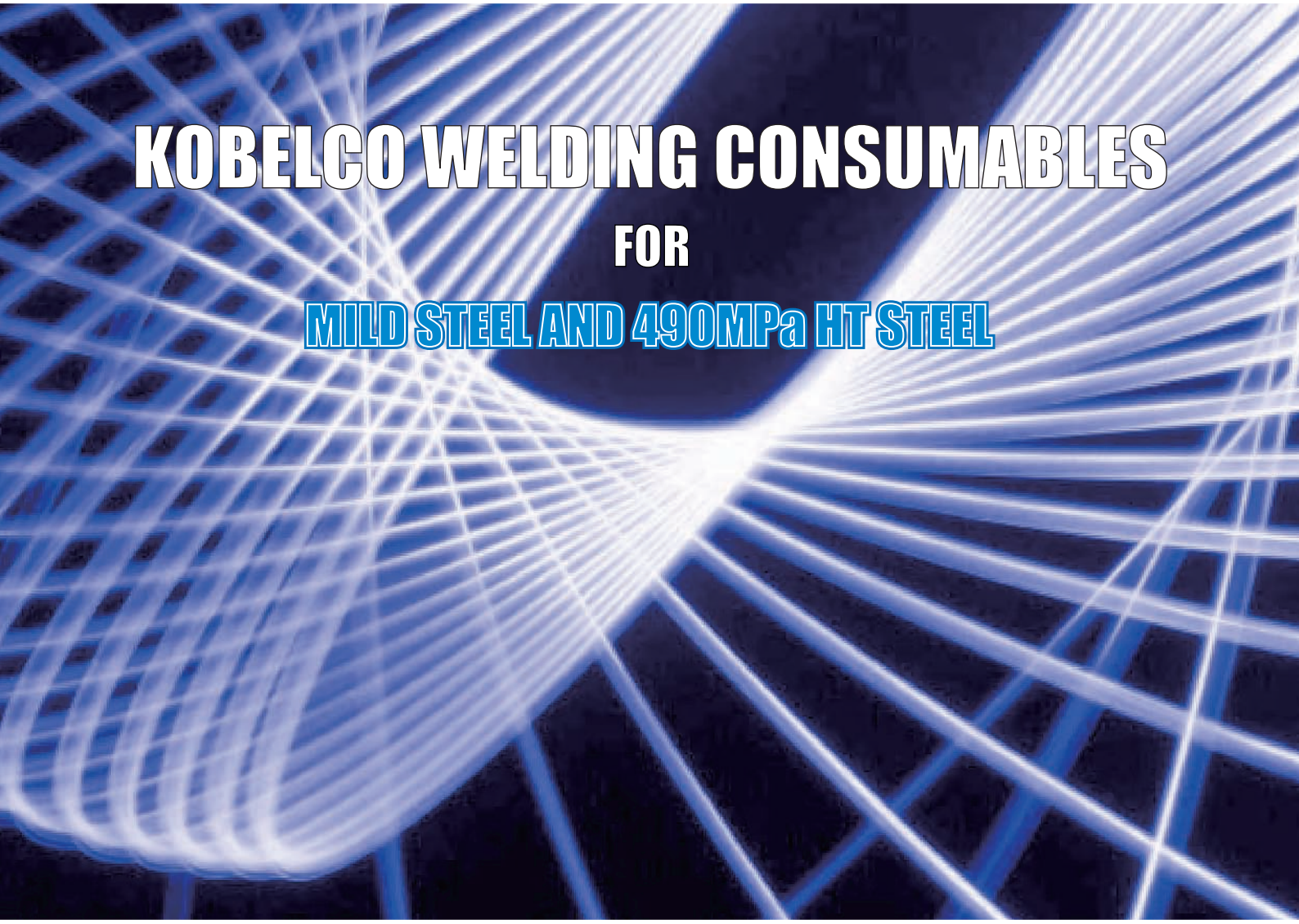
KOBELCO

2nd Special Edition

WELDING TODAY



KOBELCO WELDING CONSUMABLES FOR MILD STEEL AND 490MPa HT STEEL

KOBELCO

A Quick Guide to Suitable Welding Consumables for Mild Steel and 490MPa High Tensile Strength Steel

❑ For Shielded Metal Arc Welding (SMAW)

Applications	Brand name*1	AWS classification	Features
Thin to medium plate joints	[F] **RB-26**	A5.1 E6013	Capable of vertical downward welding.
	[F] **Z-44**	A5.1 E6013	Lower fume emissions.
	[F] **B-33**	A5.1 E6013	Better bead appearance.
	[F] **B-10**	A5.1 E6019	Deeper penetration than E6013.
	[F] **B-14**	A5.1 E6019	Better X-ray soundness.
	[F] **B-17**	A5.1 E6019	Higher resistance to hot cracking.
Thick plate joints	[F] **LB-26**	A5.1 E7016	For mild steel. Higher deposition rates.
	[F] **LB-47**	A5.1 E7016	For mild steel. Better X-ray soundness.
	[F] **LB-52**	A5.1 E7016	Typical electrode for 490MPa HT steel.
	[F] **LB-M52**	A5.1 E7016	Extra-low hydrogen. Harmless fumes.
	[F] **LB-52A**	A5.1 E7016	Extra-low hydrogen. HIgher resistance to cold cracking.
	[F] **LB-52UL**	A5.1 E7016	Ultra-low hydrogen. Moisture resistant.
	[F] **LB-57**	A5.1 E7016	Suitable for 520MPa HT steel. Extra-low hydrogen.
	[F] **LB-76**	A5.5 E7016-G	Suitable for 520MPa HT steel.
	[F] **LB-52RC**	A5.1 E7016	Suitable for HIC resistant steel.
	[F] **LB-52-18**	A5.1 E7018	Higher deposition rates. Better usability with DCEP.
	[T] **LB-7018-1**	A5.1 E7018-1	Higher deposition rates. Excellent low-temp notch toughness.
Horizontal and flat fillets	[F] **LT-B52A**	A5.1 E7018	Typical electrode for 490MPa HT steel.
	[F] **KOBE-7024**	A5.1 E7024	Suitable for manual and gravity welding.
	[F] **LT-B50**	-	Non-low hydrogen. Not suitable for thick sections.
Pipelines	[F] **KOBE-6010**	A5.1 E6010	Suitable for API grades of up to X52.
	[F] **KOBE-7010S**	A5.5 E7010-P1	Suitable for API grades of X52-X60.
	[F] **KOBE-8010S**	A5.5 E8010-P1	Suitable for API grades of X60-X70.
	[F] **LB-78VS**	A5.1 E7048	Extra-low hydrogen. Vertical downward welding.
	[F] **LB-88VS**	A5.5 E8018-G	Extra-low hydrogen. Vertical downward welding.
	[F] **LB-98VS**	A5.5 E9018-G	Extra-low hydrogen. Vertical downward welding.
Root passes	[F] **LB-52U**	A5.1 E7016	Unsurpassed penetration bead appearance.
Tacking	[F] **LB-52T**	A5.1 E7048	Excellent re-arcing with a low hydrogen coating.

1. [F] designates FAMILIARC™. [T] designates TRUSTARC™.

Tips for successful welding results

1. This guidance is to help users select appropriate welding consumables. Users are requested to confirm whether the selected brand can satisfy the job requirements before use.
2. Suitable electric polarity for SMAW electrodes are as follows: AC, DCEN or DCEP for EXX13, EXX19, and EXX24; AC or DCEP for EXX16, EXX18 and EXX48; DCEP for EXX10. Wires for FCAW and GMAW use DCEP (DW-A51B uses DCEN). For SAW flux-wire combinations, AC is recommended. Electric polarity can affect the usability of welding consumables and the chemical composition and mechanical properties of weld metals; therefore, it is recommended to confirm the performance of the consumable you selected, using the polarity of a power source available for a particular job.
3. The trade designations with a prefix of G or MF are fused-type fluxes for SAW, whereas those that begin with PF are bonded-type fluxes. The trade designations shown with a prefix of DW or MX are flux-cored wires, whereas those denoted with a prefix of MG or MIX are solid wires. Shielding gas composition can affect the usability of a wire, the chemical composition and mechanical properties of the weld metal.
4. The mechanical properties of weld metals can be affected by preheat and interpass temperatures and welding heat input. Therefore, these parameters must be controlled during welding to assure the weld quality.
5. For details of individual brands, refer to KOBELCO WELDING HANDBOOK.

❑ For Flux Cored Arc Welding (FCAW)

Applications	Brand name*1	AWS classification	Features	Shielding gas
Thin plate joints	[F] **MX-100T**	A5.18 E70C-6C/6M	Stable short-circuiting arc. Little slag.	CO_2 or Ar+CO_2
Medium plate joints	[F] **DW-100**	A5.20 E71T-1C	Higher deposition rates in all position welding.	CO_2
	[F] **DW-100V**	A5.20 E71T-1C	Higher deposition rates in vertical-up welding.	CO_2
	[F] **DW-100E**	A5.20 E71T-9C	Suitable for ship-class E-grade steels.	CO_2
	[F] **DW-50**	A5.20 E71T-1C/1M, 9C/9M	Suitable for ship-class E-grade steels.	CO_2 or Ar+CO_2
	[F] **DW-A50**	A5.20 E71T-1M	Superior usability with low spatter.	Ar+CO_2
	[F] **DW-A51B**	A5.20 E71T-5M-J	Better crack resistance with DCEN. Basic-type flux.	Ar+CO_2
Medium to thick plate joints	[F] **MX-100**	A5.20 E70T-1C	Higher deposition rates. Little slag.	CO_2
	[F] **MX-A100**	A5.18 E70C-6M	Higher deposition rates. Little slag.	Ar+CO_2
Horizontal and flat fillets	[F] **DW-200**	A5.20 E70T-1C	Larger legs. Better bead appearance and shape.	CO_2
	[F] **MX-200**	A5.20 E70T-1C	Higher resistance to inorganic zinc primer.	CO_2
	[F] **MX-A200**	A5.20 E70T-1M	Higher resistance to inorganic zinc primer.	Ar+CO_2
	[F] **MX-200E**	A5.20 E70T-9C	Suitable for ship-class E-grade steels.	CO_2
	[F] **MX-200H**	A5.20 E70T-1C	Higher speeds on inorganic primer coated plates.	CO_2

1. [F] designates **FAMILIARC™**.

❑ For Gas Metal Arc Welding (GMAW)

Applications	Brand name*1	AWS classification	Features	Shielding gas
Thin to medium plate joints	[F] **MG-51T**	A5.18 ER70S-6	Stable short-circuiting arc. All-position welding.	CO_2 or Ar+CO_2
	[F] **MG-50T**	-	Stable short-circuiting arc. All-position welding.	CO_2 or Ar+CO_2
	[F] **MIX-50**	A5.18 ER70S-3	Stable arc with lower currents.	Ar+CO_2
	[F] **MIX-50S**	A5.18 ER70S-G	Stable spray arc with higher currents.	Ar+CO_2
Thick plate joints	[F] **MG-50**	A5.18 ER70S-G	Stable arc with higher currents.	CO_2
	[F] **MG-S50**	A5.18 ER70S-G	Superior usability and mechanical properties.	Ar+CO_2

1. [F] designates **FAMILIARC™**.

❑ For Gas Tungsten Arc Welding (GTAW)

Applications	Brand name*1	AWS classification	Features	Shielding gas
Thin to thick plate joints	[F] **TG-S51T**	A5.18 ER70S-6	Superior properties after long time PWHT.	Ar
	[F] **TG-S50**	A5.18 ER70S-G	Suitable for Al-killed steels for low temp.	Ar
Root pass in pipe joints	[F] **NO65G**	A5.18 ER70S-2	More resistible to rusty surfaces.	Ar

1. [F] designates **FAMILIARC™**.

❑ For Submerged Arc Welding (SAW)

Applications	Brand name*1	AWS classification	Features
Thin plate joints	[F] **G-50** / [F] **US-36**	A5.17 F7A2-EH14	Suitable for high speed welding.
Thin to medium plate joints	[F] **G-60** / [F] **US-36**	A5.17 F7A2-EH14	Suitable for high speed welding.
	[F] **PF-H45** / [F] **US-43**	A5.17 F6A4-EL8	Suitable for single or 4-5 multi-pass welding.
Medium to thick plate joints	[F] **G-80** / [F] **US-36**	A5.17 F7A2-EH14 F6P2-EH14	Good performance in multi-pass welding.
	[F] **MF-38** / [F] **US-36**	A5.17 F7A6-EH14 F7P6-EH14	Better porosity resistance and X-ray soundness.
	[F] **MF-300** / [F] **US-36**	A5.17 F7A6-EH14 F7P6-EH14	Better slag detachability.
	[F] **PF-H55E** / [F] **US-36**	A5.17 F7A4-EH14	Double-sided two-pass or multi-pass welding.
Horizontal and flat fillets	[F] **MF-53** / [F] **US-36**	A5.17 F7A0-EH14	Better bead appearance and slag detachability.

1. [F] designates **FAMILIARC™**.

FAMILIARC™ DW-100

AWS A5.20 E71T-1C

An unsurpassed rutile flux-cored wire for mild steel and 490MPa high tensile strength steel, which is highly reputed for solid ultimate performance.

Inception of DW-100

DW-100 was developed for welding mild steel and 490MPa high tensile strength steel and launched into the world of arc welding nearly 30 years ago. The prefix of the trade designation, DW, was coined from the words, Dual Wire, because the wire consists of steel sheath and cored flux. This development provided the momentum for shipbuilders and bridge constructors in particular to employ semiautomatic and automatic welding with DW-100 instead of shielded metal arc welding with covered electrodes. This is why DW-100 is called an epoch-making flux-cored wire.

Outstanding features

The most remarkable features of DW-100 when used with CO_2 gas shielding are the following.

(1) Adjusting once a certain proper welding current within a wide range of amperage and voltage for each size of wire shown in Figure 1, there is no need to re-adjust the current position by position in all-position welding.

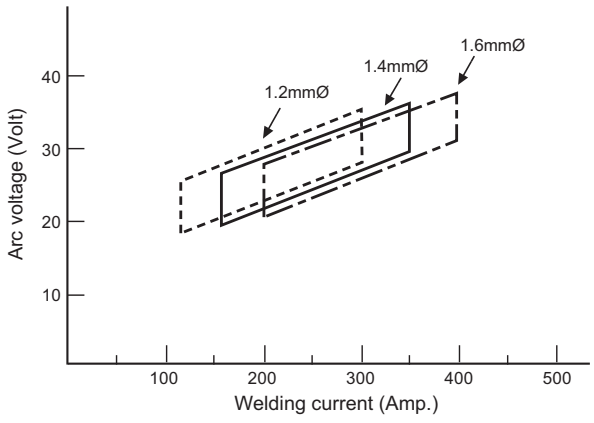


Figure 1: Proper ranges of welding current and arc voltage for each size of DW-100.

(2) Much less spattering improves the welding environment and reduce downtime for removing spatter on the weld — Figure 2.

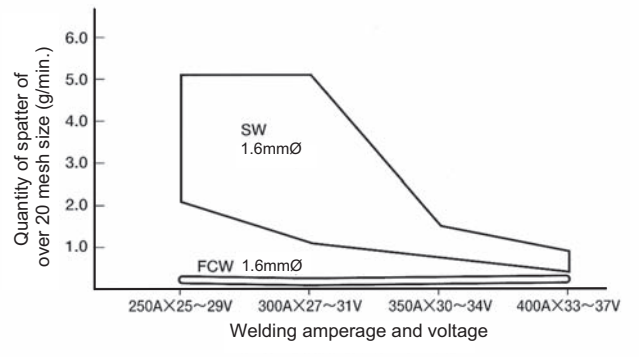


Figure 2: A comparison between DW-100 flux cored wire (FCW) and conventional solid wire (SW) on the amount of spatter in CO_2 gas arc welding.

(3) Convenient self-peeling slag removal and glossy bead appearance reduce postweld cleaning time — Figure 3.

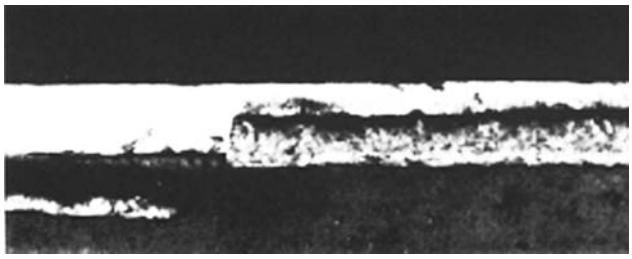


Figure 3: Convenient self-peeling slag removal and glossy bead appearance with DW-100 in horizontal fillet welding.

(4) Regular bead profiles and smooth fusion with base metal — Figure 4.

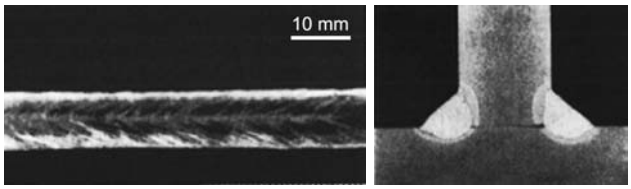


Figure 4: Regular bead appearance and smooth fusion with the base metal in horizontal fillet welding with DW-100.

(5) High deposition rates can save labor costs by reducing welding time — Figure 5.

(6) Consistent mechanical properties of tensile strength and Charpy impact toughness of the weld metal — Table 1.

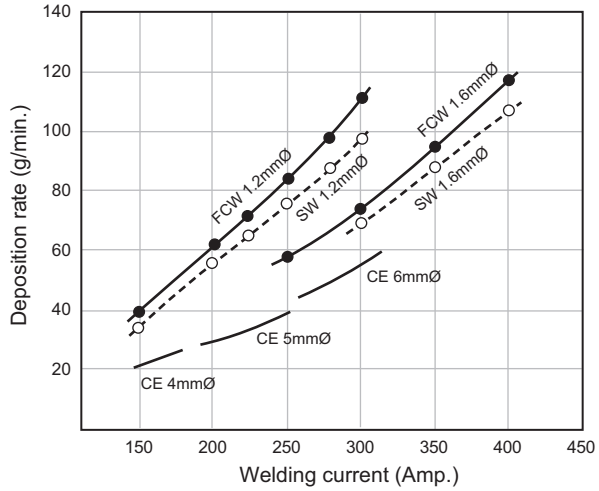


Figure 5: A comparison on deposition rates between DW-100 (FCW), conventional solid wire (SW) and covered electrode (CE) — wire extension: 25 mm, shielding gas: CO_2.

Table 1: Typical chemical and mechanical properties of DW-100 weld metal tested per AWS A5.20

C	Si	Mn	P	S
0.05	0.45	1.35	0.013	0.009
0.2% OS (MPa)	TS (MPa)	El (%)	IV (J)	
510	570	30	–18°C: 85	

A leader of flux-cored wire

Since DW-100 was launched into the market, production of flux-core wires has ever increased. This is because of ever increasing consumption of flux-cored wires not only in shipbuilders and bridge constructors but also in other various industries throughout the world. Nowadays annual production of flux-cored wires in Japan has reached over 125,000 metric tons, accounting for about 35.5% as shown in Figure 6. Among flux-cored wires, DW-100 is one of the leaders.

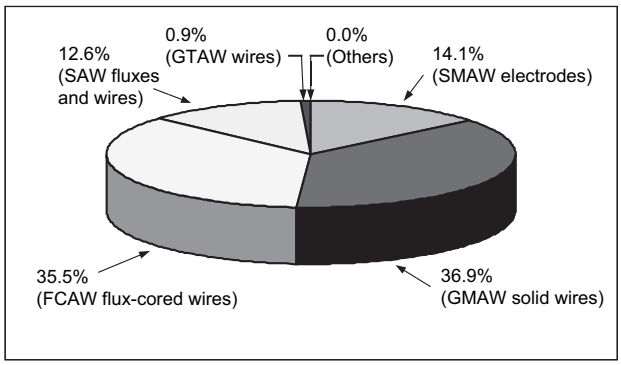
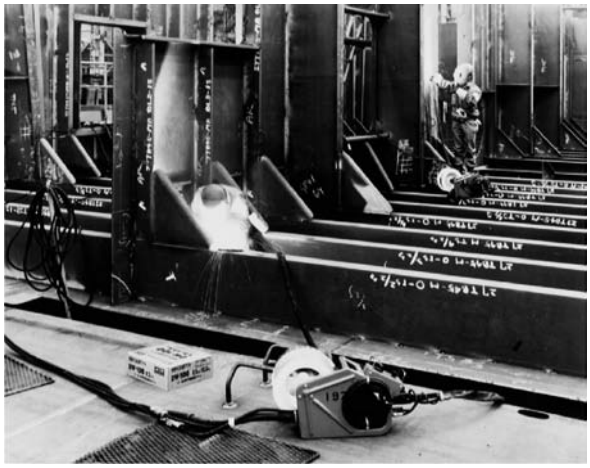


Figure 6: Annual production ratios of welding consumables in Japan in 2007 (Developed with data from Ref. 1)

A variety of applications

Nowadays DW-100 is used in various applications in such industries as shipbuilding, architectural structures, machinery, and bridges. Due to excellent usability, even an inexperienced welder can use DW-100 with satisfactory results. This usability includes stable wire feeding and tracking onto welding lines. DW-100 continually earns a high reputation from users in worldwide markets because of the services supported by the slogan, “QTQ” (Quality Products, Technical Support, and Quick Delivery) launched by Kobe Steel and the Kobelco group companies.



DW-100 shines in various applications in such industries as shipbuilding, architectural structures, bridges and machinery.

New things in the traditional

During these three decades, DW-100 has seen its features refined, and applications expanded. In order to maintain the outstanding features of DW-100, the quality control in production is the very matter Kobe Steel stresses. DW-100 is a traditional flux-cored wire, but, at the same time, highly advanced in that the quality of DW-100 has been maintained through advanced research and production engineering.

» Reference «

[1] Statistic News. Welding Technology, Vol. 56, 4/2008, Sanpo Publications Inc.

FAMILIARC™ MX-200

AWS A5.20 E70T-1C

MX-200 can release you from the headache of porosity in the fillet welding of shop-primer-paint-coated steel plates in horizontal and flat positions

Basic characteristics

MX-200 is a metal type flux cored wire suited for fillet welding of mild steel and 490 Mpa high tensile strength steel painted with shop primer. The M of the trade designation stands for Metal, while X reflects the expectation excellence. MX-200 was developed as an exclusive-use flux-cored wire for fillet welding in the horizontal and flat positions with CO_2 gas shielding.

How shop primer causes porosity

Shop primer is a coat of paint applied to the surface of steel plates in order to protect them from rusting during a long fabrication period. Shop primer is often used in shipbuilding and bridge construction. Shop primer can be a predominant cause of porosity in fillet welds. Porosity is believed to occur because the arc heat decomposes shop primer into several gases and metallic vapors, which form pores in the weld metal. The degree of porosity depends on the type and coating thickness of the shop primer, the type of welding wire and welding parameters.

Advantages characteristics

A typical flux-cored wire can overcome the porosity problem caused by shop primer if the welding speed is reduced or if the shop primer is partly removed from where the fillet welds will be laid on.

However, if you need to do fillet welding much more effectively, using higher welding speeds and without removing shop primer, you will encounter the porosity problem.

Figure 1 shows the results of testing different types of welding wires and a wide range of welding speeds for porosity in fillet welding. It clearly shows that MX-200 is far more resistant to shop primer than conventional rutile-type flux-cored wire and solid wire at a wide range of welding speeds.

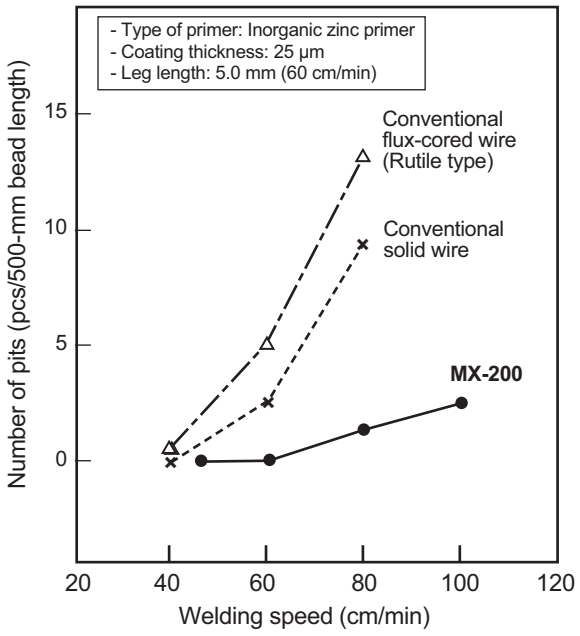


Figure 1: The results of testing the porosity resistance of MX-200 in comparison with conventional rutile-type flux-cored wire and solid wire in the fillet welding of shop-primer coated steel plates.

Besides better resistance to shop primer, MX-200 provides the following advantages:

(1) Glossy, smooth bead appearance due to thin, regular slag covering.
(2) Regular bead profile at a wide range of welding speeds due to excellent fusion at the toe of the fillet weld.
(3) Less spatters due to smooth droplet transfer.
(4) Smaller leg length (approx. 4mm) can be made more easily due to a stable arc at lower amperage.

Figure 2 shows an example of bead appearance and a cross sectional profile of a fillet weld using MX-200. It shows smooth, regular bead appearance and regular leg length with proper penetration at the root of the fillet weld.

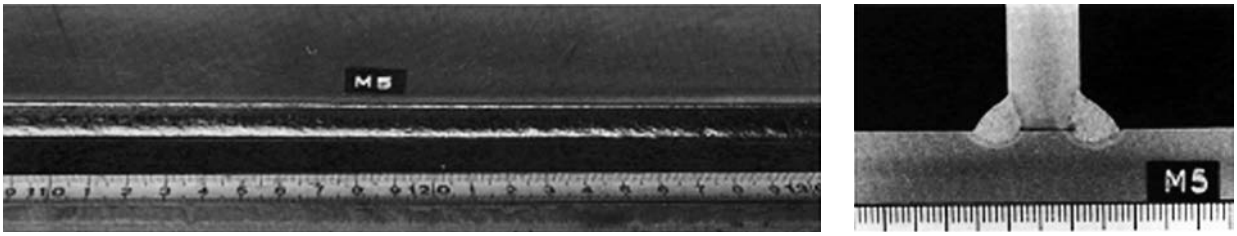


Figure 2: Bead appearance and cross-sectional macrograph of a fillet weld
(MX-200, 1.2mmØ, 280Amp., 28-32volt, 50cm/min.)

In addition to excellent resistance against shop primer and unsurpassed usability, MX-200 is well-suited for high speed welding. Figure 3 shows the relationship between welding speed and leg length of fillet welds. You can determine the required welding speed for different leg lengths using this figure.

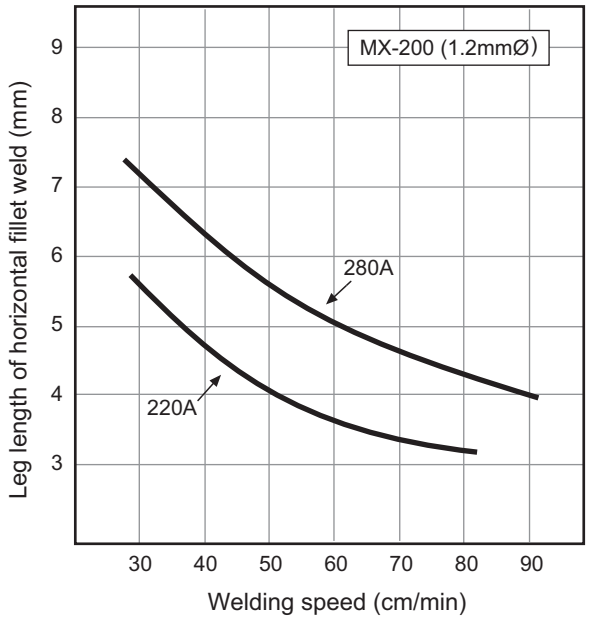


Figure 3: The relationship between welding speed and fillet leg length as a function of welding current.

Suitable for automatic welding

MX-200 persistently earns a good reputation among users in shipbuilding, bridge construction, machinery fabrication, railway-car fabrication, steel structure fabrication due to the outstanding features:

(1) Excellent resistant to shop primer
(2) Excellent usability
(3) Excellent high speed weldability

MX-200 can be used in automatic welding as well as semi-automatic welding. Figure 4 shows an example of an automatic welding process in which a portable fillet-welding carriage and MX-200 are used in fillet welding of longitudinal components in shipbuilding.

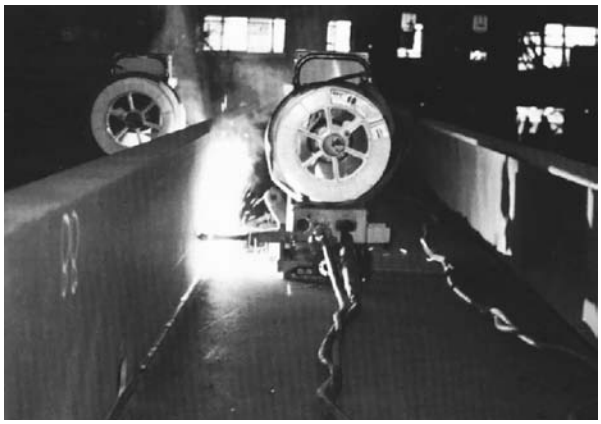


Figure 4: Fillet welding of longitudinal components by using a portable fillet welding carriage and MX-200 in shipbuilding (Photo courtesy of Tuneishi Shipyard, Japan).

Kobe Steel is sure MX-200 will provide you with efficient fillet welding at higher welding speeds and with increased mechanization in your work-shops.

FAMILIARC™ MX-100

AWS A5.20 E70T-1C

MX-100, the prototype of metal flux-cored wire, offers a softer arc, lower spatter, higher deposition rates, less slag, and more...

Inception of MX-100

MX-100 was developed in 1985 as a metal flux-cored wire for CO_2 shielded butt and fillet welding in the flat and horizontal positions. With its high deposition rate, low spatter and less slag, this development greatly improved the welding performance in semi-automatic, automatic and robotic welding of steel structures, industrial machinery and construction machinery.

MX-100 is an epoch-making metal flux-cored wire suitable for steel structures, industrial machinery and construction machinery.

Unsurpassed features

With the unique metal-rich cored flux, MX-100 is characterized by the following outstanding performance.

(1) HIGH DEPOSITION RATE: 10-30% higher when compared with solid wire (Figure 1), which is beneficial to increase the welding speed and thus reduce the total welding cost as such.

(2) LOW SPATTER EMISSION: about one-half as low as that with solid wire (Figure 2) due to better arc stability and softer arc, thereby reducing postweld cleaning work on the weldments and the nozzle of the welding torch.

(3) LOW SLAG GENERATION: comparable to that with solid wire, which enables continuous multipass welding without removing slag on each pass in thick plates of up to 25mm.

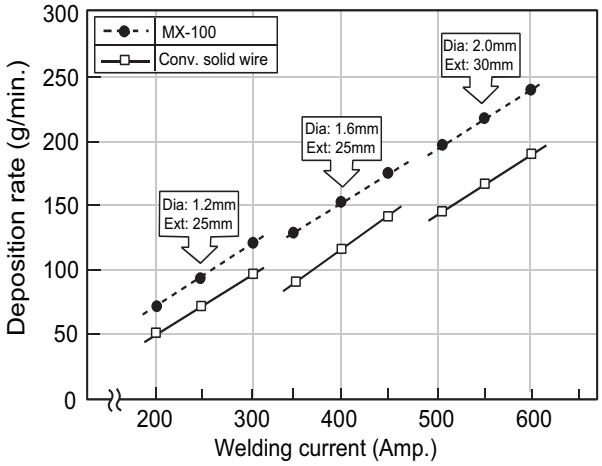


Figure 1: A comparison between MX-100 and conventional solid wire on deposition rate.

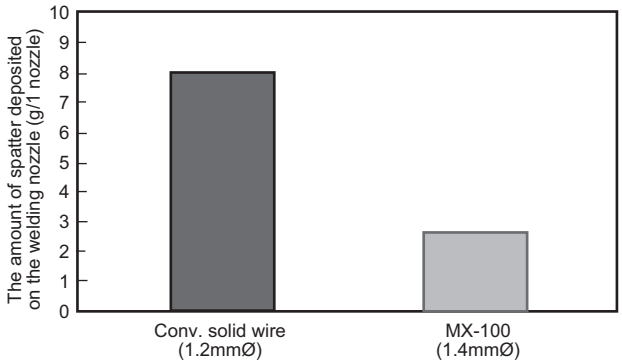


Figure 2: A comparison of amounts of spatter deposited on the welding nozzle in robotic welding of one connection core (16t×350 sq. mm).

(4) CONSISTENT CHEMICAL AND MECHANICAL PROPERTIES: suitable for mild steel and 490MPa high tensile strength steel (Table 1).

Table 1: Typical chemical and mechanical properties of MX-100 weld metal tested per AWS A5.20.

Filler metal	**MX-100**	AWS A5.20 E70T-1C
C%	0.06	0.12 max.
Si%	0.62	0.90 max.
Mn%	1.35	1.75 max.
P%	0.014	0.03 max.
S%	0.011	0.03 max.
0.2% OS (MPa)	510	400 min.
TS (MPa)	580	490 min.
El (%)	30	22 min.
IV (J)	–18°C: 50	27 min.
Shielding gas	CO_2	CO_2
Polarity	DCEP	DCEP

FAMILIARC™ MX-A100

AWS A5.18 E70C-6M

MX-A100, a highly efficient metal-cored wire, offers high deposition rates and low spatter emissions in gas metal arc welding with an Ar-CO_2 gas mixture shield in the flat and horizontal positions. Typical applications are butt and fillet welding of mild steel and 490 MPa high tensile strength steel in industrial machinery and chemical engineering machinery.

Fundamental properties

The AWS classification for MX-A100 is E70C-6M as per A5.18 (Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding). This metal cored wire is intended for both single- and multiple-pass applications. It is characterized by a spray arc and excellent bead wash characteristics. The second designator 70 indicates the minimum tensile strength (70,000 psi or 483 MPa) of the weld metal tested according to the A5.18 specification. The third designator C stands for "composite (including metal cored) wire." The suffix 6 indicates the chemical composition of the weld metal produced by the wire. The final suffix M indicates the type of shielding gas (75-80%Ar/balance CO_2) used for classification of the wire.

MX-A100 is also classified as EN ISO 17632-A-T 42 4 M M 3 H5 in accordance with the European Standard EN ISO 17632 (Tubular Cored Electrodes for Gas Shielded and Non-Gas Shielded Metal Arc Welding of Non-Alloyed and Fine-Grain Steels). "T" designates tubular cored electrodes, "42" is the code number associated with the tensile properties of the weld metal. The next "4" is also the code number related to the weld metal impact toughness. The first "M" indicates the type of cored flux: metal powder. The second "M" designates the type of shielding gas suitable for the wire: gas mixture. "3" is the code number for the proper welding positions: flat butt, flat fillet and horizontal fillet. "H5" designates the maximum diffusible hydrogen content of the weld metal: 5 ml/100g.

Table 1 shows the typical chemical composition and mechanical properties of MX-A100 weld metal tested in accordance with the AWS standard.

Table 1: Typical chemical composition and mechanical properties of MX-A100 weld metal with 80%Ar+20%CO_2

C%	Si%	Mn%	P%	S%
0.05	0.63	1.58	0.017	0.011
0.2% OS (MPa)	TS (MPa)	El (%)	IV (J)	
450	550	33	–40°C: 71	

High productivity welding

MX-A100 runs with a stable and low spatter arc. The slag produced is of a very low level, similar to that from a solid wire, and thus inter-run slag removal is not necessary. Combined with a highly reliable arc start, these characteristics make MX-A100 an ideal choice for robotic or mechanized welding.

As shown in Figures 1 and 2, this wire offers a wide range of welding currents and high deposition rates, providing high welding productivity.

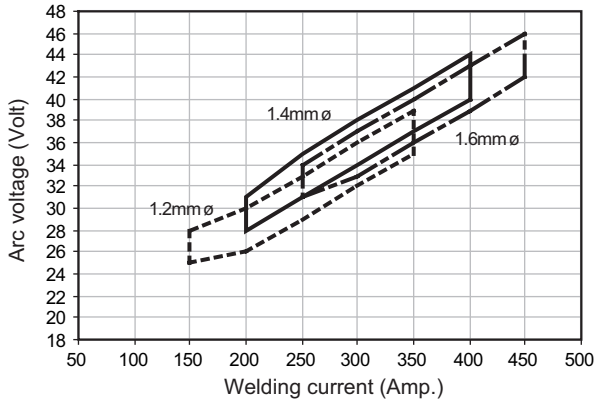


Figure 1: Recommended welding parameter ranges.

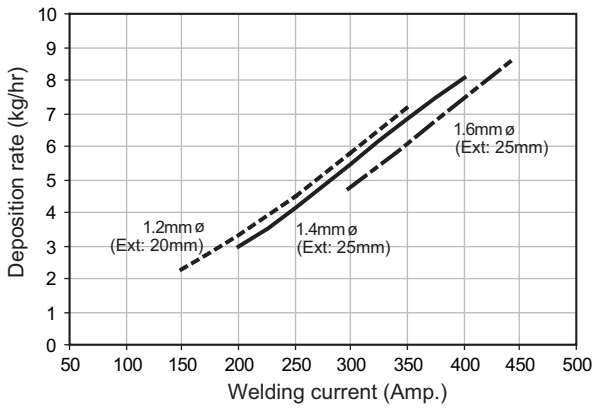


Figure 2: Deposition rates as a function of welding current.

FAMILIARC™ MX-100T

AWS A5.18 E70C-6C/6M

The high performance metal cored wire MX-100T is an excellent choice for all-position welding of thin sections of mild steel and 490 MPa high tensile strength steel. It can use either a CO_2 gas or an Ar+CO_2 gas mixture for shielding. No more burn-through with a wide tolerance of welding currents and speeds.

More resistant to burn-through

Burn-through, which results in a discontinuity in weldments, is caused when the current is too high and welding speed too slow. In burn-through, a molten metal drops to the opposite side of the groove through the root of the welding joint. Burn-through is a common problem in sheet metal welding. In general, to solve this problem, the welder may have to use smaller-size wires with lower welding currents and higher welding speeds. However, higher welding speeds tend to cause an irregular weld profile. By contrast, as shown in Figure 1, MX-100T allows to use higher welding currents or slower welding speeds than solid wires do, thereby resulting in superior weld bead appearance without burn-through.

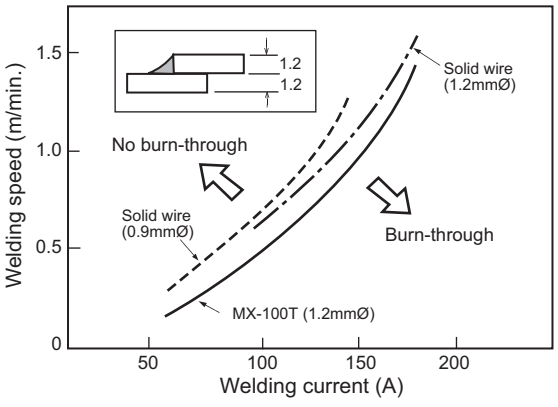


Figure 1: A comparison between MX-100T and solid wires on the welding current and speed limits in terms of burn-through.

Wider toleration of welding currents

MX-100T offers excellent arc stability at the lower welding currents (50-150A) needed for welding sheet metals (0.8-3.2 mm) by using the short-circuiting droplet transfer mode. MX-100T can also use higher welding currents, covering a wide range of welding currents as shown in Figure 2.

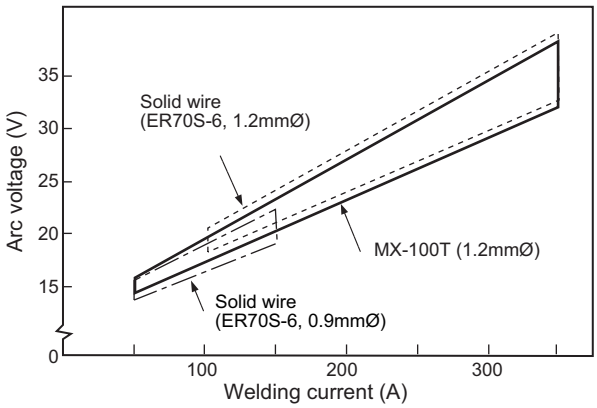


Figure 2: MX-100T features a wide welding parameter range covering those of 0.9- and 1.2-mm diameter solid wires.

Superior bead profiles

MX-100T offers smooth, regular bead profiles without undercut and overlap in all-position welding as shown in Figures 3 and 4.

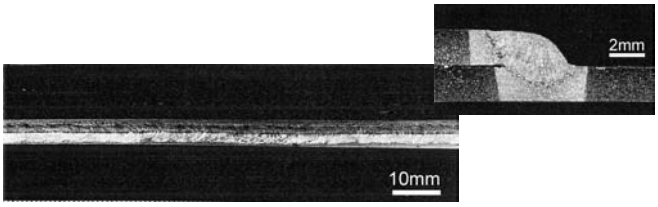


Figure 3: An MX-100T (1.2mmØ) lap fillet weld made on 2-mm thick steel sheets in horizontal welding (80 Amp.)

In addition to sheet metal welding in the auto, railroad vehicle and electrical appliance industries, MX-100T provides superior weld profiles in the one-side root pass welding of pipe joints fixed in the horizontal position.

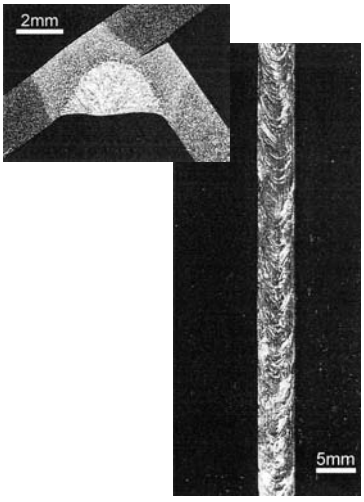


Figure 4: An MX-100T (1.2mmØ) weld made on a 2-mm thick fillet joint in vertical downward welding with an 80 amp current.

FAMILIARC™ MG-51T

AWS A5.18 ER70S-6

MG-51T: No.1 solid wire for gas metal arc welding in autos, motorcycles, containers and other sheet metal products. MG-51T uses either a CO_2 or an Ar+CO_2 gas mixture shield in all position welding.

Steady short-circuiting at low currents

Steady short-circuiting at low currents is the most valuable feature of MG-51T. If a general solid wire is used at low currents it may generate much spatter, undercut and irregular bead appearance due to unsteady short-circuiting in the molten metal transfer. In contrast, MG-51T offers low spatter and undercut generation with uniform bead appearance because of stable short-circuiting transfer of molten droplets between the tip of the wire and the molten pool. This outstanding feature is derived from the sophisticated design of chemical composition and consistent quality surface of MG-51T.

How to create steady short-circuiting

Selection of proper welding current and arc voltage is essential for creating a steady short circuiting arc, thereby facilitating all-position welding with MG-51T — Figure 1.

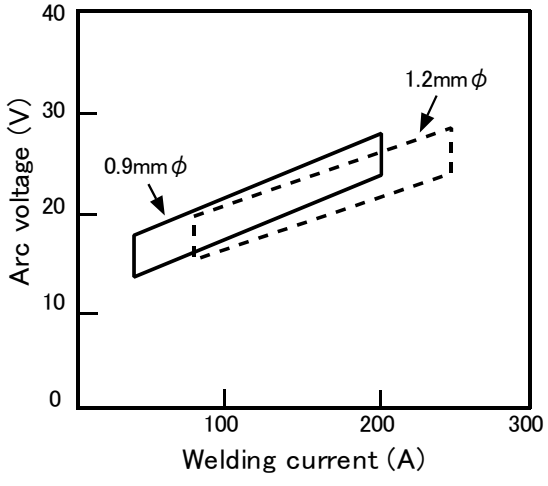


Figure 1: Proper ranges of welding currents and arc voltages for MG-51T (0.9 and 1.2mmØ).

How to adjust weld penetration

It is important to control weld penetration in welding sheet metals, because burn-through (excessive melt-through) often results in damaged welds. Although an excessive root opening and joint misalignment can also cause burn-through, an excessive welding current is more often the case. Figure 2 shows how to control weld penetration in relation to welding currents.

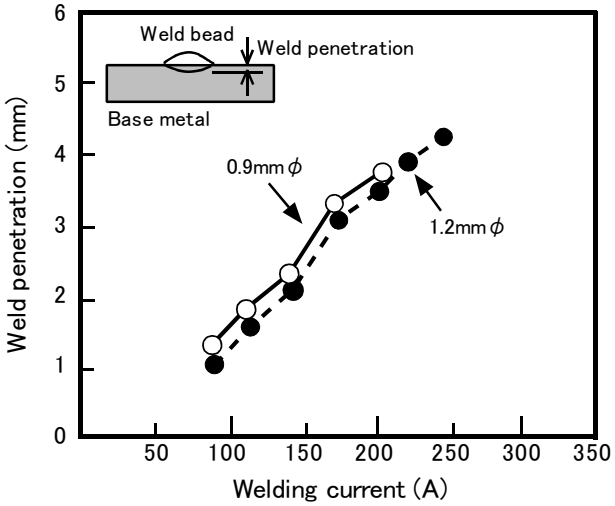


Figure 2: Weld penetration of MG-51T as a function of welding current with a short circuiting arc.

Outstanding wire-feeding and seam-tracking for higher welding efficiency

The smooth surface and consistent cast and helix of MG-51T wire provides steady wire-feeding through conduit liners and contact tips and enables exact seam-tracking along welding lines. This performance is good for decreasing downtime to improve welding efficiency in semi-automatic and automatic welding. Due to such benefits, MG-51T has seen the market expanded in the auto, motorcycle, container and other sheet metal industries.

MG-51T is one of the most popular solid wires in the motorcycle industry.

MG-51T shines in auto parts fabrication

Typical applications in auto parts for MG-51T are frame assembly, lower and upper arm, axle beam, axle housing, torque converter, impact beam, bumper reinforcement, suspension member (cross member), instrument panel reinforcement, and seat frame, as included in Figure 4.

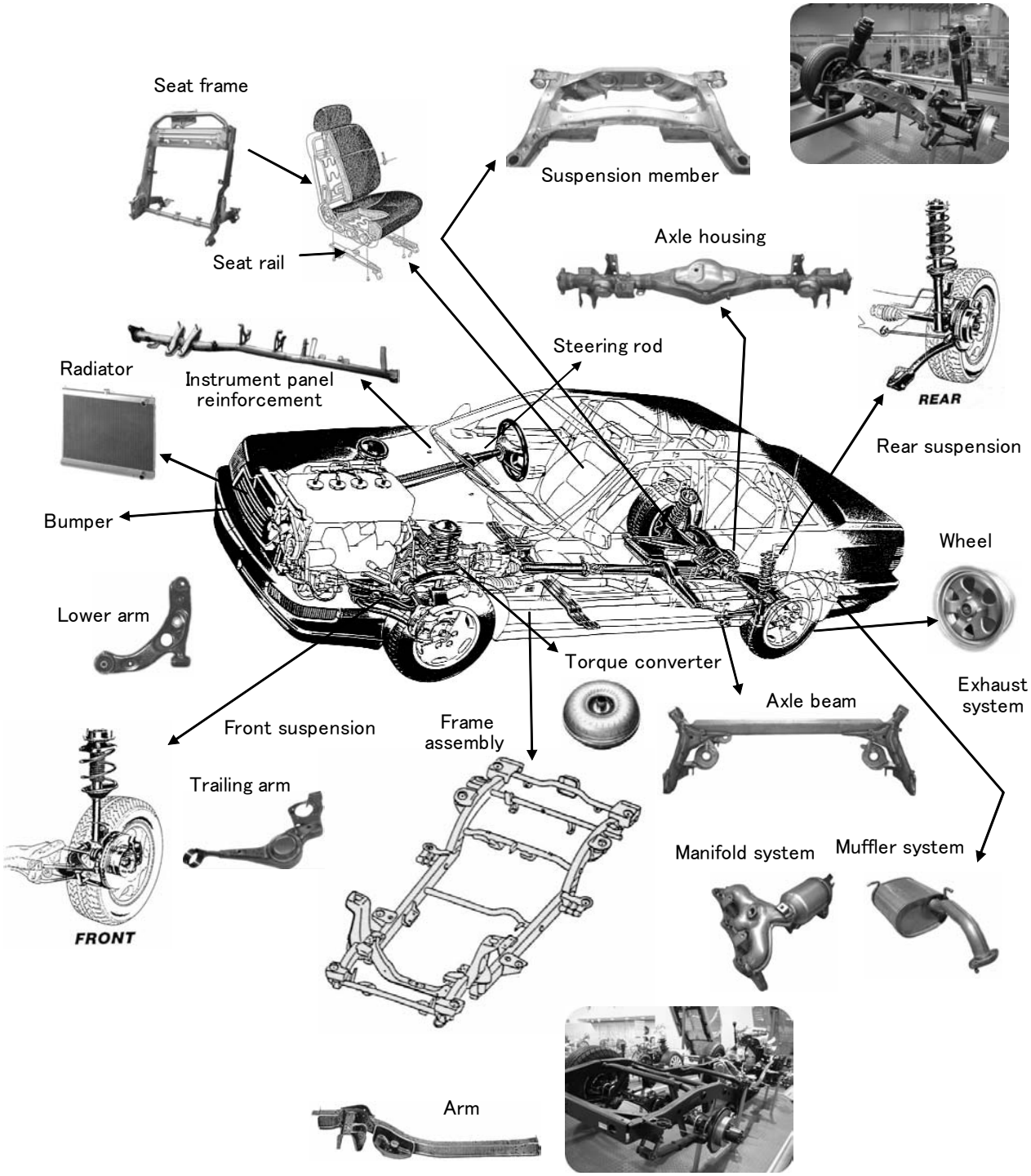


Figure 4: Varieties of auto parts where gas metal arc welding is applied.
(MG-51T is used for welding parts of mild steel and 490 MPa high tensile strength steel)

FAMILIARC™ RB-26

AWS A5.1 E6013

RB-26 is the traditional and advanced covered electrode for all-position welding (including vertical downward position) of mild steel sheets.

Inception of RB-26

RB-26 is a high titania type covered electrode for welding mild steel. It was developed in 1951. The R in "RB" stands for rutile, which is the major ingredient in the coating flux, while "B" symbolizes a slag-shield covered electrode. "26" represents the 26th year of the Showa era of Japan, corresponding to 1951 when it was developed.

Is RB-26 old-fashioned?

You may believe that RB-26 is old-fashioned due to its inception. RB-26, however, is commonly used worldwide for welding light sheet metals and light-gauge formed steel in light-duty steel structures, and for surfacing thick-section welds to improve rough surfaces (the surface dressing technique). The consumption of RB-26 differs country by country. In Southeast Asia and the Middle East, RB-26 is one of the most commonly used, contemporary electrodes.

RB-26 is superior to other E6013 electrodes on performance

RB-26 persistently earns a good reputation among users due to the following outstanding features in out-of-position welding including the vertical-down position:

(1) Smoother arc transfer
(2) Less spatter
(3) Self-peeling slag removal (Figure 1)
(4) Smoother bead surfaces with fine ripples
(5) Excellent fusion with base metals provides a longer bead per one electrode — advantageous in welding sheet metals
(6) Consistent chemical composition and mechanical properties (Table 1)

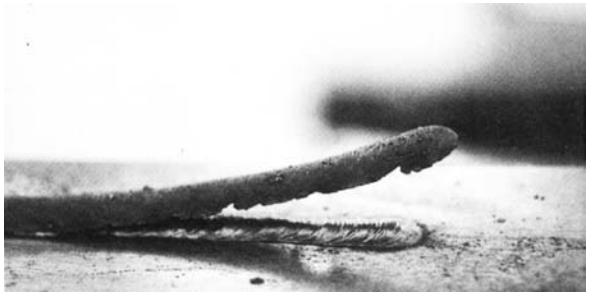


Figure 1: Convenient self-peeling slag removal with RB-26 assures a glossy bead appearance without postweld brushing.

Table 1: Typical chemical and mechanical properties of RB-26 weld metal tested per AWS A5.1

C%	Si%	Mn%	P%	S%
0.08	0.30	0.37	0.012	0.010
	YP (MPa)	TS (MPa)	El (%)	
	450	510	25	

How RB-26 is of international

Kobe Steel has established a worldwide production and sales network in order to assure quicker delivery and technical services matching local demands for RB-26. This electrode is now mainly produced by Thai-Kobe Welding Co., Ltd. in Thailand in accordance with the Kobe Steel quality standard, and is sold not only in the Thai domestic market, but also exported to other countries including Saudi Arabia, Vietnam, and Singapore. RB-26, among all the various brands classified as E6013, has persistently earned high reputation for the quality, delivery and technical service in these international markets.

Committed to quality and customer satisfaction

The high quality of RB-26 produced in both Japan and overseas is approved and certified by the ship classification societies of Nippon Kaiji Kyokai (NK), American Bureau of Shipping (AB) and Lloyd's Resister of Shipping (LR) — Table 2. These approvals and certificates will be reliable to users on the quality of RB-26.

Table 2: Ship classification approvals for RB-26

AB	LR	NK
2	2m	KMW2

Further, the emphasis on quality pervades the factories in Japan and overseas — with nearly all of our employees involved in quality control circles. To ensure RB-26 is defect-free, we inspect it piece by piece (Figure 2) and lot by lot of production by using Kobe Steel's proprietary inspection processes and procedures (Figure 3).

Figure 2: To ensure the appearance quality of RB-26, electrodes are inspected piece by piece in accordance with Kobe Steel's standard (at Thai-Kobe Welding).

Figure 3: In order to ensure the quality of RB-26, the dimensions of the electrodes are inspected lot by lot by using Kobe Steel's proprietary inspection procedures (at Thai-Kobe Welding).

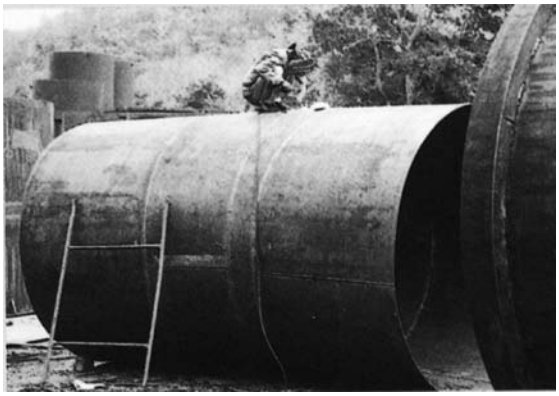
In 1999, Thai-Kobe Welding became the first welding consumables manufacturer in Thailand to achieve JQA ISO 9002 certification for customer satisfaction. Further the latest precise inspection equipment (Figure 4) has strengthened the quality control activities to maintain the traditional high quality.

Figure 4: Computerized system strengthens quality control activities (at Thai-Kobe Welding).

To ensure customer satisfaction, the marketing staffs work closely with customers and end users, providing technical services that include training in welding techniques. Unsurpassed quality of RB-26 and customer satisfaction remain our highest priorities.

Something new in the traditional

Since its inception, RB-26 has seen its features refined and its markets expanded. Kobe Steel pursues keen quality control in order to maintain the outstanding features of RB-26 produced in Japan and overseas. RB-26 is a traditional covered electrode, but, at the same time, highly advanced in that the quality of RB-26 has been maintained through advanced research and production engineering. Kobe Steel hopes RB-26 will be an indispensable electrode for your workshops.



Water tanks with a thin section are often fabricated with RB-26 in Thailand.

FAMILIARC™
LB-52U
AWS A5.1 E7016

LB-52U (E7016) is an unsurpassed covered electrode for melt-through root-pass welding, or one-sided root pass welding with penetration beads. With LB-52U your welding will be easier and faster, and you will have confidence in the quality of your welds in any kind of pipe welding of mild steel and 490MPa high tensile strength steel. Described here are the characteristics that have made LB-52U the best for one-sided pipe welding.

(1) EXCELLENT USABILITY IN ALL-POSITION WELDING

LB-52U features a very stable arc and low spatter over a wide range of welding currents. In particular, it really shines in the melt-through root-pass welding of horizontally fixed pipes due to the smooth, glossy penetration beads that protrude on the reverse side of the groove (Figure 1) and the wider tolerance of the root opening — an advantage in site welding.

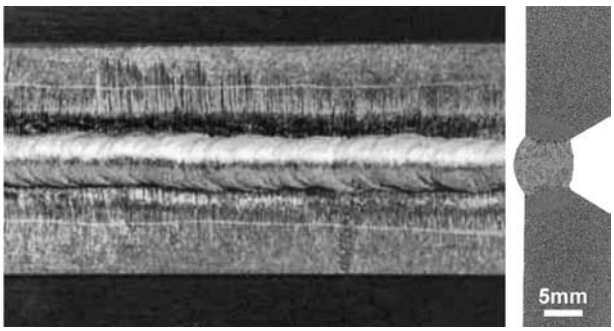


Figure 1: The surface and macrosectional profiles of a penetration bead protruding on the reverse side of a single-V-groove weld.

(2) SUPERIOR CRACK RESISTANCE AND MECHANICAL PROPERTIES

LB-52U offers superior crack resistibility due to a lower amount of diffusible hydrogen in the weld metal. In addition, it excels in mechanical properties, particularly in impact strength at low temperatures (Table 1). Therefore, it can be used for low-temperature applications as well as moderate high-temperature applications.

Table 1: Typical chemical and mechanical properties of LB-52U weld metal

C%	Si%	Mn%	P%	S%
0.07	0.55	1.05	0.011	0.006
0.2% OS (MPa)	TS (MPa)	EL (%)	IV (J)	[H]d*1 (ml/100g)
480	560	31	–29°C: 80	3.5

1. Diffusible hydrogen in the weld metal made in the welding atmosphere of 21°C × 10%RH (Gas-chromatographic method)

(3) FIELD-PROVEN ELECTRODE IN WORLDWIDE MARKETS

The outstanding usability of LB-52U in the melt-through root-pass welding of pipe joints has satisfied users around the world. LB-52U has been popular for a variety of piping jobs across Russia, Asia and the pacific region. Particularly in Russia, LB-52U, with its extraordinary reliability, has made a great contribution to the construction of long, oil and gas pipelines in freezing weather. Since 1982, more than 33,000 metric tons of LB-52U have been consumed in the construction of the Russian pipelines (Figure 2).

Figure 2: A pipeline-welding site in Russia where LB-52U is used for joining the girth joints in freezing weather.

FAMILIARC™

LB-52-18

AWS A5.1 E7018

LB-52-18 is a low-hydrogen electrode with a high deposition rate for mild steel and 490 MPa high tensile steel. It is an excellent choice for a variety of applications.

Inception of LB-52-18

LB-52-18 was developed around 1962. "L" stands for low hydrogen, while "B" symbolizes a slag-shielding covered electrode. "52" refers to the typical tensile strength of deposited metal at the time the electrode was developed. "1" shows that it can be used in all positions, while "8" is the designation for "iron powder, low hydrogen" as in the AWS E7018 specification.

High deposition rate

The deposition rate is the weight of metal deposited per unit of time. Typical deposition rates of LB-52-18 and an ordinary E7016 electrode, as a function of welding current, are shown in Figure 1. Clearly the deposition rates are dependent on welding current, and LB-52-18 provides approximately 20% higher deposition rates when compared with the conventional E7016 electrode.

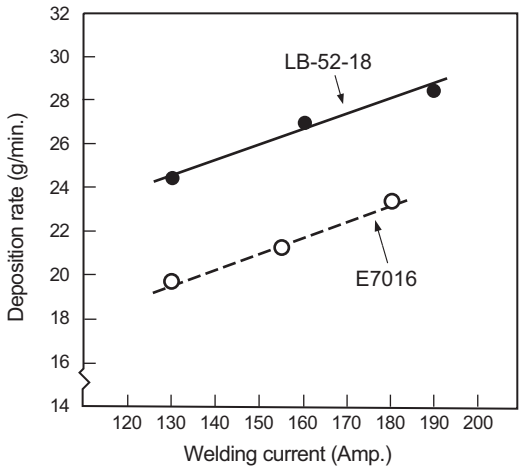


Figure 1: A comparison between LB-52-18 and conventional E7016 electrode in terms of deposition rate.

The deposition rate is an important variable in welding economics. A higher deposition rate necessarily results in a faster welding speed or shorter time for welding a certain mass of groove. Shorter welding time can reduce labor costs. LB-52-18, therefore, can provide savings by up to 20% over ordinary E7016 electrodes when the costs for material and overhead are kept constant.

Outstanding features

The features that help LB-52-18 stand apart from ordinary E7018 electrodes are:

(1) Superior welding performance with either DCEP or AC currents
(2) Superior mechanical properties with consistent tensile strength and high impact toughness (Table 1)
(3) Superior crack resistibility

Table 1: Typical chemical and mechanical properties of LB-52-18 weld metal tested per AWS A5.1

C%	Si%	Mn%	P%	S%
0.07	0.59	0.97	0.013	0.007
0.2% OS (MPa)	**TS (MPa)**	**El (%)**	**IV (J)**	**PWHT (°C x h)**
500	560	31	–29°C: 110	As weld
420	520	32	–29°C: 140	620x1

Highly reputed for 45 years

Since it was launched, LB-52-18 has seen its features refined and its markets expanded. Kobe Steel pursues keen quality control in order to maintain the excellency of LB-52-18 produced in Japan and overseas. The maintenance of quality is an important factor in the high reputation LB-52-18 has persistently earned in such diverse fields as machinery, steel structures, bridge construction and shipbuilding.

The high deposition rate with LB-52-18 is variable for the maintenance welding of heavy-duty machinery in crushing plants.

FAMILIARC™ LB-52

AWS A5.1 E7016

The No.1 low-hydrogen type electrode for both mild steel and 490 MPa high tensile strength steel suited for almost limitless applications.

Inception of LB-52

LB-52 was developed around 1958. “L” stands for low hydrogen, while “B” symbolizes a slag-shielding covered electrode. “52” refers to the level of approximate tensile strength of the deposited metal when it was developed.

Outstanding features

The outstanding features of LB-52 among other E7016 electrodes are:

(1) Excellent usability in out-of-position welding with better arc concentration, easier slag removal and smoother bead appearance
(2) Excellent mechanical properties with consistent tensile strength and high impact toughness
(3) Excellent X-ray soundness

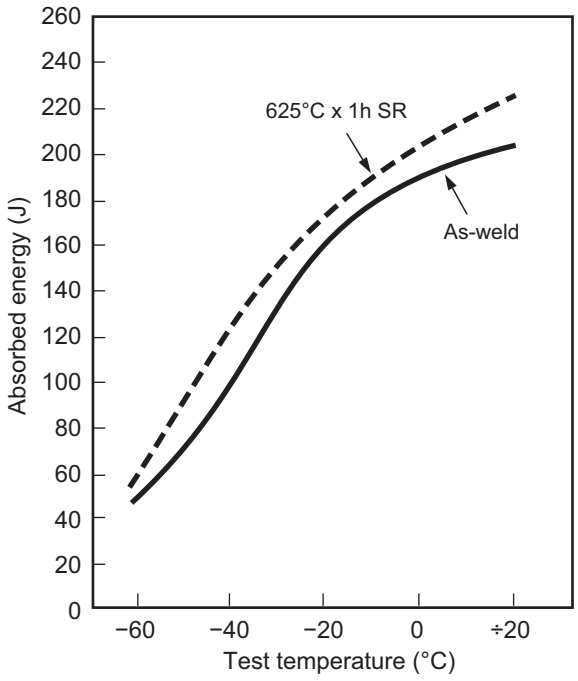


Figure 1: Charpy impact energy transition curves of LB-52 weld metals in the as-welded and postweld heat treated contitions.

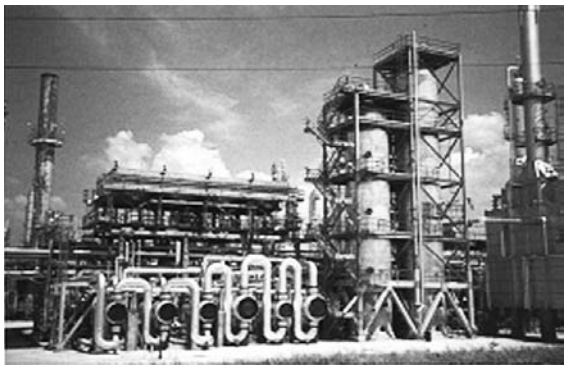
Figure 1 shows the Charpy impact energy transition curves of LB-52 weld metals tested with 2mm-V-notch specimens at a wide range of temperatures. Due to high impact toughness in both as-welded and postweld heat treated conditions, LB-52 is used for low-temperature applications down to –20°C, in addition to room temperature and elevated temperature applications. Table 1 shows the typical chemical and mechanical properties of LB-52 weld metal tested in accordance with AWS A5.1.

Table 1: Typical chemical and mechanical properties of LB-52 weld metal tested in accordance with AWS A5.1

C%	Si%	Mn%	P%	S%
0.08	0.60	0.94	0.011	0.006
0.2% OS (MPa)	TS (MPa)	El (%)	IV (J)	PWHT (°C x h)
500	570	32	–29°C:120	As weld
420	520	33	–29°C:150	620 x 1

Highly reputed for 50 years

Since it was launched, LB-52 has seen its features refined and its markets expanded. Kobe Steel pursues keen quality control in order to maintain the outstanding features of LB-52 produced in Japan and overseas. The maintenance of quality is an important factor in persistently earning a high reputation for LB-52 in almost limitless applications in such various fields as pressure vessels, storage tanks, pipelines, machinery, offshore structures, ships, bridges, and steel structures. Kobe Steel is sure LB-52 will be a reliable electrode for your workshops.



LB-52 shines in such applications as structures, pipes and vessels in the construction of chemical plants and oil refineries.

FAMILIARC™
B-14
AWS A5.1 E6019

B-14 is a versatile ilmenite type covered electrode for mild steel, offering unsurpassed usability and weldability in all-position butt and fillet welding and in welding sheet metals and medium-thick (up to 20 mm) plates.

A history of ilmenite type electrodes

Kobe Steel developed, in 1942, an epoch-making ilmenite type covered electrode: "B-17," which used ilmenite (a composition of iron oxide and titanium oxide) as the raw material for the major part of the coating flux. After a period of years, Kobe Steel developed other ilmenite type covered electrodes, B-10 and B-14, so as to satisfy the requirements of a variety of users.

The consumption of ilmenite type covered electrodes increased sharply, particularly in the shipbuilding industry (Figure 1) as the construction of ships increased through the 1960s and 1970s. The annual production of ilmenite type covered electrodes in Japan increased year by year up to 132,000 MT in 1973, comprising a major portion of the market for mild steel covered electrodes.

Figure 1: Ilmenite type electrodes shined in shipbuilding throughout the 1960s and 1970s due to excellent usability and weldability.

However, starting in 1975, right after the first global oil crisis, ship construction began to dry up, after which the consumption of covered electrodes, including the ilmenite type, rapidly decreased. Since then this trend has accelerated, with covered electrodes being superseded by gas metal arc welding wires in order to save welding costs.

But the consumption ratio of ilmenite type covered electrodes was kept high until recent years. In 1995, the annual production of ilmenite type covered electrodes was approximately 17,000 MT, which was approximately 30% of all 56,000 MT of mild steel covered electrode produced in Japan.

Ilmenite type covered electrodes classified as D4301 in the JIS standard have been also classified as E6019 (iron oxide, titania potassium type) in the AWS standard since 1991. This standardization per AWS is due to Kobe Steel's active work in the Japan Welding Engineering Society and the American Welding Society.

Nowadays, ilmenite type covered electrodes are used for welding general steel structures, pipes, and ships in Japan and overseas. Among these ilmenite type covered electrodes B-14 is one of the leading brands, which is produced by Kobe Steel and overseas subsidiary companies: TKW in Thailand, KWS in Singapore, and INTIWI in Indonesia.

What characteristics highlight B-14

Compared with conventional E6013 electrodes, B-14 features the following characteristics.

(1) Suitable for welding heavy-duty structures due to superior X-ray soundness, higher ductility, higher notch toughness (Figure 2), deeper penetration (Figure 3), and consistent tensile properties (Table 1).

(2) Suitable for welding thicker steel plates with a thickness of up to about 20 mm due to superior hot crack resistance.

(3) Higher welding efficiency due to longer unit electrode length and higher proper currents (Table 2).

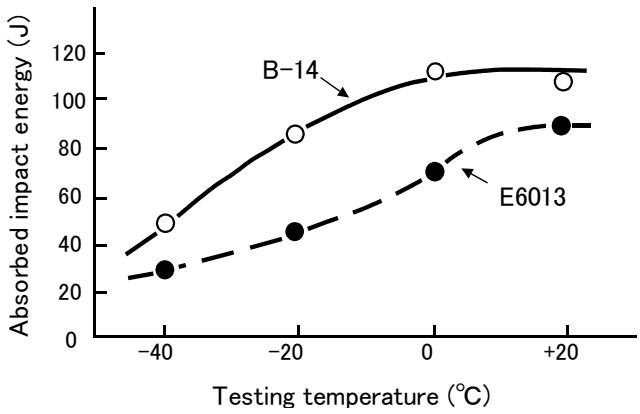


Figure 2: Charpy impact test results of B-14 and conventional E6013 weld metals.

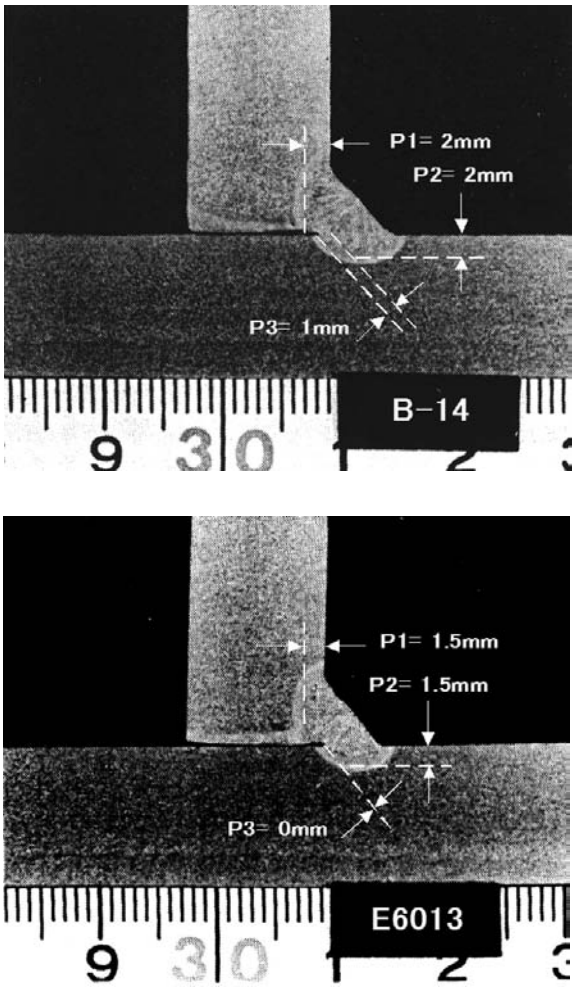


Figure 3: A comparison between B-14 and E6013 covered electrodes (4.0 mmØ,175 A) in fillet weld penetration; P1, P2, and P3 show sizes of penetration.

Table 1: Typical mechanical properties of B-14 weld metal tested in accordance with AWS A5.1

C%	Si%	Mn%	P%	S%
0.10	0.10	0.43	0.015	0.007
YP (MPa)	TS (MPa)	El (%)	IV (J)	
410	460	32	–18°C: 82	

Table 2: A comparison between B-14 and E6013 covered electrodes on unit length and proper welding current ranges

Trade desig.	Size (mmØ)	3.2	4.0	5.0
B-14	Electrode unit length (mm)	400	450	450
	Proper welding current in flat position (Amp.)	85-140	130-190	180-260
Conv. E6013	Electrode unit length (mm)	350	400	400
	Proper welding current in flat position (Amp.)	60-125	105-170	150-220

Tips for better weld results with B-14

The electrode's performance depends greatly on how it is used. In order to get the better welding results, the following key points should be noted.

(1) Use B-14 with welding currents within the proper ranges, because excessive welding currents may degrade X-ray soundness, increase spatter, and cause undercut and irregular bead appearance.

(2) Redry B-14 at 70-100°C for 30-60 minutes, if the electrode picked up excessive moisture. This is because excessive moisture in the coating may degrade electrode's usability and cause the occurrence of pits in the weld metal.

(3) Avoid excessively high temperatures and long time in redrying B-14, because the excessive redrying may damage the coating, causing less penetration, poor X-ray soundness, and electrode burn.

(4) Because B-14 is a non-low-hydrogen type electrode, medium to thick mild steel work should be preheated at an appropriated temperature and kept during welding at a proper interpass temperature.

FAMILIARC™ TG-S50

AWS A5.18 ER70S-G

TG-S50 is a versatile TIG welding solid wire with excellent usability and mechanical properties used for mild steel, 490 MPa high tensile strength steel and low-temperature Al-killed steel. Users will also find the mechanical properties approved by the ship classification societies to be reliable.

Basic characteristics

TG-S50 is a solid wire designed specifically for TIG welding. It is classified as AWS A5.18 ER70S-G. As seen in the classification the minimum tensile strength of the deposited metal is 70 kilo-pound per square inch or 480 MPa. TG-S50 uses the DCEN (DC Electrode Negative) polarity and pure argon gas for shielding.

Excellent qualities

(1) TG-S50 offers less slag generation and better fusion in the root pass welding of pipes in all positions, providing very smooth penetration beads with regular weld ripples. This usability is advantageous in the welding of process pipes (Figure 1) where stricter X-ray soundness is required.

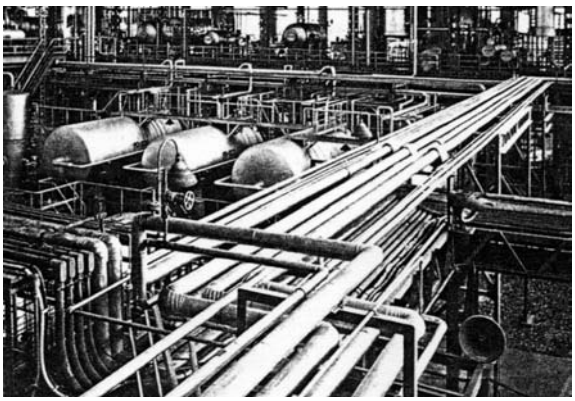


Figure 1: TG-S50 is very advantageous in the root pass welding of the process piping in all positions due to unsurpassed usability.

(2) TG-S50 offers consistent tensile strength in both as-welded and PWHT (postweld heat treatment) conditions. TG-S50 weld metal features high tensile strengths even after long-hour PWHT as shown in Figure 2. This is why TG-S50 is suitable for multi-pass welding of pressure components with thick sections by using a mechanized welding process.

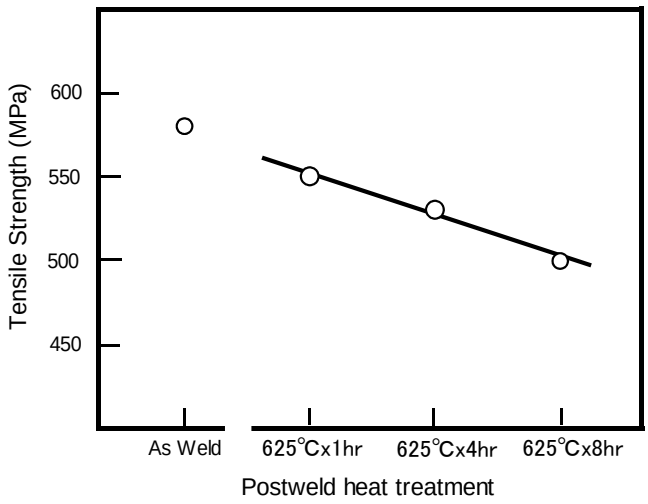


Figure 2: Typical tensile strength of TG-S50 weld metal as a function of PWHT conditions.

(3) TG-S50 provides a quite high level of absorbed energy in Charpy impact tests over a range of testing temperatures as shown in Figure 3. This is why TG-S50 is also used for low-temperature applications at down to –40°C.

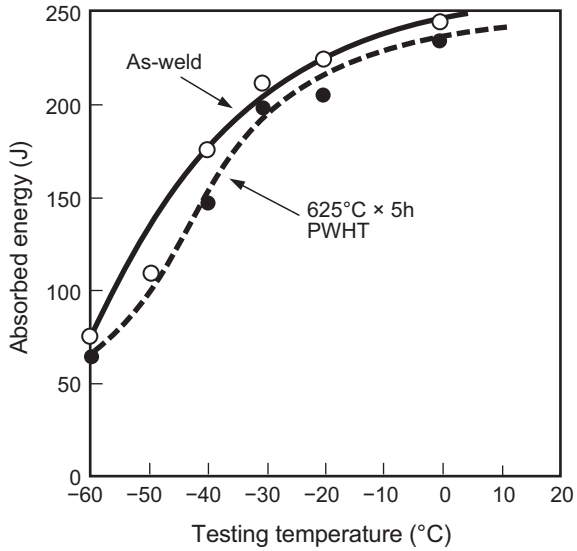


Figure 3: Charpy impact test results of TG-S50 weld metal in as-welded and PWHT conditions.

FAMILIARC™

TG-S51T

AWS A5.18 ER70S-6

TG-S51T resembles TG-S50 in terms of applications of mild steel, 490 MPa high tensile strength steel, and Al-killed steel for low temperature services but is superior in tensile strength under extended postweld heat treatment conditions.

Fundamental properties

TG-S51T is classified as ER70S-6 in accordance with AWS A5.18 (Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding). The typical chemical composition of the wire and the typical mechanical properties of the weld metal are shown in Table 1 with the AWS requirements.

Table 1 Typical chemical and mechanical properties of TG-S51T in comparison with the AWS requirements*1

Filler wire	TG-S51T	AWS A5.18-2005 ER70S-6
C%	0.10	0.06-0.15
Si%	0.89	0.80-1.15
Mn%	1.56	1.40-1.85
P%	0.010	0.025 max.
S%	0.011	0.035 max.
Cu%	0.23	0.50 max.
0.2% OS (MPa)	510	400 min.
TS (MPa)	610	480 min.
El (%)	32	22 min.
IV (J)	–29°C: 210	27 min.

1. Chemical compositions are for solid wire, and mechanical properties are for weld metal in the as-welded condition. Other chemical elements are specified — Ni, Cr, Mo: 0.15% max. each; V: 0.03% max. Cu% includes that of Cu-coating.

Suitable for extended PWHT applications

The gas tungsten arc welding (GTAW) process may partly be used (e.g. for root pass welding) on thick-wall work such as pressure vessels and process pipes that are subject to postweld heat treatment (PWHT), although the major part of the welding joints in such equipment are welded generally by more efficient processes such as shielded metal arc welding (SMAW), submerged arc welding (SAW), and gas metal arc welding (GMAW). In addition, the pipe-to-nozzle joints on a thick, large pressure vessel may be welded by a mechanized GTAW for better quality and efficiency. In these cases, the PWHT may have to be conducted for long hours according to the thickness of the work: e.g. 4 hours for 100-mm thick work. When the work is too big to conduct PWHT at one time in a particular furnace, the PWHT should necessarily be conducted several times — thus the total PWHT hours for some weld joints may be 8 to 16 depending on the number of PWHT times. This is why the GTAW weld metal may also be required to satisfy the mechanical properties after long-hour PWHT.

Table 2 shows the typical mechanical properties of TG-S51T weld metal after long-hour PWHT. Figure 1 illustrates the effects of PWHT temper parameter on 0.2% offset strength and tensile strength. Clearly, TG-S51T weld metal can satisfy 490 MPa under an extended PWHT condition.

Table 2: Typical mechanical properties of TG-S51T weld metal after long-hour PWHT

PWHT (°C × h)	0.2% OS (MPa)	TS (MPa)	El (%)	IV (J) at –30°C
625 × 8	440	560	34	170
625 × 24	420	550	35	160

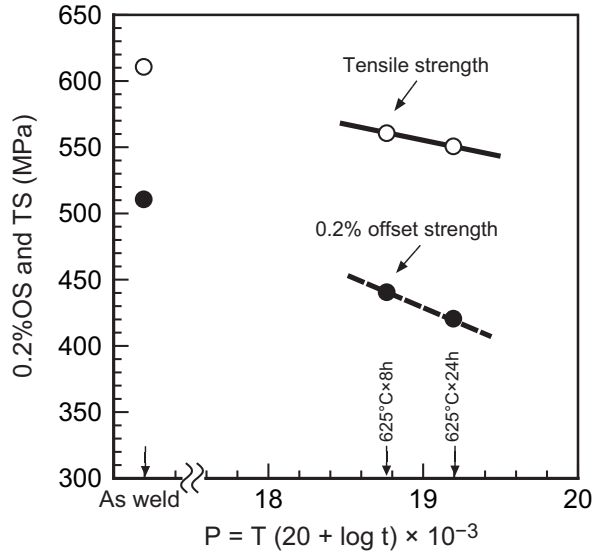


Figure 1: Tensile strength and 0.2% offset strength of TG-S51T weld metal as a function of temper parameter (T: PWHT temperature by Kelvin; t: PWHT hours).

FAMILIARC™

NO65G

AWS A5.18 ER70S-2

The NO65G filler wire is the best choice when the AWS ER70S-2 classification is a must for your welding procedures for the root pass welding of pipe joints in particular.

Basic characteristics

NO65G is a TIG welding solid wire suitable for mild steel and 490 MPa high tensile strength steel. The classification, ER70S-2, contains the following useful information. The number 70 indicates the required minimum tensile strength as a multiple of 1000 psi (70,000 psi = 480 MPa) of the weld metal made using the wire in accordance with the welding conditions specified in AWS A5.18. The letter S designates a solid wire. The suffix 2 indicates the chemical composition of the wire.

As shown in Table 1, NO65G contains small amounts of such deoxidizers as Al (aluminum), Ti (titanium) and Zr (zirconium) in addition to the common elements of C (carbon), Si (silicon) and Mn (manganese). Due to the added deoxidizers, NO65G can be more resistant against the rust formed on the surfaces of the welding groove. The rust should be removed as much as possible before welding to get better results.

Table 1: Typical chemical and mechanical properties of NO65G tested in accordance with AWS A5.18*1

C%	Si%	Mn%	P%	S%	Cu%	Al%	Ti%	Zr%
0.04	0.54	1.25	0.007	0.014	0.25	0.07	0.08	0.04

0.2%OS (MPa)	TS (MPa)	El (%)	IV (J)	PWHT (°C × h)
560	620	28	–29°C: 200	As weld
520	600	30	–29°C: 160	625 × 8

1. Chemical compositions are for solid wire, and mechanical properties are for weld metal. Copper includes that of Cu-coating. Electric polarity is DCEN. Shielding gas is pure Ar gas.

Key points in TIG welding of pipes

(1) Use proper welding currents for each diameter of the wire: 60-90A for 1.6 mmØ, 80-110A for 2.0 mmØ, and 100-130A for 2.4 mmØ.

(2) Use proper flow rates of pure argon gas for torch shielding: 8-15 liter/min. when there is no apparent ambient wind. No back shielding is needed in root pass welding with the penetration beads, unless otherwise specified.

(3) Remove such dirt attached on the surfaces of the groove as mill scale, rust, oil and grease, because it can cause porosity in the weld metal.

(4) Control the weld penetration in the root of the groove by controlling the arc exposure spot or the torch placement and the torch oscillation width as shown in Figure 1.

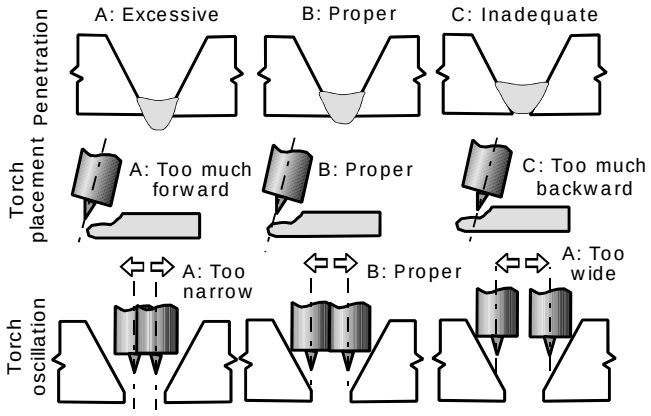


Figure 1: Penetration (top) relates to the torch placement (middle) and the torch oscillation width (bottom), respectively.

(5) The weld crater should be terminated on the groove face to prevent the occurrence of a crater crack (Figure 2).

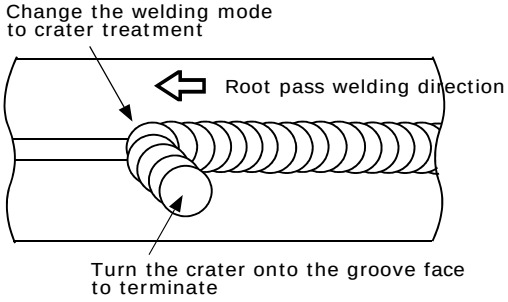


Figure 2: Proper crater treatment to prevent a crater crack.

FAMILIARC™ FAMILIARC™ MF-38/US-36

AWS A5.17 F7A6-EH14, F7P6-EH14

MF-38/US-36 is a versatile filler metal combination of fused flux and solid wire for submerged arc welding (SAW) of butt and fillet joints in ships, industrial machinery, vessels, steel frames, and bridges.

Basic properties

MF-38 is a fused type flux classified as F7A6-EH14 and F7P6-EH14 when combined with US-36 solid wire classified as EH-14 in accordance with AWS A5.17 (Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding). According to the classification system each designator is given for the particular information as follows: “F” for virgin flux, “7” for the minimum tensile strength of weld metal (70,000 psi or 480 MPa), “A” for as-welded condition, “P” for postweld heat treated condition, “6” for the Charpy impact testing temperature of –60°F (–51°C), “E” for electrode, “H” for high manganese content, and “14” for the nominal carbon content of wire (0.14%). Table 1 shows the typical chemical and mechanical properties of MF-38/US-36 tested as per AWS A5.17.

Table 1: Typical chemical and mechanical properties of MF-38/US-36 tested in accordance with AWS A5.17*1

Wire	C%	Si%	Mn%	P%	S%	Cu%
	0.12	0.03	1.95	0.013	0.005	0.11
Weld metal	C%	Si%	Mn%	P%	S%	Cu%
	0.09	0.32	1.63	0.018	0.011	-
	0.2% OS (MPa)	TS (MPa)	El (%)	IV (J)		PWHT (°C × h)
	490	570	30	–51°C: 59		As weld
	420	530	31	–51°C: 64		620 × 1

1. Welding current: AC

Outstanding features

MF-38/US-36 is more resistible to the rust and dirt of the base metal and thus offers excellent porosity resistance and X-ray soundness. The mechanical properties of multiple pass welds are consistent with approvals of ship classification societies as shown in Table 2. Figure 1 shows typical Charpy impact test results of the multi-pass weld metals.

Table 2: Approvals of ship classification societies*1

AB	LR	NV	BV	NK	Others
2T,2YT 3M,3YM	2T,2YT 3YM	Ⅱ YT (Ⅲ YM)	A2,2YT A3,3YM	KAW52T KAW53M	GL,CR KR

1. AB: American Bureau of Shipping; LR: Lloyd's Register of Shipping; NV: Det Norske Veritas; BV: Bureau Veritas; NK: Nippon Kaiji Kyokai; GL: Germanischer Lloyd; CR: Central Research of Ships S.A.; KR: Korean Register of Shipping.

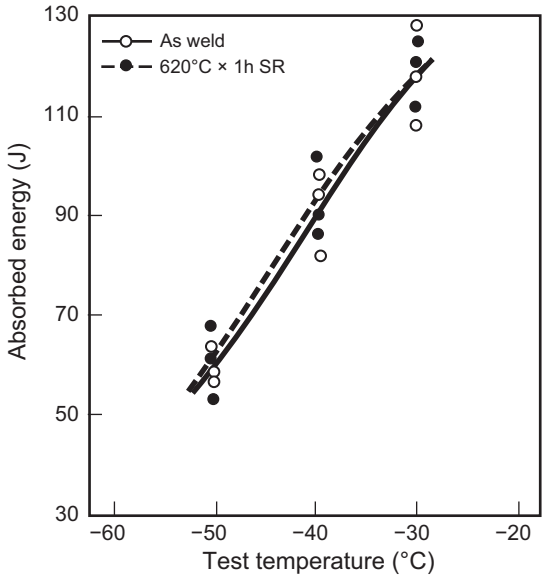


Figure 1: Consistent results in Charpy impact testing of MF-38/US-36 multi-pass weld metal (Welding current: AC).

Tips for successful welding results

(1) MF-38 has varieties of flux mesh sizes: 12×65, 20×200, and 20×D. The proper flux size should be selected according to welding current to be used for better usability. In general, coarse particle flux uses lower currents and fine particle flux is suitable for higher currents: 12×65 for 600A max., 20×200 for 600-1000A, and 20×D for 800A or higher. The most appropriate size of US-36 should be selected from among 1.6, 2.0, 2.4, 3.2, 4.0, 4.8, and 6.4mm according to the thickness of the work and welding current to be used.

(2) MF-38 is a fused flux with glassy appearance and thus is more resistible to moisture pick up. However, the flux should be redried before use by 150-350°C for 60 minutes to remove deposited moisture on the surfaces of the flux particles, thereby preventing welding defects.

KOBELCO

THE WORLDWIDE MANUFACTURER

GLOBAL MANUFACTURING AND SALES BASES

ASIA

JAPAN:
KOBE STEEL, LTD., Welding Business
Marketing Dept., International Sales & Marketing Sec.
Tel. (81) 3 5739 6331 Fax. (81) 3 5739 6960

KOREA:
KOBE WELDING OF KOREA CO., LTD.
Tel. (82) 55 292 6886 Fax. (82) 55 292 7786

KOBELCO WELDING MARKETING OF KOREA CO., LTD.
Tel. (82) 51 329 8950 to 8952 Fax. (82) 51 329 8949

CHINA:
KOBE WELDING OF SHANGHAI CO., LTD.
Tel. (86) 21 6191 7850 Fax. (86) 21 6191 7851

KOBE WELDING OF TANGSHAN CO., LTD.
Tel. (86) 315 385 2806 Fax. (86) 315 385 2829

KOBE WELDING OF QINGDAO CO., LTD.
Tel. (86) 532 8098 5005 Fax. (86) 532 8098 5008

SINGAPORE:
KOBELCO WELDING ASIA PACIFIC PTE. LTD.
Tel. (65) 6268 2711 Fax. (65) 6264 1751

ASIA

THAILAND:
THAI-KOBE WELDING CO., LTD.
Tel. (66) 2 636 8650 to 8652 Fax. (66) 2 636 8653

KOBE MIG WIRE (THAILAND) CO., LTD.
Tel. (66) 2 324 0588 to 0591 Fax. (66) 2 324 0797

MALAYSIA:
KOBE WELDING (MALAYSIA) SDN. BHD.
Tel. (60) 4 3905792 Fax. (60) 4 3905827

INDONESIA:
P.T. INTAN PERTIWI INDUSTRI
(Technically Collaborated Company)
Tel. (62) 21 639 2608 Fax. (62) 21 649 6081

INDIA:
KOBELCO WELDING INDIA PVT. LTD.
Tel. (91) 124 4010063 Fax. (91) 124 4010068

EUROPE

NETHERLANDS:
KOBELCO WELDING OF EUROPE B.V.
Tel. (31) 45 547 1111 Fax. (31) 45 547 1100

AMERICA

USA:
KOBELCO WELDING OF AMERICA INC.
Tel. (1) 281 240 5600 Fax. (1) 281 240 5625

KOBELCO

THE GUARANTEE: QTQ

QUALITY PRODUCTS
TECHNICAL SUPPORT
QUICK DELIVERY

International slogan of KOBE STEEL Welding Group