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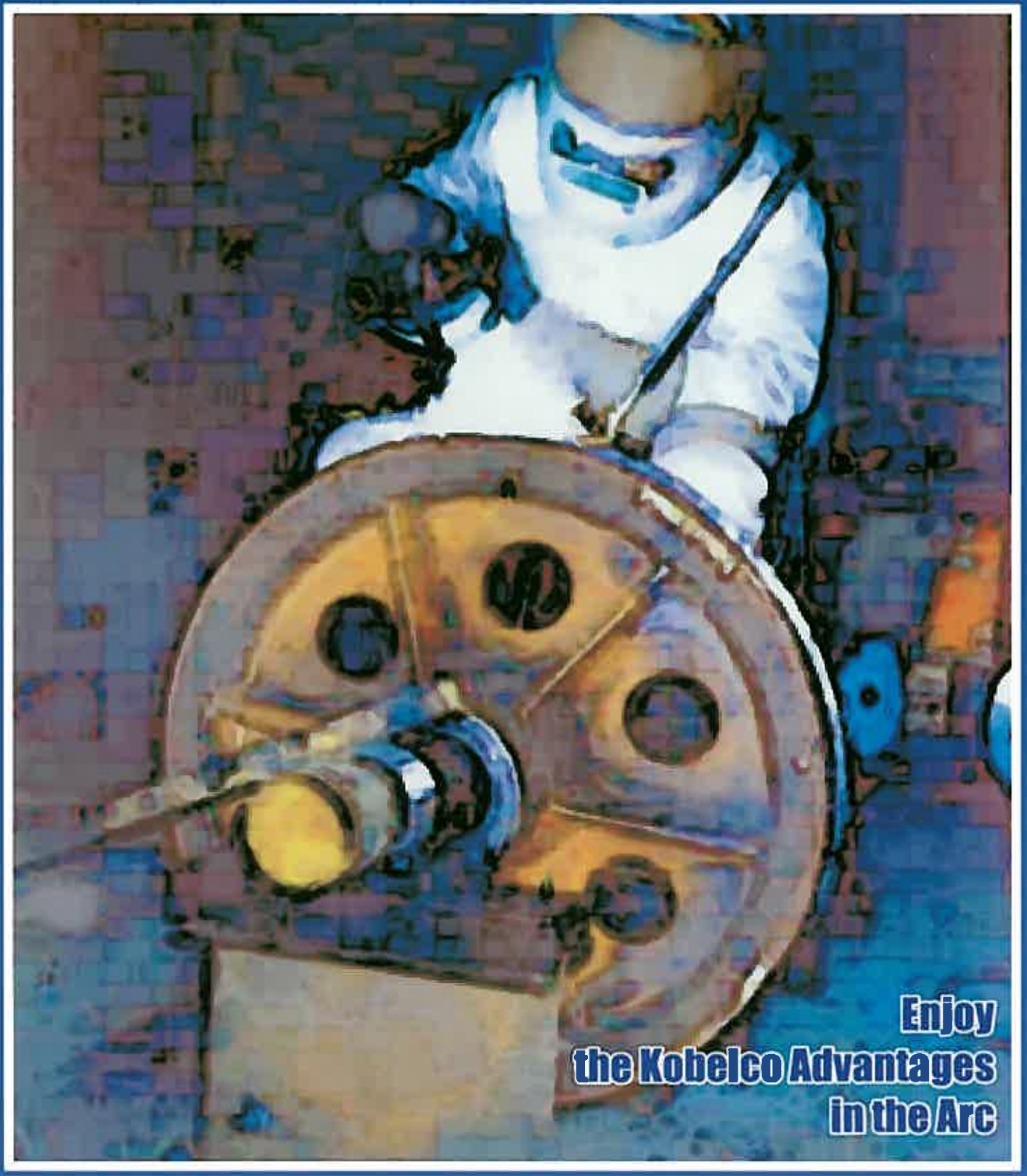


Isuzu Pick-Up Trucks: Boosting Business Pick-Up for IMCT

ISUZU MOTORS CO. (THAILAND) LTD. (IMCT) was established in 1963 and inaugurated in 1966 as a joint venture between ISUZU MOTORS LIMITED of Japan (IML) and Thai investors. IML was the first car builder in Japan and it has been the largest truck manufacturer in the category of medium- and heavy-duty trucks with gross vehicle weight of at least 6.1 tons. Based on this mother company's historically accumulated technological background and the persistent policy—Creation of Customer-Oriented Products and Services—IMCT has expanded its business, particularly, in the field of commercial vehicles.

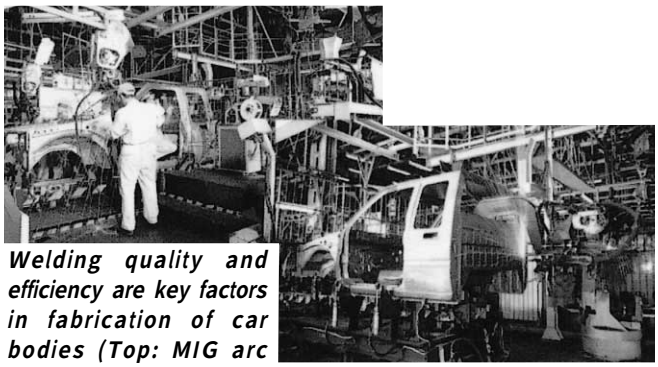
IMCT's head office rising high with much sunlight passing through its glass-rich structure in Phrapradaeng City, Thailand

IMCT started producing pick-up trucks in 1974. They began assembling truck engines, too, in 1988, which made IMCT a pioneer of the integrated car production system in Thailand. Since then, the production of pick-up trucks expanded year by year matching the Thai people's preference due to its multi-functional usability and excellent durability. In 1985, its Spacecab Model was released to strengthen the pick-up truck market share. In 1997, the production of pick-up trucks reached 1,000,000 units since its start of production.

IMCT's production management including unique quality control activities and in-factory skill/knowledge training involving all employees has provided unsurpassed pick-up trucks, which have been earning a persistently high reputation from users in the Thai market. The IMCT's quality assurance system was certified by ISO 9002 in 1998 for the production of pick-up trucks.

The peak of annual pick-up truck production, approximately 110,000 units, was reached in 1996 just before the recession caused by the devaluation of the Thai Baht in 1997. Since then, IMCT, along with other Japan-Thai joint venture companies has had to struggle to overcome the slumping economy. IMCT started the OEM supply of Isuzu TFR pick-up trucks to GM Thailand in 1997. In 1999, they started exporting pick-up trucks to Australia.

Recent gradual business recovery, particularly, in the auto industry in Thailand is encouraging IMCT's production. In 2000, IMCT produced 72,200 commercial vehicles and sold 63,000 in the Thai market. In addition, IMCT has ranked No.1 in the commercial vehicle field for 18 consecutive years and in the 1-ton pick-up truck category for five successive years. IMCT's pick-up trucks have been contributing effectively for picking up the business of this company.



Welding quality and efficiency are key factors in fabrication of car bodies (Top: MIG arc welding; Bottom: Spot welding)

MIG with solid wires is an indispensable arc welding process for fabricating car bodies. Since 1988, KOBE MIG WIRE (THAILAND) CO., LTD. (KMWT) has produced and supplied MG-51T (ER70S-6) to auto fabricators in Thailand. The spool wire is mostly used by semi-automatic MIG welding. A 250-kg-packed wire (Arrow Pack) is more suitable for automatic or robotic MIG processes because it can markedly decrease downtime when compared with spooled wires.

In order to support IMCT's expected expansion of production promoted by the latest technical and production collaboration signed between ISUZU and GM, we wish to continue to be a reliable supplier to IMCT by maintaining unmatched technical and commercial services so that they will be more satisfied.

Reported by Keiichi Suzuki
TKW/KMWT

Message from the Editor

General Manager

International Operations Department

Welding Company Kobe Steel, Ltd.

From the kick-off of the Korea-Japan World Cup at Seoul Stadium in Seoul, South Korea, until the closing cup final match at Yokohama Stadium in Yokohama, Japan, the spectacular sports show excited a lot of soccer fans all over the world. Historically the influence of such a big international show on the economy of the hosting countries have been huge. Though the economy of the co-host, Korea, has already been recovered, the economy of the other partner, Japan, is still sluggish. I hope the Japanese economy will start booming before the excitement of the World Cup cools off. Although the Cup was highly held up by the champion, Brazil, the greatest show on earth has made us all into big fans.

Meantime I believe Kobelco Welding Today is a good tool to send a lot of messages and information from KOBELCO to our dearest readers. The Internet home page of the Welding Company of KOBE STEEL can also be a useful source of information for you. Please visit our home page (http://www.Kobelco.co.jp) to find out interesting information about KOBELCO.

Masakazu Tojo
Editorial Chairman

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Letter from Tokyo

K. Sugiyama
Asst. Manager
Welding Company
Kobe Steel, Ltd.

Just 10 years have passed since I started working in the International Operations Department. Visiting many countries during that period, I have met many users and dealers. Besides having established a good business relationship with them, it is now a precious asset for me that I have been given chances of becoming acquainted with the cultures of many countries.

It seems to me that the welding business field is a gathering of strong personalities and that personal relationships are important. I should like to further strive for providing products and services of good quality with the memory of all the customers that I have met in various countries.

Indispensable 9Cr Filler Metals in Welding Power Boilers and Oil Refinery Machinery: CM-9, CM-9Cb and CM-96B9 for SMAW; TGS-9CM, TGS-9Cb and TGS-90B9 for GTAW

How 9Cr Filler Metals Help Innovate Power Boilers

Steam boilers (**Photo 1**) produce high-temperature high-pressure steam by heating pressurized water contained in hermetically sealed vessels through combustion of such fuels as coal, LNG, and oil. Steam boilers are widely used for such various applications as power plants, ships, steel mills, textile processes, chemical processes, and oil refineries.

Photo 1. A coal-fired steam boiler consists of the sophisticated piping system fabricated with tens of thousands of tubes and pipes made from carbon steel, Cr-Mo steel, and stainless steel.

Steam boilers, also known as power boilers, used in power plants generate high-temperature high-pressure steam for better power generation efficiency. The steam temperatures and pressures of coal-fired power boilers have been increasing to improve thermal efficiency. As the efficiency becomes higher, the consumption of fuels for generating unit electrical power can be decreased, thereby helping to combat global warming.

Among power boilers, supercritical pressure boilers are operated at high temperatures (e.g. 538℃) and high pressures (e.g. 24.1MPa). Ultra-supercritical (USC) pressure boilers are operated at even higher steam temperatures (e.g. 593℃) and pressures (e.g. 31.4MPa). Steam temperature and pressure are apt to be higher for more efficient power generation for the future.

As a factor in the technology of advanced power boilers, Modified 9Cr-1Mo steel (9Cr-1Mo-V-Nb) is highlighted due to its superior high temperature performance relative to conventional 9Cr-1Mo steel and Type 304 stainless steel. That is, 9Cr-1Mo-V-Nb steel can be used with a higher allowable stress in comparison with 9Cr-1Mo and, up to 600℃, in comparison with Type 304, as shown in **Fig. 1**.

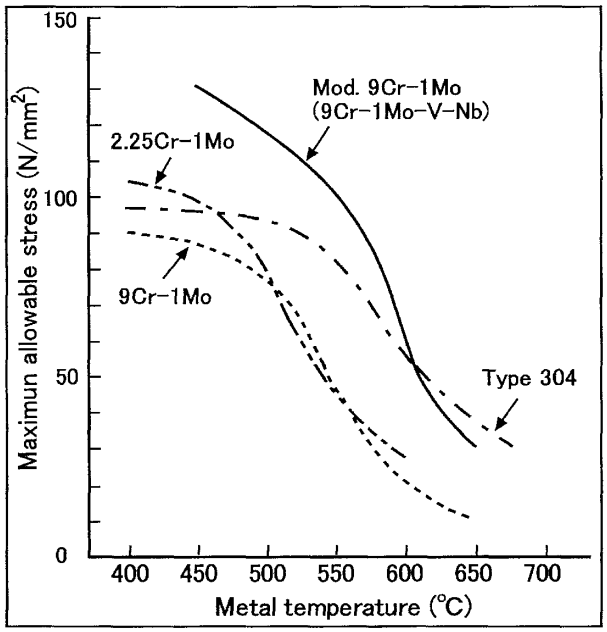


Figure 1. A comparison between 9Cr-1Mo-V-Nb and other steels on the maximum allowable stress for high-temperature equipment over a range of metal temperatures

The use of 9Cr-1Mo-V-Nb steel is expanding for ultra-supercritical pressure boilers. With ferritic 9Cr-1Mo-V-Nb steel, the countermeasures (e.g. use of expansion joints) to release thermal stresses in the tube bundle structures of steam boilers can be lessened than with austenitic Type 304, because the thermal expansion and contraction of ferritic 9Cr steels are less. The thermal stresses are raised by the thermal cycle during operation accompanied by the fluctuation of power generation in a day.

How to Select Suitable Kobelco 9Cr Filler Metals that Match the Mother Metal

Table 1 is a quick guide to suitable brands of filler metals for shielded metal arc welding (SMAW) and gas tungsten arc welding (GTAW) of 9Cr steels. The base metal grades are in accordance with the ASTM standard but this guidance can also be used for other equivalent base metal grades per other national standards.

There are two choices for 9Cr-1Mo-V-Nb steel. One is the Kobelco original type (CM-9Cb, TGS-9Cb), which satisfies the mechanical properties requirement of the AWS standard but its chemical composition is unique and it has been used for many ultra-supercritical pressure boilers fabricated by Japanese manufacturers. The other one is the AWS type (CM-96B9, TGS-90B9), which has been developed by modifying the original type so as to conform with both the mechanical and chemical requirements of the AWS standard, taking into account the usual requirements of international customers.

CM-9 and TGS-9CM: Highly Reputed for Piping Systems of Power Boilers and Oil Refinery Machinery

CM-9, since 1957, and TGS-9CM, since 1968, have been used for the process piping made of 9Cr-1Mo steel for high-temperature high-pressure boilers and oil refinery and chemical process machinery in both the domestic and overseas markets. Kobe Steel's persistent quality control and technical service have earned a high reputation from the customers of these brands.

The chemical compositions of CM-9 and TGS-9CM deposited metals match those of 9Cr-1Mo steels. However, the filler metals feature lower carbon, phosphorous and sulfur and higher manganese relative to the steel, as shown in **Table 2**. This unique chemical balance improves resistance to cold and hot cracking, creates a fine microstructure (**Photo 2**) with the absence of the ferrite precipitation, and provides good usability.

Table 2. Typical chemical compositions of deposited metals in comparison with the A213 T9 tube chemistry range (%)

Brand	CM-9		TGS-9CM	ASTM A213 T9
Current	AC	DCEP	DCEN	
C	0.08	0.08	0.06	0.15 max
Mn	0.68	0.79	0.56	0.30-0.60
Si	0.38	0.39	0.27	0.25-1.00
P	0.010	0.012	0.007	0.025 max
S	0.009	0.005	0.005	0.025 max
Cr	9.39	9.57	8.70	8.00-10.00
Mo	1.15	1.15	1.02	0.90-1.10

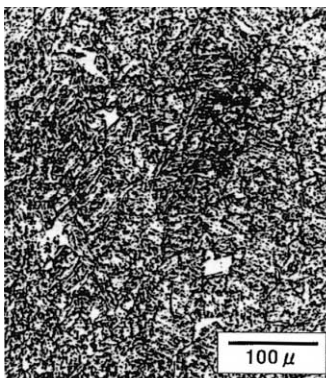


Photo 2. A microstructure of CM-9 deposited metal exhibits fine, tempered martensite without the precipitation of coarse ferrite (PWHT: 750°C×1h)

Table 1. A quick guide to matching filler metals for the 9Cr base metal grades

Type of steel	Grade of steel (ASTM)			SMAW (AWS A5.5)	GTAW (AWS A5.28)
	Plate	Tube/Pipe	Forging		
9Cr-1Mo	A387Gr.9 Cl.1, 2	A199Gr.T9 A213Gr.T9 A335Gr.P9	A182Gr.F9 A336Gr.F9	CM-9 (E8016-B8)	TGS-9CM (ER80S-B8)
9Cr-1Mo-V-Nb	A387Gr.91 Cl.2	A199Gr.T91 A213Gr.T91 A335Gr.P91	A182Gr.F91 A336Gr.F91	CM-9Cb (E9016-G)	TGS-9Cb (ER90S-G)
				CM-96B9 (E9016-B9)	TGS-90B9 (ER90S-B9)

The fine, homogeneous microstructure of CM-9 weld deposits offer sufficiently high strength over a wide range of PWHT conditions at both room temperature and elevated temperature as shown in **Fig. 2**, relative to the ASTM A213 Grade T9 tube used for boilers, superheaters and heat-exchangers. Creep rupture strength is important for the materials subject to stresses at elevated temperatures. **Figure 3** shows that CM-9 features sufficiently high creep rupture strength when compared with the average strength of 9Cr-1Mo steel.

In addition, the extra-low hydrogen content of the coating of CM-9 improves cold crack resistance in comparison with conventional low-hydrogen type electrodes. The flux composition of CM-9 is formulated so as to provide a stable arc, good slag fluidity and slag removal, which help a welder control the weld quality.

TGS-9CM offers good molten-pool washing onto the groove surfaces, which helps a welder control root pass contour in the all position welding of tubes and pipes. For mechanized GTAW, spooled TGS-9CM is available.

CM-9Cb and TGS-9Cb: Unmatched Filler Metals for Ultra-Supercritical Pressure Boilers

In the early 1980's when the research and development of coal-fired, ultra-supercritical pressure boilers began among the leading steel producers and boiler fabricators in Japan, Kobe Steel developed suitable filler metals for the Modified 9Cr-1Mo steel.

This advanced steel is alloyed with considerable amounts of vanadium, niobium and nitrogen in addition to chromium and molybdenum to improve elevated-temperature strength. However, filler metals, inherently, cannot accommodate as much niobium and nitrogen as contained in the steel because such elements result in poor weldability. This is why CM-9Cb and TGS-9Cb have unique chemical compositions that provide good performance in mechanical properties and welding workability in out-of-position welding. **Table 3** shows the typical chemical compositions of these filler metals, in comparison with the chemical requirements for a 9Cr-1Mo-V-Nb steel tube of ASTM A213 T91. Simple alloying of conventional 9Cr-1Mo filler metal with vanadium and niobium creates a heterogeneous

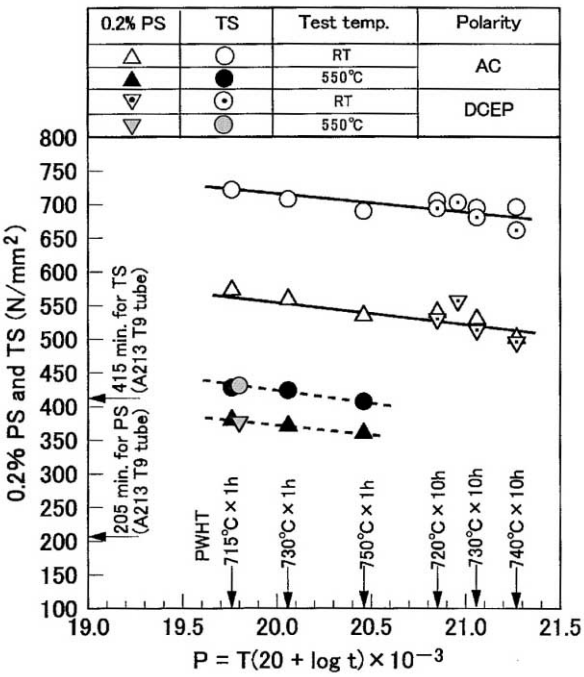


Figure 2. Mechanical properties of CM-9 (5.0φ) deposited metal in flat position as a function of Rarson & Miller temper parameter (P) in PWHT

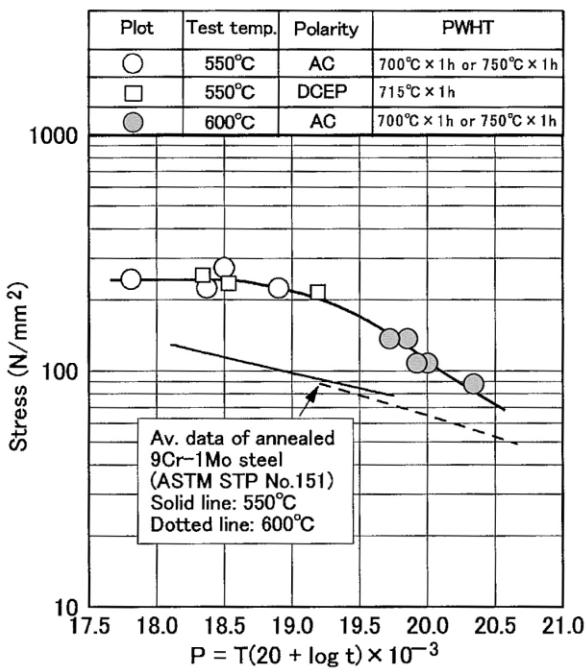


Figure 3. A master creep curve of CM-9 (5.0φ) deposited metal in flat position as a function of Rarson & Miller parameter in creep rupture testing.

microstructure consisting of coarse, polygonal ferrite precipitates in the martensitic matrix, thereby decreasing strength and impact toughness. However, CM-9Cb (**Photo 3**) and TGS-9Cb offer fine, homogeneous microstructures created by the elaborate chemical compositions.

Table 3. Typical chemical compositions of CM-9Cb and TGS-9Cb deposited metals, in comparison with the A213 T91 tube chemistry range (%)

Brand	CM-9Cb	TGS-9Cb	ASTM A213 T91
Current	AC	DCEN	
C	0.06	0.07	0.08-0.12
Mn	1.51	0.99	0.30-0.60
Si	0.31	0.16	0.20-0.50
P	0.006	0.008	0.020 max
S	0.003	0.006	0.010 max
Cr	9.11	8.97	8.00-9.50
Mo	1.06	0.90	0.85-1.05
Ni	0.94	0.68	0.40 max
V	0.18	0.18	0.18-0.25
Nb	0.03	0.04	0.06-0.1
N	0.030	0.022	0.030-0.070
Al	—	—	0.04 max

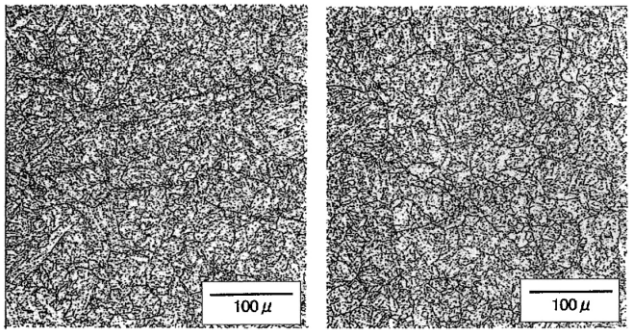


Photo 3. CM-9Cb deposits homogeneous microstructure consisting of tempered martensite with the absence of polygonal ferrite after PWHT (750°C×5h), exhibiting a dendritic zone in the left and a pass-to-pass tempered zone in the right

Typical applications for CM-9Cb and TGS-9Cb are girth welding of superheater tubes, reheater tubes and steam headers of USC boilers that are operated in hard steam conditions (e.g. 593℃×31.4MPa). Therefore, strength at elevated temperatures is a key property of this kind of filler metals. **Figures 4** and **5** show high-temperature strength and creep rupture strength of CM-9Cb deposited metal, respectively. These figures verify that CM-9Cb satisfies the minimum yield strength, tensile strength and rupture strength of Modified 9Cr-1Mo steel.

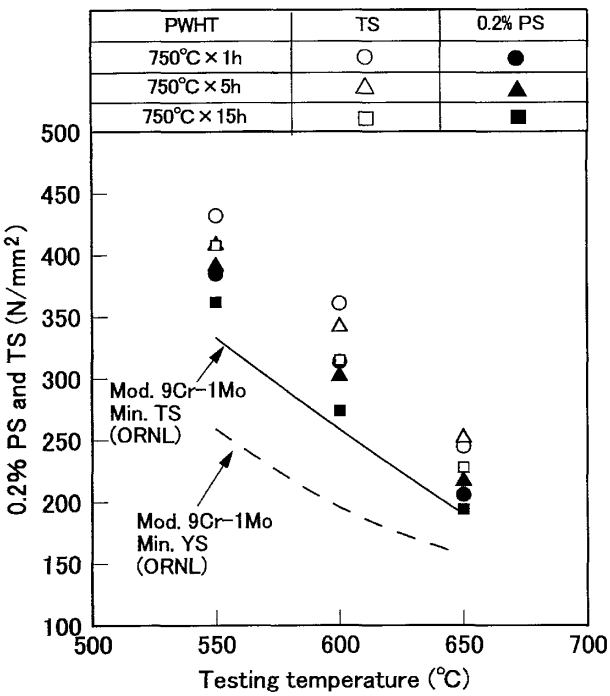


Figure 4. High-temperature strength of CM-9Cb (4.0φ) deposited metal in flat position, satisfying the minimum strength of Mod. 9Cr-1Mo steel within the given PWHT conditions

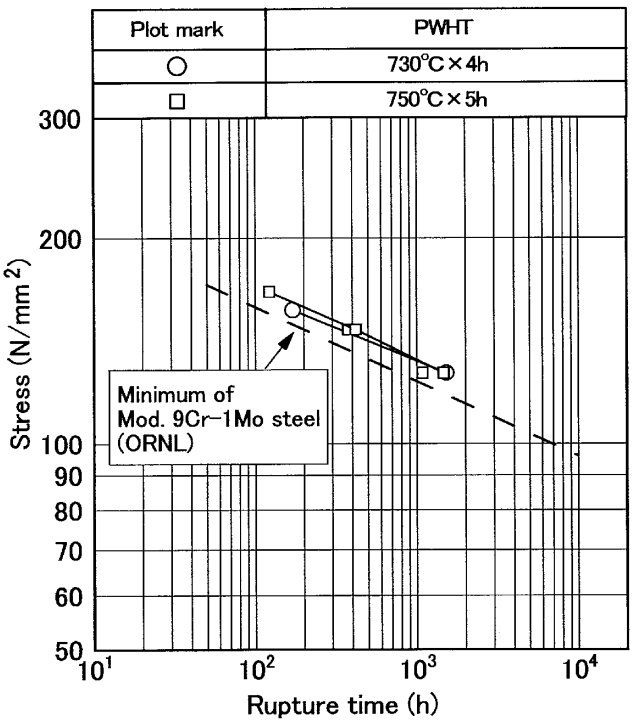


Figure 5. Creep rupture strength of CM-9Cb (4.0φ) deposited metal in flat position, satisfying the minimum rupture strength of Mod. 9Cr-1Mo steel

CM-96B9 and TGS-90B9: AWS Class Filler Metals for International Applications

These new brands have been developed by modifying the chemical composition of CM-9Cb and TGS-9Cb to make it easier to select a suitable filler metal for 9Cr-1Mo-V-Nb steel for international customers. The welding usability, mechanical properties and crack resistance of these new brands are comparable to the Kobelco original brands. **Table 4** shows typical chemical compositions of these brands and the AWS requirements for both filler metals.

Table 4. Typical chemical compositions of CM-96B9 and TGS-90B9 deposited metals in comparison with the AWS requirements (%)

Brand Current	CM-96B9 DCEP	TGS-90B9 DCEN	AWS E9016-B9	AWS ER90S-B9
C	0.11	0.12	0.08-0.13	0.07-0.13
Mn	1.12	1.04	1.25 max	1.25 max
Si	0.23	0.17	0.30 max	0.15-0.30
P	0.009	0.007	0.01 max	0.010 max
S	0.002	0.005	0.01 max	0.010 max
Cu	0.01	0.10	0.25 max	0.20 max
Ni	0.83	0.93	1.0 max	1.00 max
Cr	9.13	9.14	8.0-10.5	8.00-9.50
Mo	0.99	0.91	0.85-1.20	0.80-1.10
V	0.23	0.16	0.15-0.30	0.15-0.25
Nb	0.037	0.027	0.02-0.10	0.02-0.10
Al	—	—	0.04 max	0.04 max
N	0.027	0.050	0.02-0.07	0.03-0.07

Table 5 shows the mechanical properties of CM-96B9 and TGS-90B9 deposited metals for comparison with the AWS requirements. These data verify that both brands fulfill the requirements even in the stricter condition of PWHT with a longer soaking time than the AWS specification.

Table 5. Room temperature tensile test results of CM-96B9 (5.0 φ, DCEP)) and TGS-90B9 (1.2φ, DCEN) deposited metals in flat position in comparison with the AWS requirements

Brand	PWHT (℃×h)	0.2%PS (N/mm^2)	TS (N/mm^2)	El (%)
CM-96B9	740×1	754	850	20
	740×8	637	761	22
TGS-90B9	745×1	756	851	23
	745×8	603	770	26
AWS E9016-B9	740×1	530 min	620 min	17 min
AWS ER90S-B9	745×1	410 min	620 min	16 min

Tips for Successful Welding of 9Cr steels

(1) Remedies to cold or delayed cracks

9Cr-1Mo and 9Cr-1Mo-V-Nb steels have higher self-hardenability relative to such Cr-Mo steels as 2.25Cr-1Mo, 1.25Cr-0.5Mo, and 0.5Mo. Therefore, preventive measures against cold cracking must be stricter. The most effective measures are preheating the work by 250-350℃ and, if PWHT is not carried out before the weld cools down to the ambient temperature after welding is finished, postheating the weld by 250-350℃ for 30-60 minutes. Working in this manner can decrease the hardness of the weld, promote hydrogen diffusion out of the weld, and thereby prevent cold cracking. Redrying the covered electrodes by 325-375℃ for 1 hour is a must before use.

(2) Preventing hot or solidification cracks

Kobelco 9Cr filler metals contain phosphorous and sulfur at quite low levels and sufficient manganese to minimize the susceptibility to hot cracking or solidification cracking. However, 9Cr metals are inherently susceptible to hot cracking. Small diameter tubes having thin sections also sometimes suffer from hot cracks. Therefore, excessively high welding currents should be avoided.

(3) Proper PWHT temperature

PWHT temperature is a key factor to control the quality of 9Cr welds. ASME Sec. VIII Div.1, for instance, specifies a minimum PWHT temperature of 675℃ for 9Cr-1Mo steel (e.g. A213 T9) and 704℃ for 9Cr-1Mo-V-Nb steel (e.g. A213 T91). However, for better quality in ductility and toughness of weld metal, the range 710-780℃ is recommended for the 9Cr filler metals discussed in this article.

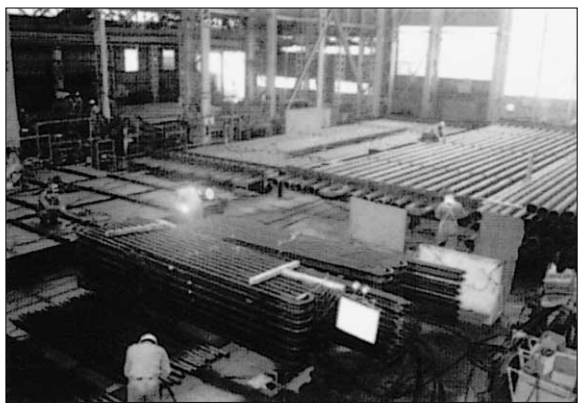
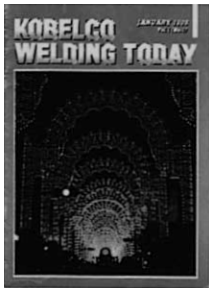


Photo 4. 9Cr steels are indispensable for superheater tubes, reheater tubes and steam headers of coal-fired steam boilers in the trend of higher steam conditions
(Photo courtesy: Nagasaki Kogyosho Co., Ltd., Japan)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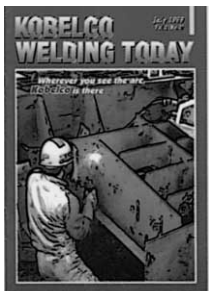
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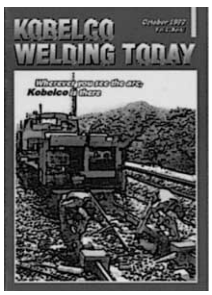
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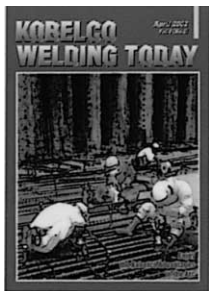
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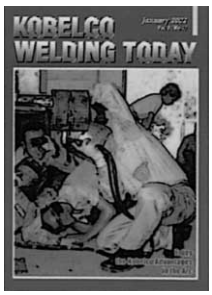
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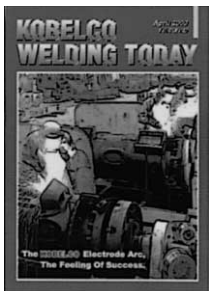
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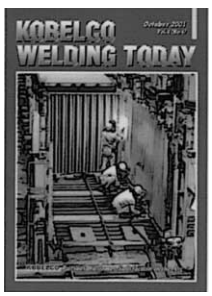
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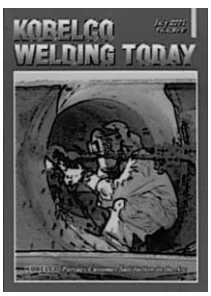
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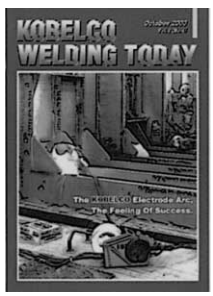
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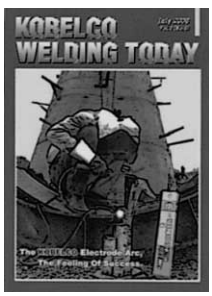
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KOBELCO WELDING TODAY, launched in January 1998, has now entered its fifth year, thanks to your constant support. To express our gratitude for your past and future support, we should like to offer a magazine file for KOBELCO WELDING TODAY shown in the following photo to 500 readers selected in a drawing. If you wish to win this Kobelco original magazine file, please send the information below to our E-Mail address. The deadline for entry will be August 31, this year. The winners will have the magazine file sent to them.

•E-Mail address: iod@melts.kobelco.co.jp
(1)Your name and company
(2)Mailing address and ZIP code
(3)Phone number and Fax number
(4)Your choice of the best article of the last 4 years and a half
(5)How you get the KWT magazine
(6)Your request or comment if any

We plan to revise the contents of KOBELCO WELDING TODAY from 2003 for your better satisfaction. May we expect your further support?

KWT editorial staff

Be happy with a Kobelco original magazine file: good for binding 20 KWT books in one; blue color; comical design of the smiling QTQ man; and ...

Kobelco Attains Record-Breaking Number of Sales Leads at MAX International or AWS Show 2002

Thousands of welding industry professionals came to Chicago to experience the American Welding Society's 2002 Welding Show, the largest welding event of the year. Chicago's McCormick Place South hosted 435 exhibitors, filling the 120,000-square-feet exhibition hall with the latest technologies in welding, cutting, and metal fabrication. More than 23,400 people registered to attend this Welding Show, anticipating the promise of finding advanced ways to join materials by experiencing state of the art in fabrication technology.

KOBELCO's booth was set up to provide the visitors with hands-on or "feel-free" access to the exhibits including DW Stainless Series, DW-50, Frontiarc-711, and MXA-70C6

Kobelco Welding of America, Inc. (KWAI) exhibited high quality flux-cored wires for stainless steel (**DW Stainless Series**) and mild steel (***DW-50***, ***Frontiarc-711***, *and* ***MXA-70C6***). In particular, ***MXA-70C6*** (AWS E70C-6M), a new metal-cored wire using an Ar+CO_2 gas mixture, attracted many visitors because this flux-cored wire offers higher deposition rates than ER70S-6 solid wire, little slag generation compared to solid wire, and is spatter free with a 90%Ar+10%CO_2 shielding gas.

In addition to the product display, KWAI put more emphasis on inviting visitors into the Kobelco booth, rather than attracting them with technical demonstrations. As an incentive to urge active participation by the KWAI salesmen in this campaign, "The Best Solicitor Award," was devised, and the booth was designed to provide plenty of space for business talks. As a result, KWAI succeeded in attaining a new record of 120 sales leads, which is almost three times the average number of sales leads we had in the past trade shows. The salesman who won the award was Ken Schwerin, a rookie of KWAI,

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Next year marks the 50th anniversary of the AWS Welding Show. This special milestone will be commemorated at COBO Hall in Detroit, Michigan, beginning on April 8th and running through April 10th. KWAI is looking forward to meeting you in Detroit.

Attending the AWS Show are all KWAI staff for sales and technical services for the US market

Discussing how to provide the visitors with "feel-free" entry into the booth are all KWAI staff, before the opening hour of the exhibition hall

Reported by A. Sawada, KWAI

JAPAN INTERNATIONAL WELDING SHOW 2002

The Kobelco Arc ... for a Better Global Environment and Harmony with People

The Japan Internationa1 Welding Show 2002 was held from April 24 through 27 at BIG SITE in Ariake in Tokyo. The theme of the show was "Toward Environmentally-Friendly Fabrication Technology in a New Era of Welding and Joining Created by IT." With this contemporary theme, the exhibition drew about 98,000 visitors. This figure is almost double that of the last show, which was unexpectedly big in the still sluggish Japanese economy. This seems to symbolize the large expectations for the welding industry.

The main theme of Kobe Steel's exhibits this time was "KOBELCO Establishes Harmony with the Whole Earth and Environment." As the readers may well be aware, we live in an era when retaining a good environment is a major responsibility for all of us. Therefore, with a view toward reducing the environmental load of welding operations, Kobe Steel has put strength on innovative welding consumables that reduce welding fumes and spatter and increase welding efficiency (thus reducing the load on welders). Kobe Steel exhibited the new covered electrode for shielded metal arc welding and the innovative solid wires for gas metal arc welding The non-copper-coated solid wires—but having special coating—lessen environmental impact by cutting out the copper-coating process during manufacturing.

A welding contest was held, too, for the members of the Shin-yo-kai, the sales network of Kobelco's welding materials that takes pride in more than 50 years of its brilliant history. The district representatives who were selected in the local elimination contests gathered for a high-leveled skill competition.

Japan International Welding Show 2002 was held at Tokyo Big Sight—the all-round convention facility having a huge floor area of 230,000 square meters (Courtesy of www.bigsight.or.jp)

The next welding show will be held in Osaka in 2004, the year when the Olympic Games will open in Athens. We look forward to seeing you at our booth in the show in Osaka.

Reported by D. Hino, KSL

Editorial Postscript

Thank you very much for reading KOBELCO WELDING TODAY. How swiftly time flies! It's already time to make a feature plan for the 5th year of this magazine. The thickness of the pile, from the first issue of KWT to the latest, shows us how much time has passed. Those who have puzzled over how to keep all the issues of the 5 years and those who wish to read the magazine more conveniently are fully encouraged to apply for the feature plan of the lucky draw for the magazine file. We should be very happy if you attach to your application, comments for improving the contents of KOBELCO WELDING TODAY. And please continue to stay with KWT.

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