KOBELCO WELDING TODAY

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Count on KOBELCO Solid and Flux-Cored Wires!

Photo courtesy of Hitachizosen Co., Ltd.

DW-309MoL & DW-309MoLP

The Indispensable FCWs for Dissimilar Metal Welding in Desalination Plants, Chemical Tankers and Plats, and Paper Mills

Part of the DW stainless steel series, DW-309MoL and DW-309MoLP are special flux-cored wires. They are indispensable filler metals for welding dissimilar metal joints, such as in the buffer layer of clad steels, and the underlayer for overlaying. Mo-bearing austenitic stainless steel (316L and 317L), duplex stainless steel, carbon steel, and low-alloy steel usually constitute such dissimilar metal joints and clad steels. For the overlaying substrates, carbon steel and low-alloy steel are used. The demand for cost effective clad steels in particular, and thus for suitable filler metals, is expected to increase due to the brisk business in the relevant industries.

DW-309MoL and DW-309MoLP are classified as AWS A5.22 E309LMoT0-1/-4 and E309LMoT1-1/-4 respectively. As the AWS classifications indicate, the former is suitable for flat and horizontal fillet welding, whereas the latter is suitable for positional welding; both wires use either CO_2 gas or 75-80%Ar/20-25%CO_2 mixture shielding gas. The typical chemical and mechanical properties of these wires are shown in Table 1.

Table 1: Typical chemical and mechanical properties of DW-309MoL and DW-309MoLP deposited metals with CO_2 shielding gas

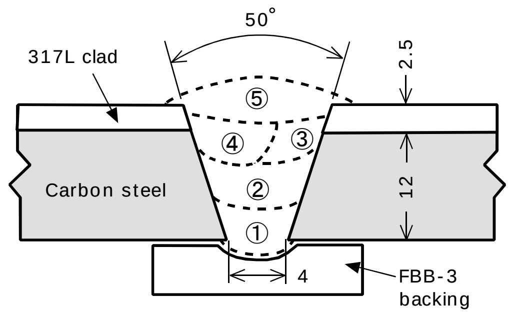
Product name	**DW-309MoL**	**DW-309MoLP**
C (%)	0.027	0.025
Si (%)	0.61	0.62
Mn (%)	1.18	0.81
P (%)	0.019	0.020
S (%)	0.009	0.010
Ni (%)	12.60	12.44
Cr (%)	23.20	22.60
Mo (%)	2.37	2.21
FS (%)[1]	18.0	17.1
0.2% PS (MPa)	540	540
TS (MPa)	720	699
El (%)	30	30

1. Ferrite percent per a Schaeffler diagram.

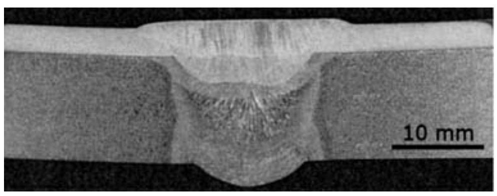
As DW-309MoL and DW-309MoLP weld metals contain sufficient amounts of ferrite, they can accommodate the detrimental effects caused by dilution by the carbon or low-alloy base metal. These effects may include the formation of martensite (brittle structure) and a fully austenitic structure (sensitive to hot cracking) in the weld metal. Similar to mild-steel titanium-type flux-cored wires, these wires offer excellent usability with a stable arc, low spatter, self-peeling slag removal, regular bead shape, and glossy bead appearance. Table 2 shows an example of a welding procedure for 317L stainless clad steel.

Table 2: One-side welding of 317L stainless clad steel plate with DW-309MoL and a FBB-3 backing

Pass No.	Filler metal	Size (mm)	Welding position	Amp. (A)	Volt. (V)	Speed (cm/min)
1	DW-100	1.2Ø	Flat	200	24	15
2	DW-100	1.2Ø	Flat	280	30	25
3	**DW-309MoL**	1.2Ø	Flat	180	26	43
4	**DW-309MoL**	1.2Ø	Flat	180	26	30
5	DW-317L	1.2Ø	Flat	190	28	14



(a) Weld pass sequence



(b) Cross section macrostructure

Strong economies gear up business

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

On the first of July, Hong Kong celebrated the 10th anniversary of its return to China. 10 years have passed since 1997, when Hong Kong's political identity changed from British colony to a Special Administrative Region of China in the "one county, two systems" framework. In contrast to widespread pessimism that questioned Hong Kong's future prosperity and political stability right before the return, Hong Kong has seen substantial economic growth, benefiting from the mobilization of "people, goods, and money" from China during the decade. The world will continue to pay special attention to Hong Kong from the standpoint of economics and politics in the future.

In the meantime, P.T. Intan Pertiwi Industry (INTIWI) in Indonesia, who has been a partner of Kobe Steel's since starting production of stick electrodes in 1977 under license from Kobe Steel, has celebrated their 30th anniversary this year. They produce many kinds of stick electrodes including RB-26, LB-52, CIA-1, NC-38, and HF-350. I appreciate their activities and contribution in helping Kobelco welding products earn a high reputation. I hope both of us will maintain our fruitful relationship.

The world economies appear strong, and the demand for welding consumables and robots is healthy. We are making our best effort to supply enough quantity of products to respond to global customers' needs. Last but not least, I am happy to work with pro-Kobelco customers like you, who read KOBELCO WELDING TODAY, and I extend my deepest appreciation for your support for Kobelco products and services.

Environment: the business key word

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

Incidents that arouse our concerns about global warming are occurring everywhere in the world in recent years: abnormal sea-level rises, extreme hot weather, drought, and more. Such abnormal phenomena are now believed to have been caused by such human activities as emitting excessive carbon dioxide into the air. We must take these phenomena seriously as a warning from the earth. To disregard these signs of warning is certain to adversely affect the healthy prosperity of the coming generations. In this sense, it is imperative that every person and every enterprise do whatever they can with a sense of urgency. In Japan, it may be possible to conserve resources by reducing the use of plastic bags for shopping and disposable chopsticks as well as to develop hydrogen as an alternative car fuel. One automobile manufacturer is said to be eyeing the development of a car that purifies the air as it runs.

Kobe Steel has also developed environmentally-friendly non-copper-coated solid wires (SE-50T, SEA-50, etc.) ahead of other manufacturers. Such wires enjoy a good reputation among customers certified by ISO 14000. Also, the demand for LB-52U, a covered arc welding electrode for pipelines, has been increasing remarkably mainly in Russia. The electrode is used for gas and oil pipelines in particular. I hope the electrode will also be used for water pipelines as securing drinking water has become a problem recent years. We will put more emphasis on the development of such environmentally-conscious products. I hope you will support us in this effort.

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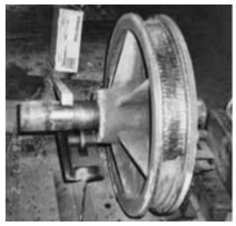
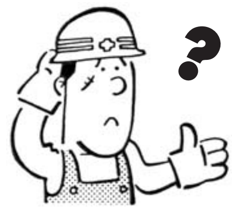
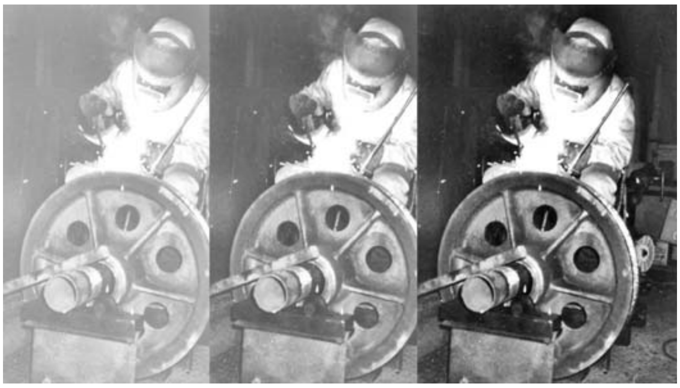




Types of Wear and Suitable Hardfacing Filler Metals



Hardfacing is the application of a hard, wear-resistant material to the surface of a workpiece by welding, spraying, or allied welding processes, to reduce wear or loss of material caused by friction or abrasion. Hardfacing is carried out either during maintenance to reclaim machinery parts by repairing worn or lost surfaces, or in production to add hard, wear-resistant weld metals to the surfaces of machinery parts. This article will focus on hardfacing by arc welding, concentrating on the varieties of filler metals and how to select them.

How metals can be worn in service

Wear can be defined as the deterioration of metal surfaces that occurs through mechanical action or by destructive thermal or chemical contact. The mechanical action that causes wear involves relative motion between the component surface and some material it comes into contact with. Wear can be classified as (1) adhesive wear, (2) impact wear, and (3) abrasive wear. It is essential to know how metals are worn in service in order to select an appropriate filler metal for a particular hardfacing application.

(1) ADHESIVE WEAR: When a force is applied that is sufficient to bring microscopically uneven metal surfaces into contact that is close to their interatomic distance, adhesion occurs between the faying surfaces of the metals. Adhesive wear occurs when the adhered part of the metal lower in strength is detached by the adhered part of a higher strength metal, causing metal to flake as shown in Figure 1. Typically, pistons and cylinders, gears, shafts, bearings, cams, and sprockets can suffer this type of wear in operation.

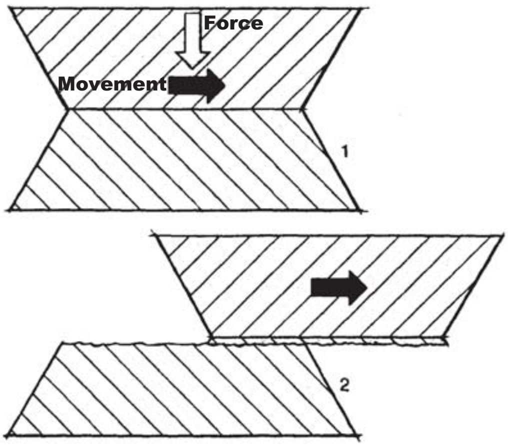


Figure 1: Adhesive wear: Adhesion in the metal interface causes detachment of a lower-strength metal. (Source: Welding Design & Fabrication)

(2) IMPACT WEAR: Repeated striking by or on solid surfaces causes pitting damage, in which fatigue loading results in the removal or displacement of material, forming cavities in the surface as shown in Figure 2. Forging hammer heads and anvils are typical parts which can be damaged by impact wear.

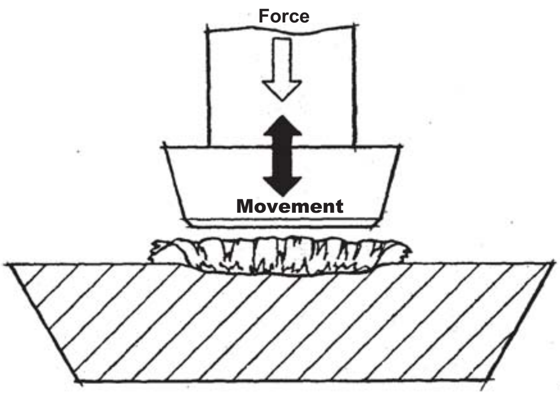


Figure 2: Impact wear: Repeated striking of metals causes fatigue and the removal of the lower-strength metal. (Source: Welding Design & Fabrication)

(3) ABRASIVE WEAR: Abrasive wear is caused by granular solids scratching, indenting and colliding against the surface of a metal, thereby detaching the surface gradually in flakes. Abrasive wear can be classified loosely as "abrasion" or "erosion." Abrasion can further be classified, according to the extent of stress applied on the surfaces, as scratching abrasion, caused by low shearing stresses (Figure 3); grinding abrasion, caused by medium shearing stresses (Figure 4), and gouging abrasion, caused by high shearing stresses including impact stresses (Figure 5).

Scratching abrasion can typically be observed in chutes, plows, conveyor screws, and wheel loader buckets. In general, as the hardness of a metal increases, the resistance against scratching abrasion can be improved. Grinding abrasion occurs typically in bulldozer blades, bulldozer shoes, and dredger cutter knives. Typical machinery parts that can suffer gouging abrasion include bulldozer ripper tips, crushers, and mill hammers.

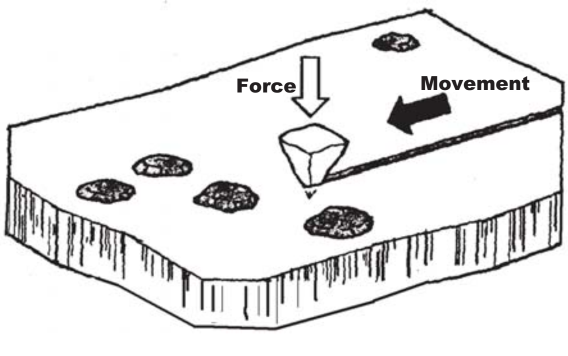


Figure 3: Scratching abrasion: The scratching action of granular solids against a metal surface under low or medium stresses causes gradual flaking of the metal. (Source: Welding Design & Fabrication)

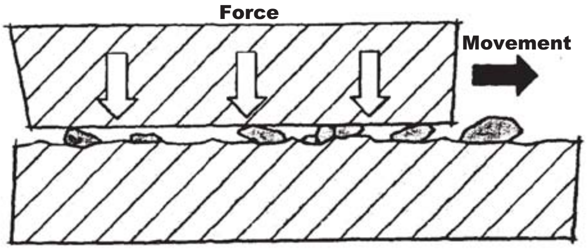


Figure 4: Grinding abrasion: The grinding action of granular solids indenting a metal surface under medium or high stresses causes gradual removal of the metal. (Source: Welding Design & Fabrication)

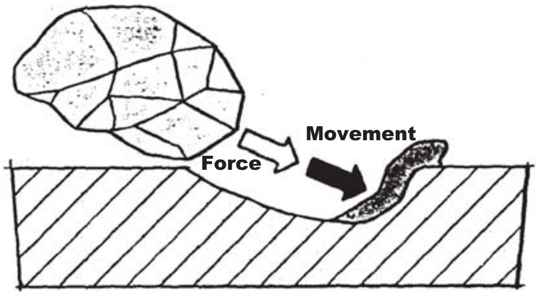


Figure 5: Gouging abrasion: A collision of rocky solids against a metal surface under high stresses causes quicker, larger-mass removal of the metal by shearing stresses. (Source: Welding Design & Fabrication)

Erosion is generally referred to as the mechanical wear of a metal caused by contact with fluids as shown in Figure 6. The fluid may or may not contain granular solids. Cavitation erosion is caused by impact stresses following the explosion of bubbles in a fluid. Examples of typical equipment that can be damaged by erosion include dragger sand pump casings and impellers, mud pumps, pipelines, and agitators. Cavitation erosion can occur in hydraulic power turbines, ship propellers, regulating valves, and pump impellers.

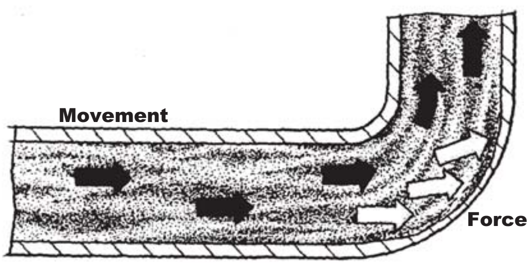


Figure 6: Erosion: Contact with fluids can cause removal of metal. Depending on the fluid the erosion can be classified as sand erosion, cavitation erosion, erosion corrosion, and rain erosion. (Source: Welding Design & Fabrication)

Varieties of filler metals

A wide variety of hardfacing filler metals are available. The JIS standard specifies Z 3251 for shielded metal arc welding covered electrodes and Z 3326 for flux-cored arc welding wires. The AWS standard specifies A5.13 for shielded metal arc welding covered electrodes and A5.21 for solid electrodes and rods, metal-cored and flux-cored electrodes and rods, and tungsten carbide rods.

Table 1: Classification of Kobelco hardfacing filler metals

Deposited metal microstructure and alloying formula		Hv range	Features	Resistible type of wear in application[1]							Covered electrode for SMAW	Flux-cored wire for FCAW	Solid wire for GMAW	Flux and flux-cored wire for SAW
				MTM	ABR	HTW	CAV	COR	HRT	IMP				
Pearlite		200-400	• Good crack resistance • Good machinability	○	△	×	–	–	×	○	**HF-240 HF-260 HF-330 HF-350**	**DWH-250 DWH-350**	**MG-250 MG-350**	**G-50/USH-250N G-50/USH-350N**
Martensite		350-800	• Good wear resistance	○	○	△	–	×	△	△	**HF-450 HF-500 HF-600 HF-650 HF-700 HF-800K**	**DWH-450 DWH-600 DWH-700 DWH-800**	-	**G-50/USH-400N G-50/USH-450N G-50/USH-500N MF-30/USH-550N MF-30/USH-600N**
13%Cr stainless steel		350-500	• Good resistance to oxidation, heat, corrosion, and wear	○	△	○	○	○	○	△	**HF-13 CR-132 CR-134 CR-136**	**DWH-131S DWH-132 DWH-134**	-	-
Semi-Austenite		500-700	• High toughness • Good wear resistance	○	○	△	△	△	△	△	**HF-12**	-	-	-
High Mn austenite	13%Mn	150-500	• High toughness • Good impact wear resistance • High work-hardenability	×	○	×	△	×	×	◎	**HF-11**	**DWH-11**	-	-
	16%Mn -16%Cr	200-400	• High hardness at high temperatures • High toughness	○	△	○	○	○	○	○	**HF-16 MC-16**	**DWH-16**	-	-
High-Cr iron		600-800	• Excellent erosion resistance • Good resistance to corrosion and heat	△	◎	◎	×	○	○	×	**HF-30**	**DWH-30 DWH-30MV**	-	-
Tungsten carbide		800-1200	• Excellent resistance to heavy abrasion	×	◎	×	×	×	×	×	**HF-950 HF-1000**		-	-

1. MTM: Metal-to-metal wear; ABR: Abrasion; HTW: High temperature wear; CAV: Cavitation; COR: Corrosion wear; HRT: Heat resistance; IMP: Impact wear; ◎ : Excellent; ○ : Good; △ : Slightly no good; × : No good; –: Not used for general applications.

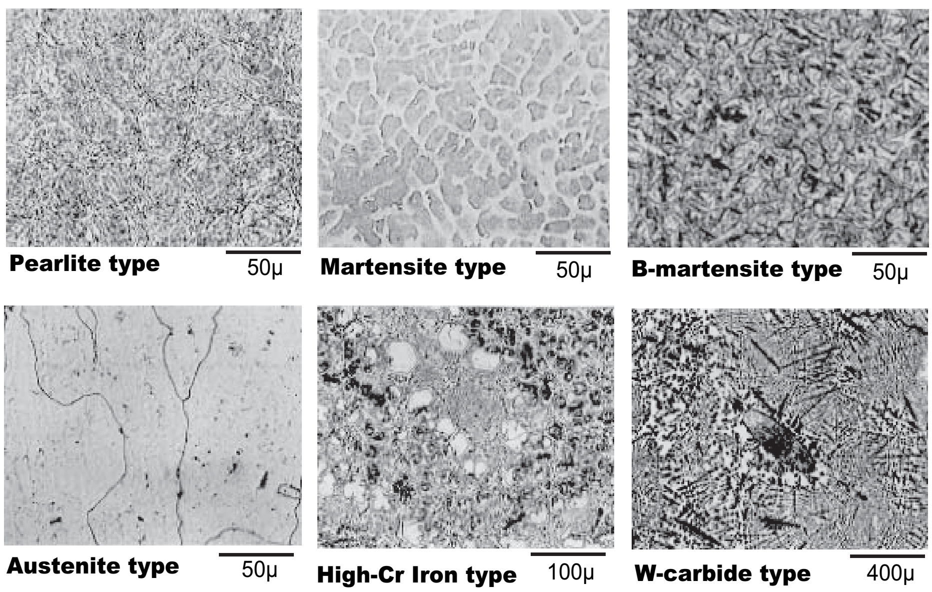


Figure 7: Typical microstructures of different hardfacing deposited metals [Refs. 1 and 2]
(The microstructure of hardfacing alloys consists, depending on the chemical composition, of hard-phase precipitates such as Fe, Cr, Mo, W or V carbides or Fe-borides in a softer iron matrix.)

In addition to the standard filler metals, many more proprietary types (including wires, strips, and fluxes for submerged arc welding) are available from suppliers.

In practice, selecting an appropriate filler metal by analyzing the microstructure of the weld metals and characteristic alloying elements is more useful than by using the standardized classifications, as shown in Table 1. For example, pearlite-type filler metals resist metal-to-metal wear (MTM) (or adhesive wear) and impact wear (IMP), but not abrasion (ABR) and high temperature wear (HTW), and they have poor heat resistance (HRT). Each type of deposited metal has a microstructure (Refer to Figure 7) that can be characterized by describing advantageous qualities and limitations.

(1) PEARLITE TYPE
This type of filler metal deposits a metal with a pearlitic microstructure when the weld is cooled in still air after welding. Pearlitic deposited metal exhibits comparatively low hardness; while it does not resist scratching abrasion, it is suitable for underlaying (rebuilding) before hardfacing with harder filler metals. This type of filler metal can also be used for hardfacing the work that has to be machined after welding. This type of deposited metal features quench hardenability; therefore, it can be hardened by induction and flame hardening to improve wear resistance. Typical applications include shafts, gears, and wheels. Figure 8 shows an example of a hardfacing application.

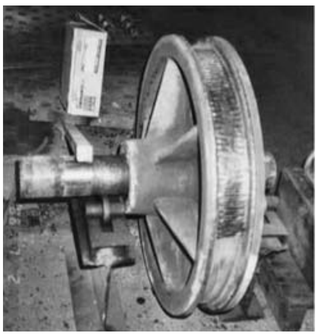


Figure 8: A wheel made of low alloy steel as a typical application for **DWH-250** flux-cored wire of pearlite type.

(2) MARTENSITE TYPE
This type of filler metal contains sufficient amounts of carbon and alloying elements so that the deposited metal transforms to martensite in the as-welded condition in still air. Martensitic deposited metal offers excellent resistance to wear due to its very high hardness. On the other hand, it does not resist impact wear because of its lower ductility. The martensite type includes boron-martensite filler metals (**HF-800K** and **DWH-800**) that exhibit higher hardness with boron and the gamma-rich martensitic filler metal or semi-austenitic filler metal (**HF-12**) that features excellent ductility with residual austenite. Typical applications include bulldozer idlers, rollers and truck links, bucket edges, tamping dies, mixer blades, cutter knives, and casings. Figure 9 shows an example of hardfacing application.

Figure 9: A crusher arm of mild steel, a typical application for **DWH-800** flux-cored wire of the boron martensite type.

(3) 13%Cr STAINLESS STEEL TYPE
This type of filler metal provides a martensitic deposited metal, which exhibits excellent metal-to-metal wear resistance at high temperatures. **HF-13** is suitable for valve sheets and agitator propellers. **CR-132, CR-134, CR-136, DWH-131S, DWH-132**, and **DWH-134** are suitable especially for rollers of steel mills.

(4) HIGH-Mn AUSTENITE TYPE
This type of filler metal features a microstructure of austenitic deposited metal at room temperature. Variations include 0.8%C-13%Mn and 0.7%C-16%Mn-16%Cr formulas. The 0.8%C-13%Mn type (**HF-11, DWH-11**) offers high ductility and high work-hardenability. It exhibits excellent resistance against impact-wear and gouging wear, but poor resistance to grinding abrasion. The 0.7%C-16%Mn-16%Cr type (**HF-16, DWH-16**) maintains high hardness at elevated temperatures over 700°C, allowing it to resist high-temperature wear and impact-wear. Typical applications of 0.8%C-13%Mn type include crusher hammers and jaws. The 0.7%C-16%Mn-16%Cr type filler metals are used for hot shears and saws, rolling mill guides, and hot forging dies. **MC-16** (0.1%C-16%Mn-16%Cr type) offers a stable austenitic structure with high ductility, which is suitable for joining 13%Mn steels and rail crossings and for underlay-

ing before hardfacing. Figure 10 shows an example of a hardfacing application.

Figure 10: A typical application for **DWH-16** flux-cored wire of the high-Mn austenite type: a hot shear bite of med.C-1%Cr-Mo steel.

(5) HIGH-Cr IRON TYPE

This type of filler metal features 2.5-6%C-20-35%Cr deposited metal, which exhibits a microstructure consisting of a large amount of Cr-carbide precipitated in a cast iron matrix. The hardness of the deposited metal is around Hv700; nevertheless, its wear resistance is superior to that of conventional Hv700-class martensitic deposited metals because of very hard Cr-carbide (Hv: 1700-2000) dispersed in a hexagonal or acicular shape in the matrix as shown in Figure 7. On the other hand, the resistance to impact wear is low. Typical applications include crusher rotors and sand pump casings. Figure 11 shows an example of a hardfacing application.

Figure 11: A typical application for **DWH-30** flux-cored wire and **HF-30** covered electrode of the high-Cr iron type: a double-roll crusher of mild steel.

(6) TUNGSTEN CARBIDE TYPE

The deposited metal of this type of filler metal features a microstructure consisting of very hard, tungsten carbides (Hv: 1900-2500) precipitated or intervened in the matrix; therefore, its microscopic hardness exhibits varied measurements. The nominal hardness of HF-950 deposited metal is Hv930, and that of HF-1000 deposited metal is Hv1038. This type of deposited metal exhibits very good resistance against heavy abrasive wear, but poor impact resistance. Typical applications include shovel teeth, cutter knives, concrete cutters, and earth drills. Figure 12 shows an example of a hardfacing application.

Figure 12: A typical application for **HF-950** covered electrode of the W-carbide type: dipper teeth of high-Mn steel.

Tips for successful hardfacing

In order to prevent cracking in the rebuilding and hardfacing of the weld, the control of preheat and interpass temperature is essential. Table 2 provides a guide to preheat and interpass temperatures in relation to the carbon equivalent of the base metal. In order to determine the exact preheat and interpass temperature, the size of work, the type of filler metal, and the welding process should be taken into consideration even when the carbon equivalent is the same.

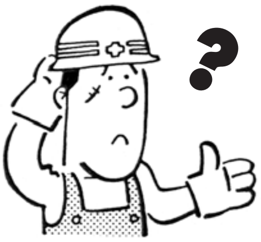
Table 2: A guide to preheat and interpass temperature

Type of base metal	Carbon equivalent[1]	Preheat and interpass temperature (°C)
Carbon steel and low-alloy steel	0.3 max	100 max.
	0.3-0.4	100 min.
	0.4-0.5	150 min.
	0.5-0.6	200 min.
	0.6-0.7	250 min.
	0.7-0.8	300 min.
	Over 0.8	350 min.
High-alloy steel (e.g. High-Cr steel)		400 min.
High-Mn steel (13%Mn steel)		Use no preheat and cool each pass faster.
Austenitic stainless steel		Use no preheat and control interpass temperature at 150°C max.

1. Carbon equivalent = C+1/6Mn+1/24Si+1/5Cr+1/4Mo+1/15Ni

»References«

[1] S.Yamamoto. Welding of Specific Steels and Cast Irons. Shinko Welding Service Co., Ltd.
[2] Kobe Steel Welding Technical Guide, No. 244, 1990



Welding of 13%Mn steel

Question:

We used manual arc welding to hardface a crusher jaw with a hard-facing filler metal of HF-11 of the 13%Mn type. Consequently, the weld detached from the base metal. What caused this to happen, and what welding procedure would have prevented it?

Answer:

Crusher jaws are typically made of 1.2%C-13%Mn austenitic cast steel. As this steel offers toughness and ductility with high work-hardening capability, it resists wear especially in service accompanied by impact loads. On the other hand when this steel is heated at temperatures above 300°C for prolonged periods, carbides precipitate at the grain boundaries, reducing toughness and ductility and thereby causing cracking. The high work-hardenability of this steel ensures that the surface layer is work-hardened after operation. Figure 1 shows how 13%Mn cast steel used in the mantle of a gyratory crusher can become work-hardened after operation. Clearly the layer at 1.5-2 mm from the surface exhibits markedly higher hardness than the interior.

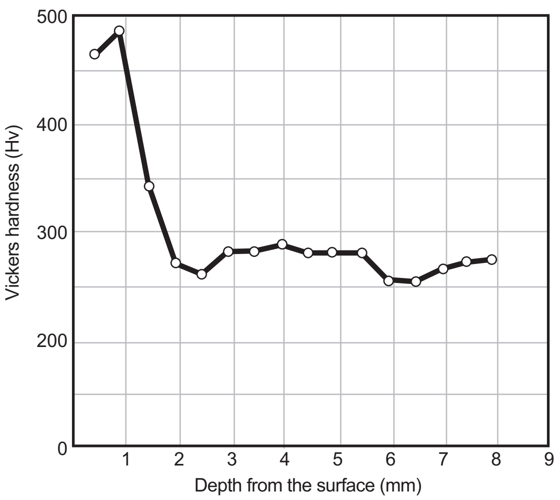


Figure 1: Hardness distribution of the 13%Mn cast steel mantle of a gyratory crusher after operation [Ref. 1].

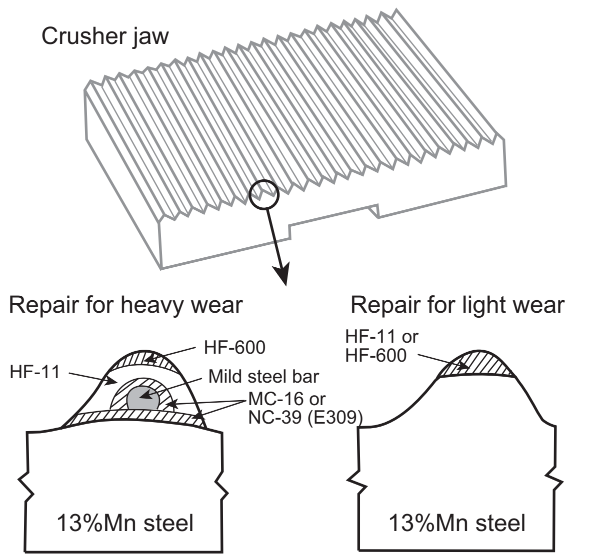
Crusher jaws can be rebuilt and hardfaced successfully by arc welding; however, on account of the properties of 13%Mn cast steel, close adherence to the following welding procedure is strongly recommended.

(1) Grind away the work-hardened layer of the base metal to prevent cracking in the interface between the weld metal and base metal.

(2) Avoid overheating the base metal — and thus prevent embrittlement caused by precipitation of carbides — by cooling the weld faster as follows:

- Use no preheat.
- Avoid continuous welding and, if possible, apply water to cool the workpiece.
- Interpass temperature should be 150°C max.
- Keep heat inputs as low as possible by limiting amperage and depositing stringer beads.

(3) Select appropriate filler metals depending on the amount of wear to be rebuilt or hardfaced as shown in the figure below. HF-11 is a 13%Mn austenitic hardfacing covered electrode. HF-600 is a martensite-type hardfacing covered electrode with a nominal hardness of Hv:600. MC-16 is a 16%Mn-16%Cr austenite-type covered electrode.



(4) Use no postweld heat in order to avoid carbide precipitation and embrittlement.

» Reference «

[1] S.Yamamoto. Arc Welding of Specific Steels and Cast Irons, Shinko Welding Service Co., Ltd.

Technical Services for Customers in Thailand and Singapore

Technical Services to Grow Pro-Kobelco Customers

First off all, I would like to introduce myself. My name is Rachan Rottaphol. I happened to start to work for TKW on my 24th birthday; therefore, I celebrated my new job with a birthday cake after my first-day of work. You may want to know my present age, but I dare not write it down here because I always encourage myself to tackle my job as a young man would accomplish new challenges.

Diligent students of a Technical College listen to the lecture provided by an engineer from TKW (above). A welding demonstration is very instructive to review the lecture (bottom).

The Customer Service Department to which I belong covers technical services for the customers for both Thai-Kobe Welding (TKW) and Kobe MIG Wire Thailand (KMWT). Our task is to provide customers with satisfaction from using Kobelco welding consumables in terms of technical support in accordance with the QTQ (Quality Products, Technical Support, and Quick Delivery) policy common to all the Kobelco Welding Group Companies.

As one of our department's activities, we hold welding training courses in cooperation with Technical Colleges (vocational schools) to extend a technical support for the students of the colleges. In Thailand, there are 76 Technical Colleges set up in individual provinces. The main purposes of this training course are to give the students a chance to learn about the present situation of the Thai welding industry, practical welding technologies, and marketed welding consumables. Specifically, the syllabus of this course includes (1) the welding processes and procedures practiced in Thai fabricators, (2) how to use welding consumables, and (3) welding defects and preventive measures. Moreover, welding techniques ranging from the basic level to the advanced level are demonstrated by our certified demonstrator. These specific programs are quite instructive to the students because what they can learn in this course is not included in their routine studies.

For the program this year, we have selected five Technical Colleges located in such industrial districts as Samutprakarn province, Bangkok, Rayong province, Nakhon Sawan province, and Ratchaburi province in cooperation with the Research and Development Dept. and Marketing Dept. of the TKW/KMWT. I believe this program will help the students acquire practical knowledge and skill, and I hope they will become pro-Kobelco customers in Thai industries after they finish school.

Reporter:
Rachan Rottaphol
Assistant Manager
Customer Service Dept.
TKW / KMWT

Technical service centers in the marine and offshore business

Hi, my name is Roy Goh, I'm with Kobe Welding Singapore (KWS). I belong to the Business Development Dept. (BDD), being engaged in technical service as part of my duties as a sales engineer. During my years of working for KWS, I have experienced handling a variety of technical matters. Recently, I have got very busy with customer services related to the offshore business.

Today, Singapore's marine and offshore industry is known as world-class with international clients. It is one of the world's premier ship repair centers and a world leader in the conversion of Floating Production, Storage and Offloading (FPSO) and Floating Storage and Offloading (FSO) units. The industry is a niche player for the building of customized and specialized vessels. Singapore is also a global leader in the building of jack-up rigs. Its rig-builders are capable of building, repairing, upgrading and converting rigs and other offshore platforms for operations in deep water and harsh marine environments. Renowned globally for its reliable and convenient range of comprehensive marine services, Singapore is a one-stop marine center for ship owners, managers, and agents around the world. Generating an annual turnover of $7 billion and employing some 48,000 workers, the marine industry plays a crucial part in Singapore's economic growth. Ship repair and conversion form the backbone of the local marine industry, accounting for more than half of the total revenue.

The boom in offshore structures came several years ago. To respond to this trend, the BDD started to collect and consolidate customer information in a market survey and, based on the results, was able to offer them unique submerged arc welding flux and wire of PFH-80AS/US-80LT for HT80 (780MPa) grade steel. This flux-wire combination performed excellently in the customers' DCEP power source applications. Due to our persistent and continuous efforts through technical proposals, presentations, supports, and follow-up, they finally accepted the combination of flux and wire for their jack-up rigs. Today our customers continue to be satisfied with its performance and have adopted it as their norm in production.

Jack-up rig is a typical application for PFH-80AS/US-80LT.
(Photo courtesy of Kansai Design Co., Ltd.)

This is an unprecedented achievement executed by KWS in collaboration with Kobe Steel. Recently, we have also started to offer a unique low hydrogen covered electrode for DCEP power source applications for offshore structures of HT80 grade low temperature steel. This electrode provides the good mechanical properties of the weld metal and joint together with excellent crack resistance. We, the entire staff of KWS, will continue to ascertain customer needs and respond to all aspects of welding technical matters to contribute to the welding industry, based on the QTQ slogan.

Reporter:
Roy Goh
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