-MPa high strength steel. The low-hydrogen type electrodes are suited for medium to thick base metals due to superior crack resistibility. As is common with all low-hydrogen type electrodes, the back-stepping technique should be used when starting the arc, and a short arc length should be maintained at all times. These techniques are effective in preventing the occurrence of porosity. In E7016 electrodes the "uranami" welding electrode or the one-side welding electrode is available (LB-52U), which is exclusively used for root passes. An electrode that emits about 25% less fumes than conventional ones is available (ZERODE-55).

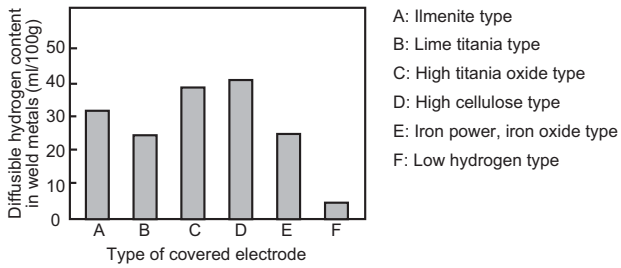


Figure 2: A comparison of diffusible hydrogen content in weld metals of several different types of covered electrodes (measured by the glycerol displacement method)

E7018 electrodes: The coverings of these electrodes are similar to those of E7016, except for the addition of a relatively high percentage of iron powder and slightly increased thickness. Consequently, the deposition rates of E7018 electrodes are higher, and they can be used at higher travel speeds. In addition, E7018 electrodes offer better usability with DC currents than E7016 electrodes. A smooth, quiet arc, low spatter, and medium arc penetration characterize E7018 electrodes. The fillet welds made in the horizontal and flat welding positions have a slightly convex weld face, with a smooth and finely rippled surface. E7018 electrodes are suitable for medium to thick base metals due to excellent crack resistance.

E7024 electrodes: Their coverings contain large amounts of iron powder in combination with ingredients similar to those used in E6013 electrodes. The coverings are thick, usually amounting to about 50% of the weight of the electrode, which allows higher deposition rates. E7024 electrodes are well suited for making fillet welds in the flat or horizontal positions. A smooth, quiet arc, low spatter, low arc penetration, and excellent slag removal characterize these electrodes. The weld face is slightly convex to flat, with a smooth surface and a fine ripple. They can be used at high travel speeds. Some brands can also be used in gravity and auto-contact welding. E7024 is also available in a version (ZERODE-43F) that emits about 30% less fumes than conventional ones.

Table 5 compares major covered electrodes for mild steel in terms of welding performance, mechanical properties, chemical composition, and suitable applications. As regards welding performance, E6013 electrodes offer excellent usability (glossy bead appearance, self-peeling slag removal, less undercut, and low spatter). Excellent weldability and superior crack resistance characterizes E7016 electrodes. E6027 electrodes provide excellent welding efficiency due to superior deposition rates. E6010 electrodes provide excellent welding efficiency due to higher melting rates. With respect to mechanical properties, E7016 electrodes offer higher tensile strength, ductility, and impact value. Higher manganese and silicon in the weld metal characterize E7016 electrodes.

For vertical down welding of steel pipes, E6010 electrodes are suitable due to low amounts of slag. Sheet metal is the typical application for E6013 electrodes due to shallow penetration. E6019 electrodes are most versatile due to good welding performance, good mechanical properties, and a wide range of applications from medium to thick work. For fillet welding, E6027 electrodes are indispensable due to higher efficiency and excellent bead appearance. For welding of heavy thick work, E7016 electrodes are a must due to excellent crack resistance.

Table 5: A comparison between major covered electrodes for mild steel in terms of quality and application

AWS classification		E6010	E6013	E6019	E6027	E7016
Type of coverings		High cellulose	High titania potassium	Iron oxide, titania potassium	High iron oxide, iron powder	Low hydrogen potassium
Welding performance	Usability	Fair	Excellent	Good	Excellent	Fair
	Weldability	Fair	Fair	Good	Fair	Excellent
	Efficiency	Excellent	Fair	Good	Excellent	Fair
Mechanical (1) properties	Yield strength (MPa)	420	450	410	440	500
	Tensile strength (MPa)	490	510	460	500	570
	Elongation (%)	27	25	32	30	32
	Impact value (J)	82 (0°C)	60 (0°C)	110 (0°C)	78 (0°C)	210 (0°C)
Chemical (1) composition	C%	0.12	0.08	0.10	0.07	0.08
	Mn%	0.51	0.37	0.43	0.69	0.94
	Si%	0.18	0.30	0.10	0.41	0.60
Application		Vertical down welding of steel pipes	General use for sheet metals	General use for medium to thick steels	Fillet welding of medium to thick steels	General use for medium to heavy-thick steels

1. Mechanical properties and chemical compositions show typical values of particular brands.

Moisture Absorption and Redrying

Electrode coverings can absorb moisture in the air unless appropriate protective measures are taken. Moisture absorption rates can vary within the same atmospheric condition depending on the type of coverings. Low hydrogen type covered electrodes pick up moisture more slowly than ilmenite type covered electrodes as shown in Figure 3. This is because the covering of low hydrogen type electrodes contains no organic substance. With the same type of coverings, the moisture absorption rate can vary in relation to the temperature and humidity of the atmosphere as shown in this figure.

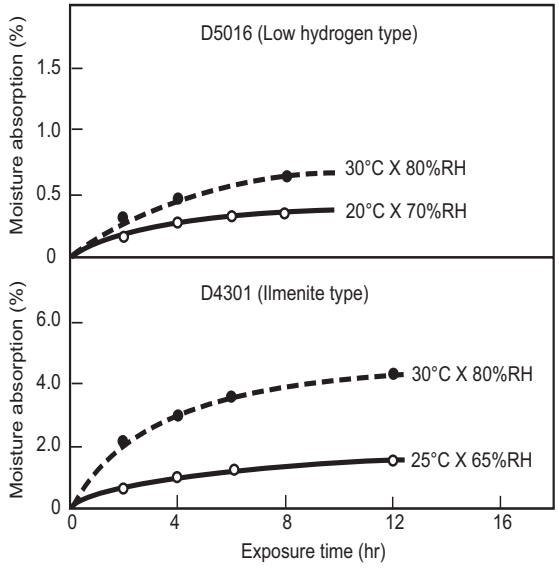


Figure 3: A comparison of moisture absorption rates of low hydrogen and ilmenite type covered electrodes.

If a covered electrode has picked up moisture, its welding performance may be degraded; the typical signs of degraded performance are
(1) a stronger and unstable arc
(2) increased spatter
(3) deeper penetration and increased undercut
(4) irregular slag covering and a rough bead face
(5) poor slag removal
(6) cracks in the weld
(7) blowholes in the weld metal

The adverse effects caused by moisture absorption depend on the type of electrode. In the case of low hydrogen electrodes, small amounts of absorbed moisture should be noted because this type of electrode is commonly used in heavy thick work that tends to cause hydrogen-assisted cracking. Therefore, redrying or conditioning the electrodes is necessary prior to use in order to restore the low hydrogen character. For electrodes that are not low-hydrogen, such as those classified as E6013, E6019, and E6027, redrying before use is needed to restore their usability and X-ray soundness when they pick up excessive moisture.

When redrying covered electrodes, control of the drying temperature and time is important. Excessively high temperatures may cause decomposition of gas generating and deoxidizing ingredients in the coverings, which can lead to blowholes in and degraded mechanical properties of the weld metal. Excessively long redrying times can deteriorate the electrode coverings.

Goodbye and Hello KWS

After seven years at Kobe Welding Singapore (KWS), I came back to the International Operations Dept. in July this year. When I was assigned to KWS, the ASEAN countries were in the midst of a monetary crisis, and KWS was not spared its effect. My business life with KWS, therefore, started in severe circumstances. We had to confront many difficulties; however, by pushing through management reforms and gaining sincere cooperation from the employees, our production volume and sales eventually doubled those of seven years ago.

Back in the International Operations Dept., I am in charge of coordinating the manufacturing at bases in Thailand, Singapore, and Indonesia as well as marketing as the manager of the Asia Pacific-Middle Eastern markets. The sales target in these markets is US $200 million per year, to be achieved by expanding production and sales of Thai-Kobe Welding (TKW), Kobe MIG Wire Thailand (KMWT), KWS, Intan Pertiwi Industri (INTIWI), and ST Kobe Welding Malaysia (KWM) as well as increasing sales of Kobe Steel's products. I am determined to spare no effort to achieve this target, though I couldn't succeed without your cooperation. I hope you will extend to me as much help as you can.

Seiki Kanehira
Deputy General Manager
International Operations Dept.,
Welding Company, Kobe Steel, Ltd.

Hello from KWS

Yoshiro Takayama
Managing Director
Kobe Welding Singapore

I was assigned to KWS in June this year. Soon after coming to Singapore, I heard many Japanese living here invariably say that time elapses quickly in Singapore since there are no four distinct seasons. So, besides doing my best to make my business life productive and fulfilling, I decided to make my private life more fruitful by taking on some new activities. I became a member of an amateur orchestra, and started practicing golf under a teaching professional. Now that I am scheduled to hit the links soon, I will be fulfilling long-cherished desire. I am also taking lessons in yoga to keep fit.

KWS was established in 1979, and it will celebrate its 30th anniversary in 2009. They say that a company has achieved success if it operates for 30 years. It is my wish to hail the 30th year by maintaining our present good business performance. For the successful management of KWS into the future, I believe in "co-existence and co-prosperity." Though it sounds like a cliche, it is very important. While the astute prowess of former managing directors enabled KWS to develop into a well-established business corporation, we must not forget that the support shown by trading companies, dealers, subcontractors, the Welding Company of Kobe Steel and the KOBELCO group companies in neighboring countries has been essential in creating the present prosperity. Thanks to the firm support shown by them all, KWS can sell its products to shipbuilders, offshore structure fabricators and petrochemical industries in Singapore and Malaysia and has expanded its export territory that now covers Middle East and Korea.

When I was in the International Operations Dept., I was in charge of all of KOBELCO's world markets, which required me to travel 18 countries in all. I wish to use my experience to contribute to building up such strength that KWS can continue to grow steadily in whatever environment develops and step forward toward the next 30 years and pursue a dream of everlasting prosperity together with the KOBELCO group companies.

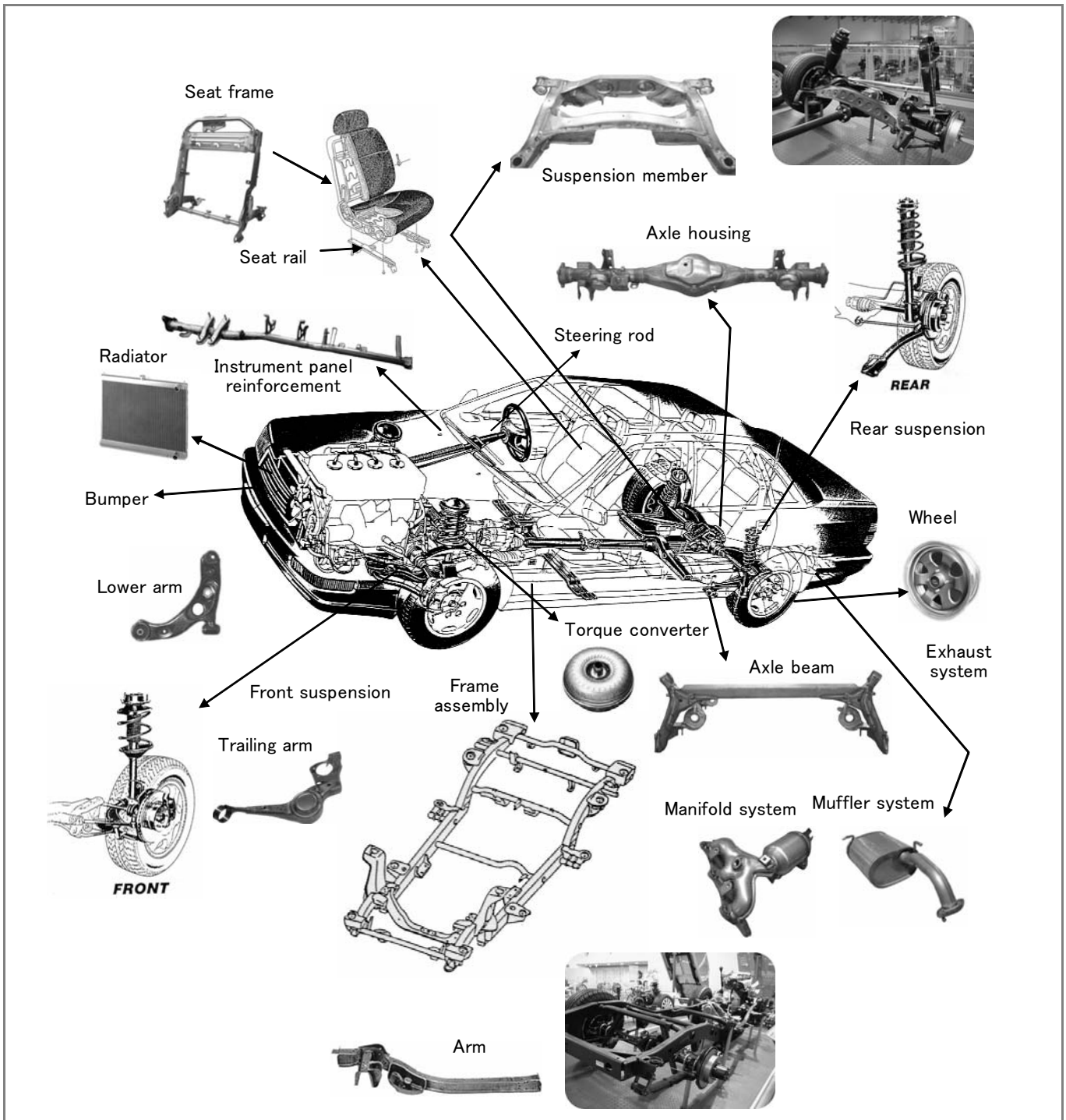
KOBELCO GMAW WIRES FOR AUTO PARTS

KOBELCO GMAW wires satisfy diversified customer requirements: lower spatter, higher travel speeds, higher resistance to burn through in sheet metals, deeper penetration in thicker steels, and better porosity resistance in galvanized steel sheets. The following quick guide suggests the most appropriate wires for particular base metals, shielding gases, and power sources for welding auto parts.

A Quick Guide to Gas Metal Arc Welding Wires for Auto Parts

Name of part (1)	Type of steel (2) (Plate thickness)	Welding method	Recommended brand (3)	Wire diameter
• Frame assembly • Lower and upper arm • Axle beam • Axle housing • Torque converter	Mild steel and 490-MPa high tensile strength steel plate (2.6-4.0 mm thick.)	CO_2	MG-51T	1.2-1.6 mmØ
		MAG, Pulsed MAG	MIX-50 MIX-1TS	
• Impact beam • Bumper reinforcement	Mild steel and 490-MPa high tensile strength steel plate (1.4-2.3 mm thick.)	CO_2	MG-51T	1.2 mmØ
		MAG, Pulsed MAG	MIX-50 MIX-1TS	
• Suspension member (Cross member)	Mild steel and 490-MPa high tensile strength steel plate (1.6-2.6 mm thick.)	CO_2	MG-51T	1.2 mmØ
		MAG, Pulsed MAG	MIX-50 MIX-1TS	
	Galvanized steel plate (1.6-2.6 mm thick.)	CO_2	MG-1Z	1.2 mmØ
		MAG, Pulsed MAG	MIX-1TS MIX-1Z	
	Anti-corrosion steel plate (1.6-2.6 mm thick.)	Pulsed MAG	MIX-1TS	
• Instrument panel reinforcement • Seat frame	Mild steel and 490-Mpa high tensile strength steel plate (0.8-1.6 mm thick.)	CO_2	MG-51T	0.8-1.0 mmØ
		MAG	MIX-50	
• Body exterior plate • Pillar reinforcement	Galvanized steel plate (0.6-1.1 mm thick.)	MAG + Variable polarity power source	MIX-50	0.6-0.9 mmØ
• Exhaust muffler • Exhaust manifold	Stainless steel plate (0.8-2.0 mm thick.)	MAG	MXA-430M (Ferritic)	1.2 mmØ
		Pulsed MIG	MGS-430M (Ferritic) MGS-308 (Austenitic) MGS-309 (Austenitic)	1.2 mmØ

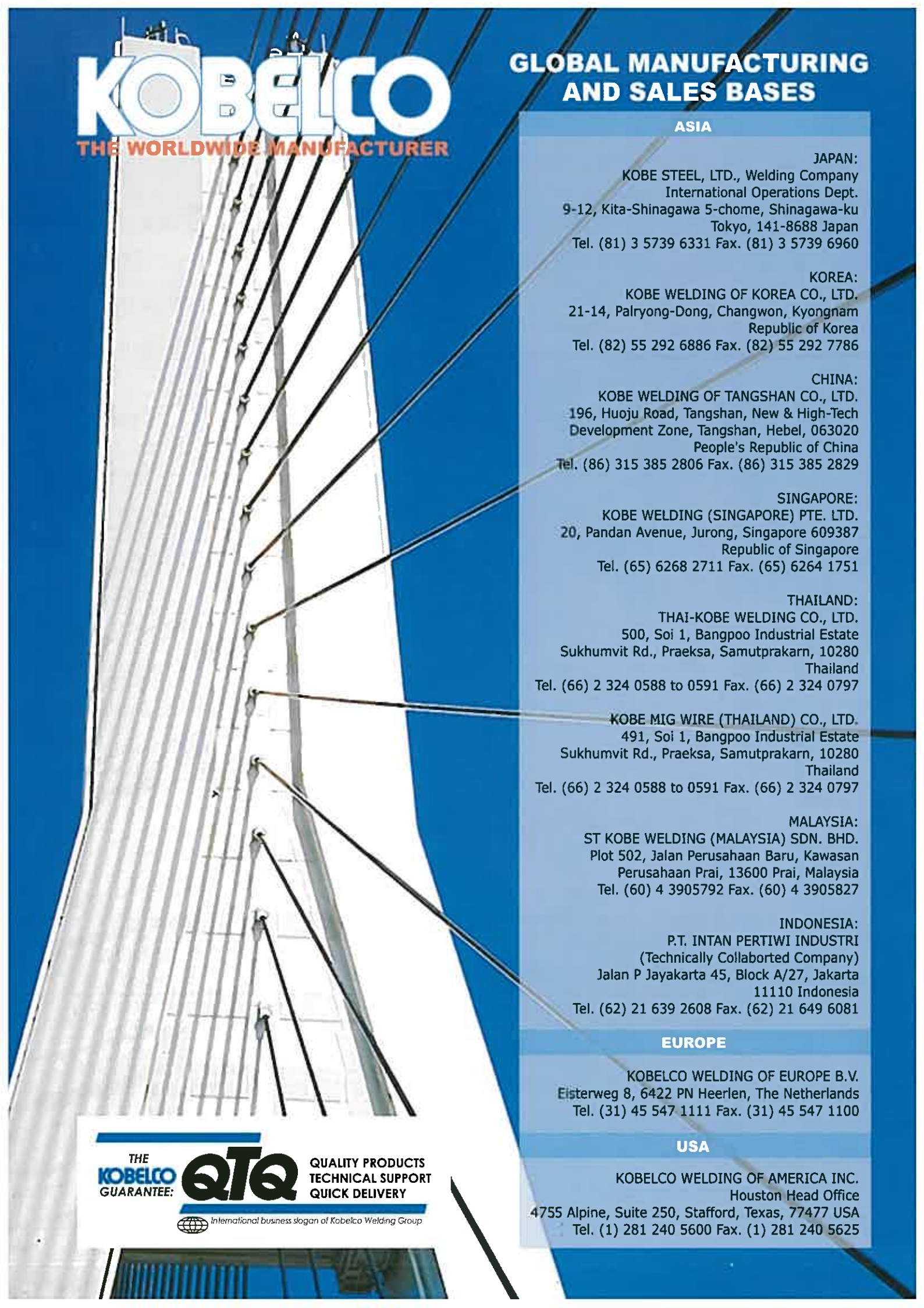
1. Refer to the figure on the right page.
2. For higher tensile strength steel, matching welding wires may be necessary.
3. Other brands may also be suitable depending on the application.



Auto parts where gas metal arc welding may be applied

KOBELCO WELDING TODAY
October 2006 Vol. 9 (No. 4)

Publisher:
International Operations Dept., Welding Company, Kobe Steel, Ltd.
Editor:
KOBELCO WELDING TODAY Editorial Staff
URL: http/www.kobelco.co.jp
E-mail: iod@melts.kobelco.co.jp



GLOBAL MANUFACTURING AND SALES BASES

ASIA

JAPAN:
KOBE STEEL, LTD., Welding Company
International Operations Dept.
9-12, Kita-Shinagawa 5-chome, Shinagawa-ku
Tokyo, 141-8688 Japan
Tel. (81) 3 5739 6331 Fax. (81) 3 5739 6960

KOREA:
KOBE WELDING OF KOREA CO., LTD.
21-14, Palryong-Dong, Changwon, Kyongnam
Republic of Korea
Tel. (82) 55 292 6886 Fax. (82) 55 292 7786

CHINA:
KOBE WELDING OF TANGSHAN CO., LTD.
196, Huoju Road, Tangshan, New & High-Tech
Development Zone, Tangshan, Hebel, 063020
People's Republic of China
Tel. (86) 315 385 2806 Fax. (86) 315 385 2829

SINGAPORE:
KOBE WELDING (SINGAPORE) PTE. LTD.
20, Pandan Avenue, Jurong, Singapore 609387
Republic of Singapore
Tel. (65) 6268 2711 Fax. (65) 6264 1751

THAILAND:
THAI-KOBE WELDING CO., LTD.
500, Soi 1, Bangpoo Industrial Estate
Sukhumvit Rd., Praeksa, Samutprakarn, 10280
Thailand
Tel. (66) 2 324 0588 to 0591 Fax. (66) 2 324 0797

KOBE MIG WIRE (THAILAND) CO., LTD.
491, Soi 1, Bangpoo Industrial Estate
Sukhumvit Rd., Praeksa, Samutprakarn, 10280
Thailand
Tel. (66) 2 324 0588 to 0591 Fax. (66) 2 324 0797

MALAYSIA:
ST KOBE WELDING (MALAYSIA) SDN. BHD.
Plot 502, Jalan Perusahaan Baru, Kawasan
Perusahaan Prai, 13600 Prai, Malaysia
Tel. (60) 4 3905792 Fax. (60) 4 3905827

INDONESIA:
P.T. INTAN PERTIWI INDUSTRI
(Technically Collaborted Company)
Jalan P Jayakarta 45, Block A/27, Jakarta
11110 Indonesia
Tel. (62) 21 639 2608 Fax. (62) 21 649 6081

EUROPE

KOBELCO WELDING OF EUROPE B.V.
Eisterweg 8, 6422 PN Heerlen, The Netherlands
Tel. (31) 45 547 1111 Fax. (31) 45 547 1100

USA

KOBELCO WELDING OF AMERICA INC.
Houston Head Office
4755 Alpine, Suite 250, Stafford, Texas, 77477 USA
Tel. (1) 281 240 5600 Fax. (1) 281 240 5625

THE KOBELCO GUARANTEE: QTQ
QUALITY PRODUCTS
TECHNICAL SUPPORT
QUICK DELIVERY

International business slogan of Kobelco Welding Group