

mitsubishi

HARDFACING ALLOYS



Mitsubishi Stands for Quality!



MITSUBISHI HARDFACING ALLOYS

Mitsubishi Materials Corporation has been developing and manufacturing special hardfacing alloys since the 1930's.

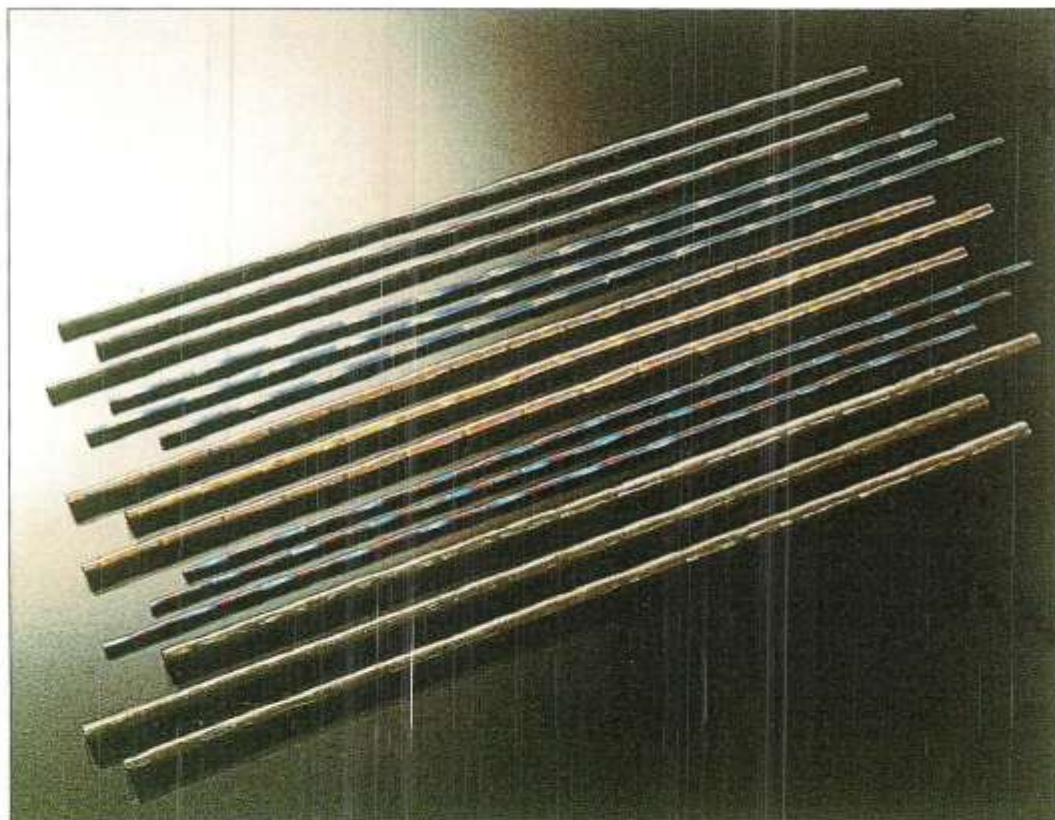
These hardfacing alloys include Cobalt base, Nickel base, Iron base and Tungsten Carbide Compounds which offer outstanding wear resistance at both room and high temperatures.

They are deposited onto metal surfaces which then become resistant to wear, corrosion and heat, giving increased life expectancy in service. To keep costs to a minimum the alloys are deposited only on those parts of a component which are subjected to extremes of heat or wear.

As well as their more applications in marine or vehicle engines, the special properties of these compounds make them valuable across a wide range of industrial applications. The oil & petroleum, nuclear, plastics, steel and metal-processing industries rely on them, as do glass bottle and ceramics manufacture. Quarrying, mining, earth-moving and construction, timber and the wood-pulp industry- all find hardfacing alloys essential to their day-to-day equipment reliability and long-term productivity.



POWDER



BARE CAST ROD

IMPORTANT NOTE

The properties listed in this booklet are typical or average values based on laboratory tests conducted by the manufacturer. They are indicative only of the results obtained in such tests and should not be considered as guaranteed maximums or minimums. Materials must be tested under actual service conditions to determine their suitability for a particular purpose.

Mitsubishi Materials Corporation makes no warranties, expressed or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose, except as expressly stated in Mitsubishi Materials Corporation's sales contract.

Quality Assurance System of MITSUBISHI MATERIALS CORPORATION OKEGAWA PLANT [ISO 9001]

Okegawa Plant, part of Mitsubishi Materials Corporation, has achieved ISO9002-1987 (JIS Z9902-1991) registration for quality system in 1993. Registration had been revised to ISO9001-2000 (JIS Q9001:2000) now. Besides ISO9001 registration, under its stringent controls implies a high level of customer approval, which includes customers in nuclear power plant, automobile industries, etc.

ISO9001 Management System Certificate








Certificate Number: **JQA-QMA10673**

Organization:
**MITSUBISHI MATERIALS CORPORATION
OKEGAWA PLANT
1230 KAKIIBIKIYA, OKEGAWA-SHI, SAITAMA, JAPAN**

JQA certifies that the above organization operates the Quality Management System, within the scope of the Appendix attached, which has been assessed and found to comply with the requirements of:

ISO 9001 :2000 / JIS Q 9001 :2000



Registration Date : November 21, 2000
Last Renewal Date : May 12, 2006
Expiry Date : May 12, 2006

M. Ueda
MITSUBISHI UEDA
PRESIDENT

JAPAN QUALITY ASSURANCE ORGANIZATION
To be used in conjunction with attached Appendix.

TOKYO, JAPAN**JQA**www.jqa.or.jp

ISO9001 Appendix

Certificate Number: **JQA-QMA10673** 1 / 1

Organization:
**MITSUBISHI MATERIALS CORPORATION
OKEGAWA PLANT**

Scope of Registration:
THE MANUFACTURE OF WELDING CAST IRON AND ELECTRODES, ATOMIZED POWDER, FORGINGS, SHEETS, STRIPS AND PLATES, COLD-WORKED PIPE AND TUBE, FORGICATED PRODUCTS, PRECISION FORGINGS FOR AUTOMOBILE, COPPER ALLOY EXTRUDED PRODUCTS, AND PRECISION CASTINGS (EXCEPT ASME STAMP APPLICATION)

ASSOCIATED ORGANIZATION:
- EISEI METALS CORPORATION
1230 KAKIIBIKIYA, OKEGAWA-SHI, SAITAMA, JAPAN
(THE MANUFACTURE OF FORGINGS, PRECISION FORGINGS FOR AUTOMOBILE, COPPER ALLOY EXTRUDED PRODUCTS)

Registration Date : November 21, 2000
Last Renewal Date : May 12, 2006
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M. Ueda
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JAPAN QUALITY ASSURANCE ORGANIZATION
This Appendix is an integral part of the Certificate and should only be used in conjunction with the Certificate.

TOKYO, JAPAN**JQA**www.jqa.or.jp

MITSUBISHI HARDFACING ALLOYS

ALLOY		NOMINAL CHEMICAL COMPOSITION (wt%)									TYPICAL HARDNESS HRC	
		Co	Cr	W	C	Fe	Si	Ni	OTHERS			
CO-BASE	MHA No.1	Bal	30	12	2.5	<3	<2	<3	—	54(G) 53(T)	46(D) 54(P)	
	No.4	Bal	30	14	0.6	<3	<2	<3	—	44(P)		
	No.6	Bal	28	4	1	<3	<2	<3	—	44(G) 43(T)	37(D) 40(P)	
	No.6H	Bal	30	5.5	1.3	<1.25	<2	<3	—	45(T) 38(D)	42(P)	
	No.12	Bal	29	8	1.35	<3	<2	<3	—	48(G) 47(T)	40(D) 47(P)	
	No.12H	Bal	30	8	1.5	<3	<2	<3	—	48(T)		
	No.21	Bal	27	—	0.25	<2	<1	<2.5	Mo:5	25(T) 33(D)	30(P)	
	No.21E	Bal	27	—	0.25	<2	1.5	<2.5	Mo:5	25(T) 33(D)	30(P)	
	No.32	Bal	26	12	1.8	—	<2	22	—	43(G) 41(T)	44(P)	
	No.190	Bal	26	14	3.2	—	<2	—	—	56(G) 57(T)	56(P)	
	No.1016	Bal	32	17	2.5	<3	<2	—	—	57(G) 57(T)	58(P)	
	No.694	Bal	28	19	0.9	<3	—	5	V :1	50(T)		
	No.400	Bal	8.5	—	<0.03	<3	2.6	—	Mo:28.5	53(P)		
	No.800	Bal	17.5	—	<0.03	<3	3.4	—	Mo:28.5	57(G) 58(T)	56(P)	
NI-BASE	No.40	—	7.5	—	0.25	2.5	3.5	Bal	B :1.6	37(P)		
	No.50	—	11.0	—	0.45	2.9	3.9	Bal	B :2.3	47(P)		
	No.60	—	14.8	—	0.75	3.5	4.3	Bal	B :3.1	57(P)		
	No.700	—	15.5	—	<0.03	<3	3.4	Bal	Mo:32.5	50(P)		
WC	501	Tungsten Carbide + Alloy B									HRA 76(G)	
	502	Tungsten Carbide + BISHILITE® No.6									HRA 83(G)	

Applicable Standard

MHA No.1 :AWS A5.21 ERCrC-C (BARE CAST ROD), AWS A5.13 ECoCr-C (COVERED ELECTRODE)
MHA No.6 :AWS A5.21 ERCrC-A (BARE CAST ROD), AWS A5.13 ECoCr-A (COVERED ELECTRODE)
MHA No.12 :AWS A5.21 ERCrC-B (BARE CAST ROD), AWS A5.13 ECoCr-B (COVERED ELECTRODE)
MHA No.21 :AWS A5.21 ERCrC-E (BARE CAST ROD), AWS A5.13 ECoCr-E (COVERED ELECTRODE)
MHA No.32 :AWS A5.21 ERCrC-F (BARE CAST ROD)
MHA No.190:AWS A5.21 ERCrC-G (BARE CAST ROD)

	AVAILABLE FORM			METAL TO METAL WEAR	IMPACT	EROSION	CORROSION	COLD ABRASION	HOT ABRASION *2	TYPICAL APPLICATION
	BARE CAST ROD	COVERED ELECTRODE	POWDER							
	○	○	○	◎	X	◎	◎	◎	◎	SEAL RINGS, CUTTERS, CHAIN SAWS, CRUSHERS
	○	○	○	◎	◎	◎	◎	○	○	DIES FOR DRY CELL BATTERIES
	○	○	○	◎	◎	◎	◎	○	○	ENGINE VALVES, EXTRUSION SCREWS
	○	○	○	◎	◎	◎	◎	○	○	ENGINE VALVES, EXTRUSION SCREWS
	○	○	○	◎	○	◎	◎	◎	◎	ENGINE VALVES & SEATS, EXTRUSION DIES
	○	○	○	◎	○	◎	◎	◎	◎	ENGINE VALVES & SEATS, EXTRUSION DIES
	○	○	○	◎	◎	◎	◎	○	○	HOT TRIMMING DIES, VALVES
	○	○	○	◎	◎	◎	◎	○	○	HOT TRIMMING DIES, NUCLEAR VALVES
	○		○	◎	◎	◎	◎	◎	○	ENGINE VALVES
	○		○	◎	X	◎	◎	◎	○	TRI-CONE ROCK BITS FOR OIL DRILLINGS
	○		○	◎	X	◎	◎	◎	○	CRUSHERS
	○		○	○	X	◎	◎	◎	◎	TURBINE BLADE INTERLOCKING SURFACES
	○		○	◎	X	◎	◎	◎	◎	VALVES
	○		○	◎	X	◎	◎	◎	◎	EXCELLENT WEAR RESISTANCE UNDER HEAVY ABRASION AND CORROSION
	X		○	○	◎	○	◎	○	○	MOULDS, VALVES AND PLUNGERS
	X		○	○	△	◎	◎	○	○	SHAFTS, SLEEVES
	X		○	◎	X	◎	◎	◎	◎	SHAFTS, SLEEVES, VALVE PLUGS
	○		○	◎	○	○	◎	○	○	VALVES
	○		○*3	◎	X	○	○	◎	◎	EXCELLENT WEAR RESISTANCE UNDER HEAVY ABRASION AND CORROSION
	○		○*3	◎	X	◎	○	◎	◎	GUIDE ROLLERS, SHOVELS, SHOVEL BUCKETS

* 1 G:OXY-ACETYLENE, D: SMAW, T:GTAW, P:PTA

* 2 ◎ EXCELLENT ○ GOOD △ SATISFACTORY X NOT RECOMMENDED

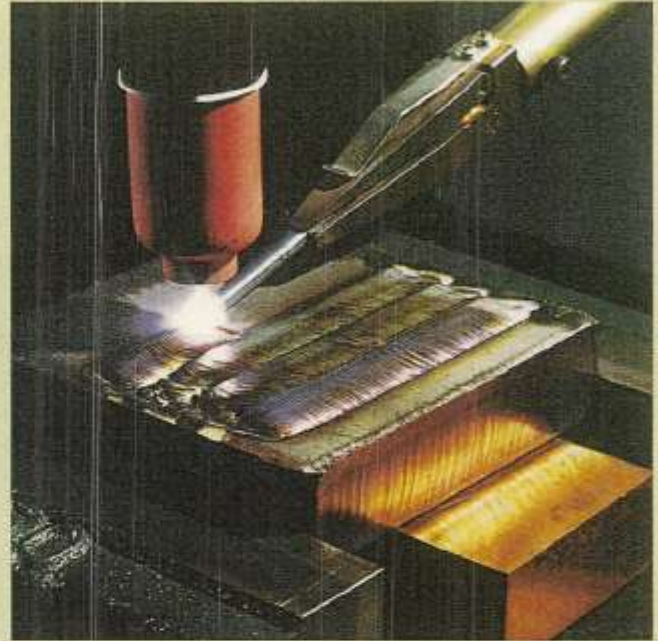
* 3 MIXED POWDER

PROCESS

AVAILABLE HARDFACING PROCESS



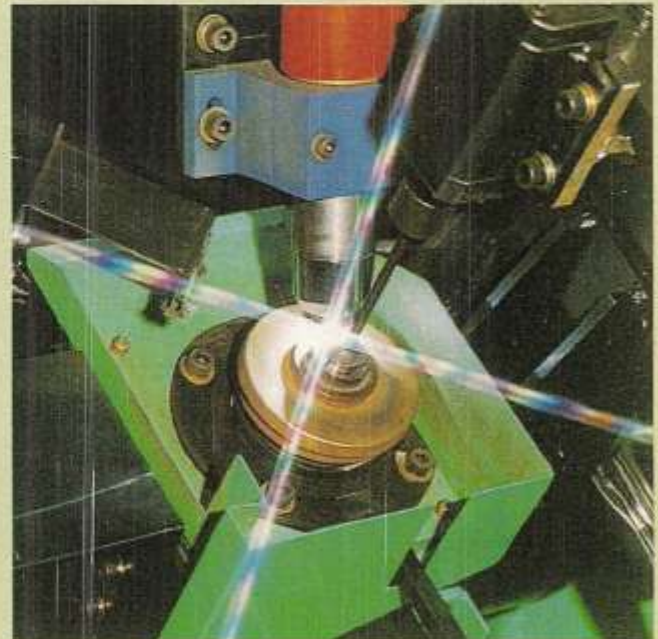
Oxy-Acetylene (O/A) Gas Process



GTAW Process



SMAW Process



PTA Process

Alloy No.		O/A GAS	SMAW	GTAW	PTA
Co-Base	1, 6, 6H, 12, 12H	○	○	○	○
	4, 21, 21E	×	○	○	○
	32, 190, 1016, 694, 400, 800	○	×	○	○
Ni	40, 50, 60,	×	×	×	○
	700	○	×	○	○
WC	501, 502	○	×	×	*○

○ Available
 × Not Available
 ※ Mixed Powder

AUTOMOBILE & MARINE INDUSTRIES



ENGINE VALVES
(MHA No.6, No.12, No.32, No.1)

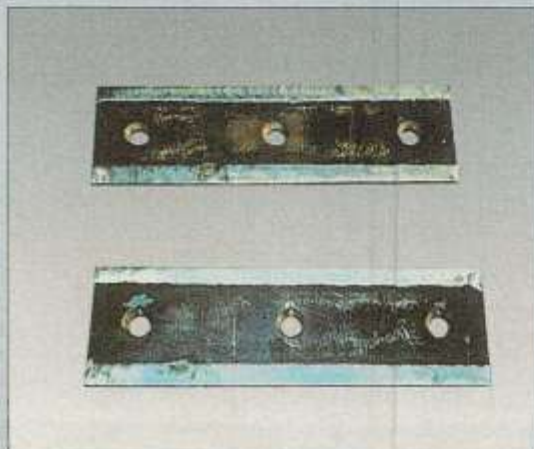


ENGINE VALVE & SEATS
(MHA No.6)

STEEL & METAL-PROCESSING INDUSTRIES



PINCH ROLLER (MHA No.12)

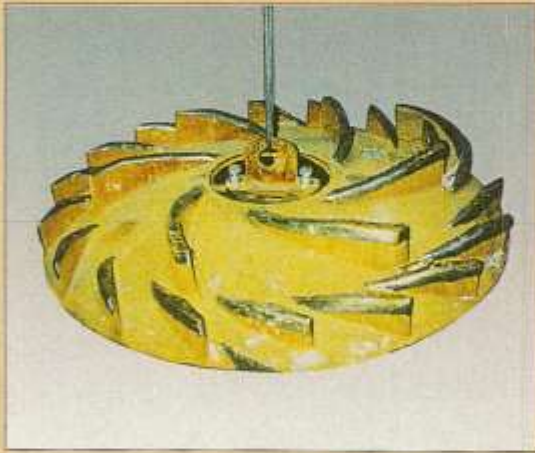


CRUSHER PARTS FOR LIMESTONE ROCK
(MHA No.1016)



ROLLERS (MHA No.12)

WOOD-PULP INDUSTRY



ROTOR (MHA No.12)



SCREW (MHA No.6)



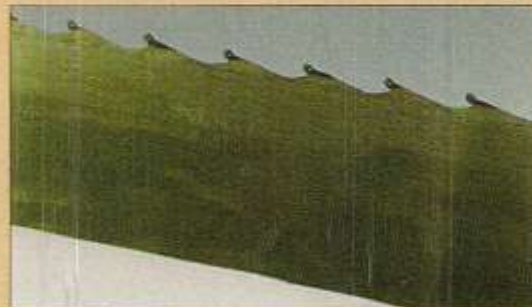
SCREW PRESS (MHA No.6)



ROTOR (MHA No.1)



CUTTING BLADES (MHA No.6)



CHAIN SAW (MHA No.1)

PETROCHEMICAL INDUSTRY



VALVE STEM (MHA No.6)



CRUSHER PARTS (MHA No.1)



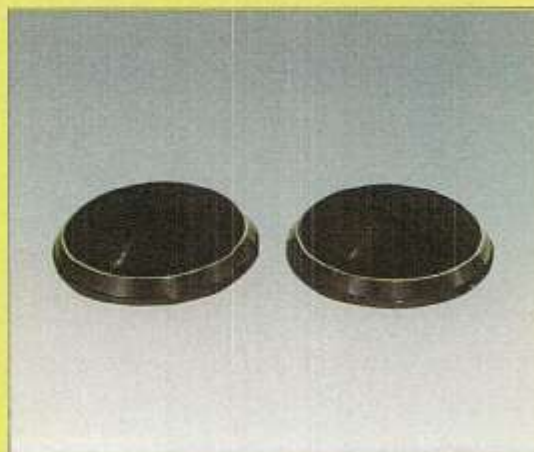
PLASTIC EXTRUSION SCREWS
(MHA No.6)



SEAT RINGS (MHA No.6)



THERMOWELLS (MHA No.6)



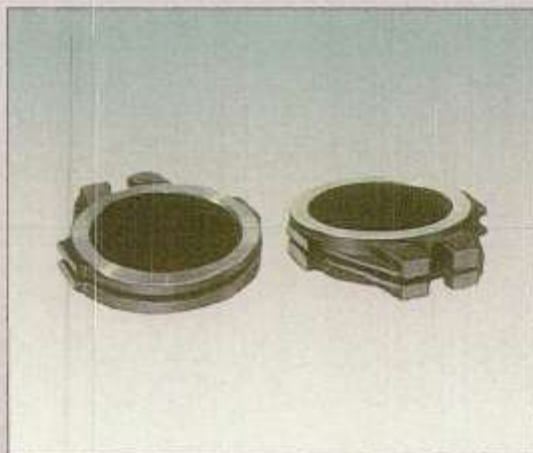
GLOVE VALVES (MHA No.6)

EXAMPLES

ELECTRIC POWER & ELECTRICAL INDUSTRY



ADAPTER (MHA No.6)



GATE VALVE DISCS (MHA No.6)



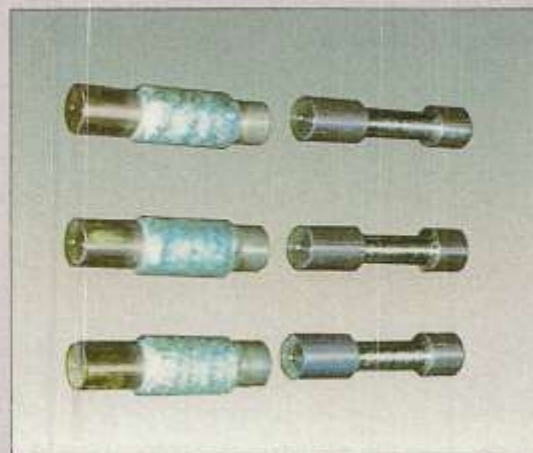
BEARINGS (MHA No.6)



SLEEVES (MHA No.6)



CUTTING BLADES (MHA No.6)



ADJUSTING BOLTS (MHA No.4)

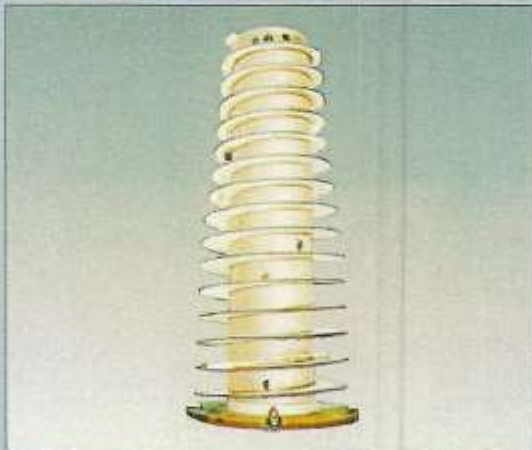
MACHINERY & OTHERS



RING (MHA No.12)



ROTOR FOR REFUSE DISPOSAL
(MHA No.12)



CENTRIFUGAL MACHINE SCREW
(MHA No.501)



STIRRING RODS (MHA No.6)



CYLINDER LINERS FOR RUBBER EXTRUSION
(MHA No.12)



WORM FOR FODDER CRUSHER
(MHA No.12)

PHYSICAL AND MECHANICAL PROPERTIES OF MHA

ALLOY	PHYSICAL PROPERTIES					MECHANICAL PROPERTIES	
	DENSITY (g/cm ³)	MELTING RANGE °C	SPECIFIC HEAT (cal/g·°C)	COEFFICIENT OF THERMAL EXPANSION (50~600°C) mm/m·°C	DYNAMIC MODULUS OF ELASTICITY (N/mm ²) ※	TENSILE STRENGTH (N/mm ²) ※	COMPRESSION STRENGTH (N/mm ²) ※
MHA No.1	8.48	1235~1320	0.094	13.1×10 ⁻⁵	249000	760	1580
MHA No.6	8.42	1260~1357	0.101	15.3×10 ⁻⁵	206000	920	1700
MHA No.12	8.47	1255~1341	0.098	14.1×10 ⁻⁵	200000	970	1780
MHA No.21	8.30	1358~1421	0.101	14.9×10 ⁻⁵	207000	800	2010
MHA No.32	8.68	1260~1349	0.101	13.8×10 ⁻⁵	274000	770	2000
MHA No.1016	9.00	1215~1299	0.104	12.8×10 ⁻⁵	265000	620	1650
MHA No.190	8.69	1214~1286	0.105	12.9×10 ⁻⁵	244000	880	2460
MHA No.694	9.04	1253~1437	0.098	13.2×10 ⁻⁵	250000	800	1910
MHA No.800	8.61	1275~1468	0.105	12.7×10 ⁻⁵	243000	690	1780
MHA No.40	8.22	1006~1084	—	13.2×10 ⁻⁶	—	—	—
MHA No.50	8.14	1002~1081	—	12.9×10 ⁻⁶	—	—	—
MHA No.60	7.80	971~1075	—	12.6×10 ⁻⁶	—	—	—
MHA No.700	8.63	1263~1356	0.096	12.0×10 ⁻⁶	215000	470	1450

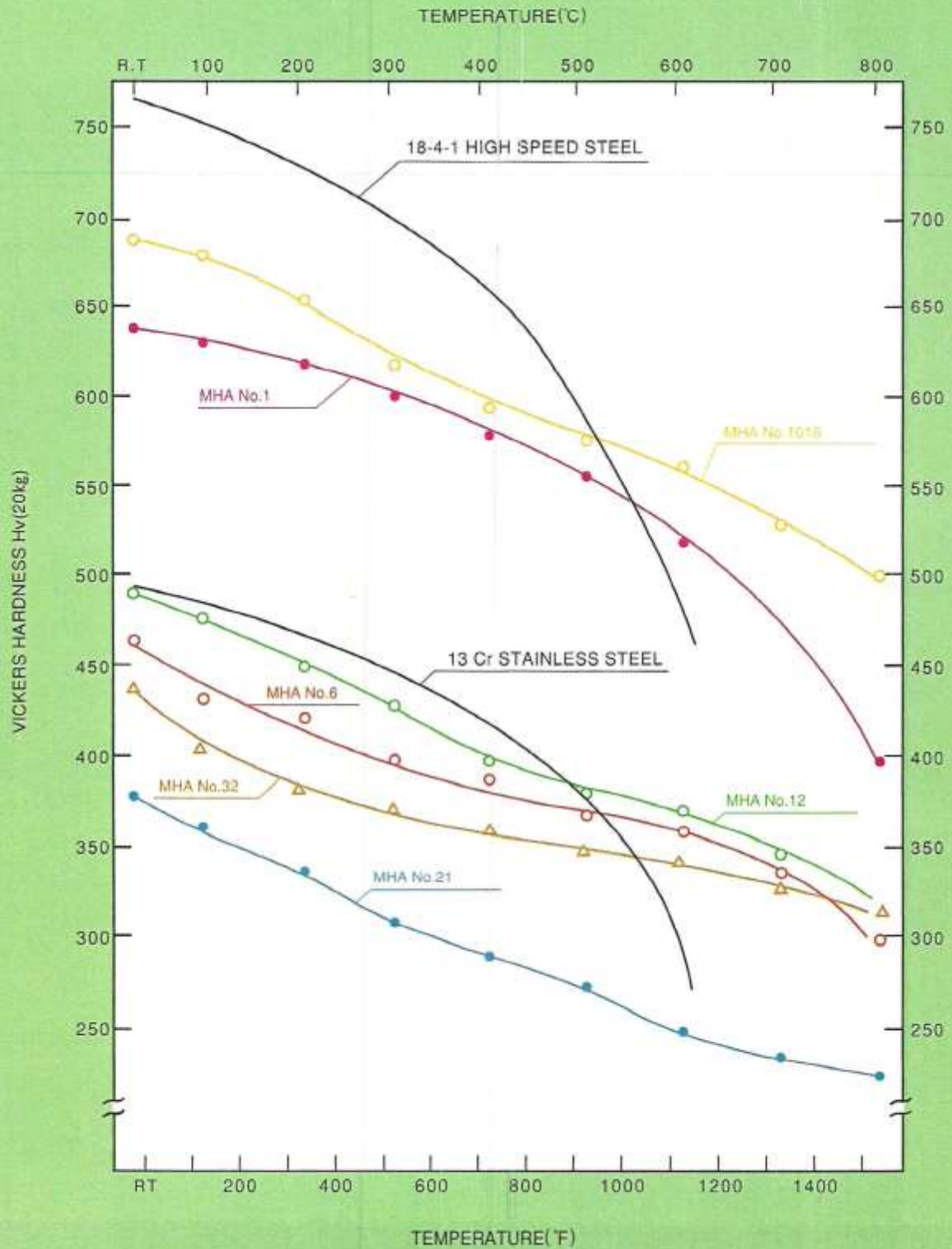
※ N/mm²×0.145=ksi, °F=(°C×9/5)+32

CORROSION RESISTANCE

MEDIA	CONCENTRATION	TEMPERATURE °C (°F)	MHA No.1	MHA No.6
ACETIC ACID	5%	BP	○	○
	80%	RT	○	○
	80%	BP	○	○
ACETIC ACID, GLACIAL		RT	○	○
		BP	○	○
NITRIC ACID	10%	BP	○	○
	65%	66°C (151)	△	×
HYDROCHLORIC ACID	1%	50°C (122)	—	○
FORMIC ACID	80%	BP	—	○
PHOSPHORIC ACID	10%	BP	●	○
	50%	66°C (151)	○	○
SULFURIC ACID	5%	RT	○	○
	5%	66°C (151)	○	○
	5%	BP	×	×
SEA WATER		RT	○	○
CHLORINE GAS (WET, DRY)		RT	○	○
SODIUM HYDROXIDE	5%	RT	●	●

CORROSION RATE
 ○ 0.13mm/yr max
 ● 0.13-0.51mm/yr
 △ 0.51-1.27mm/yr
 × 1.27mm/yr min

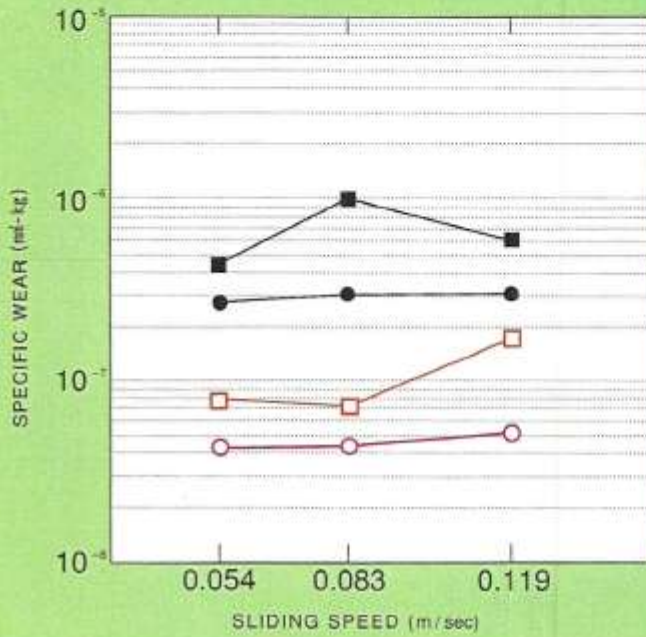
HIGH TEMPERATURE HARDNESS



PROPERTIES

COMPARATIVE WEAR DATA

(OHGOSHI TYPE WEARING TEST RESULTS)

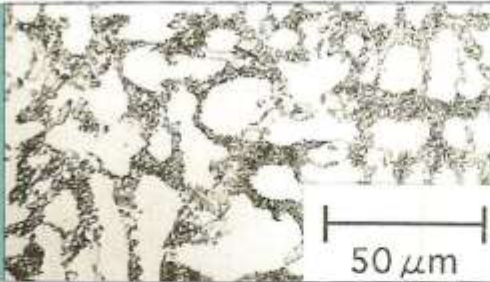


Dry in Air
 Room Temperature
 Load 18.2kgf(179N)
 Rotating Specimen: SUJ-2(HRC57)
 Fixed Specimen: ○ MHA No.1(HRC54)
 □ MHA No.6(HRC42)
 ● SKD 57 (HRC54)
 ■ S45C (HRC20)

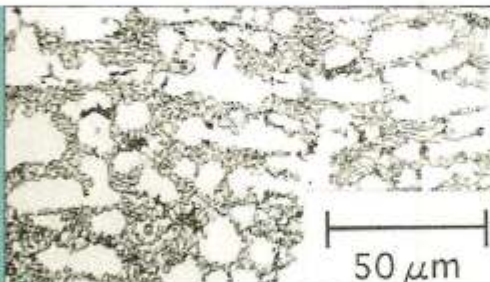
MICROSTRUCTURES

OXY-ACETYLENE

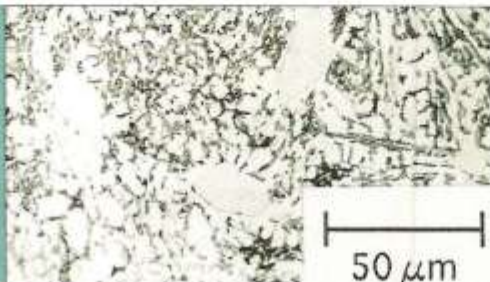
MHA No.1



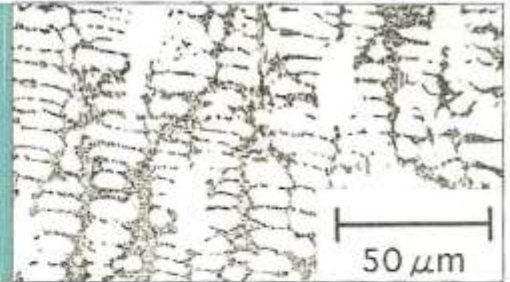
MHA No.12



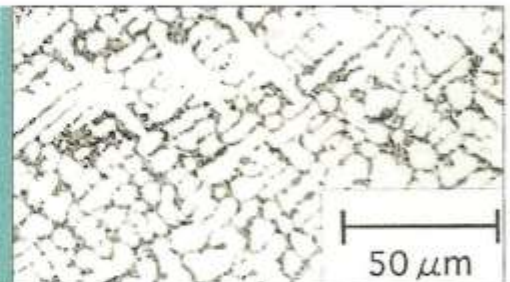
MHA No.1



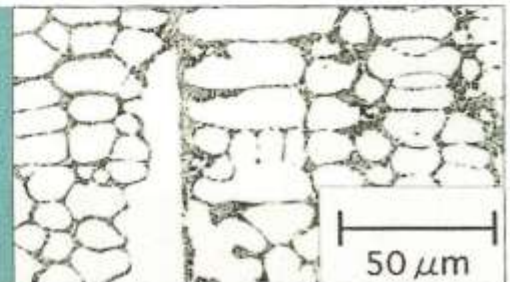
GTAW, MHA No.6



SMAW, MHA No.6



PTA, MHA No.6



HARDFACING PROCESS

● OXY-ACETYLENE PROCESS

This is the best process to control dilution of the hardfacing alloy by the base metal because the OXY-ACETYLENE flame temperature is much lower than that of an arc, so melting of the rod and preheating of the base metal are easily controlled. A general oxy-acetylene hardfacing guide is:

- (1) The surface of the part to be hardfaced must be free from rust, scale, grease, dirt and other foreign materials.
- (2) Preheat and postheat the work (if necessary) according to Table 1 to minimize the possibility of cracks developing in the deposit or base metal.
- (3) Produce "sweating surface" (ie, just melting the surface) by excess acetylene feather before starting hardfacing.
- (4) Use excess acetylene feather as shown in Figure 1 for depositing rod.

Flame Adjustment

Hardfacing Alloy No.	Recommended Flame
No.1, 6, 12, 32, 1016, 190 No.501, 502	3X

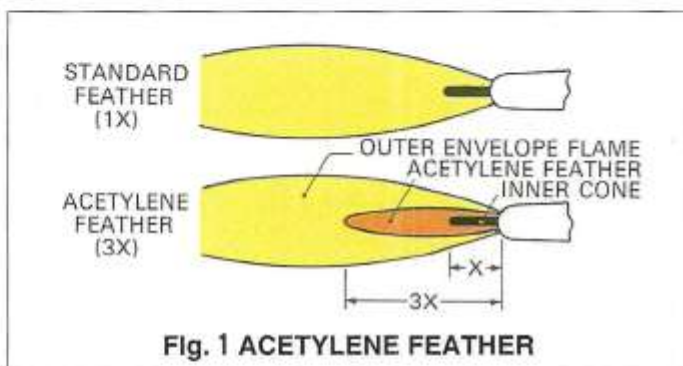


Fig. 1 ACETYLENE FEATHER

Table 1. Guide for Pre-heating and Post-heating

BASE METAL	PRE-HEATING	POST-HEATING
Low Carbon Steels (C : 0.4% max) (small items)	Unnecessary	Air-Cool
Low Carbon Steels (C : 0.4% max) (large items) High Carbon Steels Low Alloy Steels (small items)	350~450°C 660~840°F	Slow-Cool in Diatomaceous Earth
High Carbon Steels Low Alloy Steels (large items)	500~600°C 930~1100°F	Slow-Cool in Diatomaceous Earth
Air-Quench Type Steels	600~650°C 1100~1200°F	Hold for 30 minutes in 650°C (1200°F) furnace and Slow-Cool
Austenitic Stainless Steels (small items)	Unnecessary	Air-Cool
Austenitic Stainless Steels (large items)	500~600°C 930~1100°F	Slow-Cool in Diatomaceous Earth
13 Cr-Type Stainless Steels	600~650°C 1100~1200°F	Heat uniformly in 800~850°C (1480~1570°F) furnace and keep 650~700°C (1200~1300°F) for 4hrs. per 1 in. (25mm) thickness and cool 50°C (90°F) per hour.

●GAS TUNGSTEN ARC (GTA) PROCESS

When the oxy-acetylene process is not suitable for the base material or when carburization by oxy-acetylene deteriorates corrosion resistance of the base material, GTA is recommended. The general guide for this process is:

- (1) The surface of the part to be hardfaced must be free from rust, scale, grease, dirt and other foreign materials.
- (2) Preheat and or postheat the work according to Table 1 if it is necessary to minimize the possibility of cracks developing in the deposit or base metal.
- (3) Use direct straight polarity. Recommended nominal current settings are shown in Table 2.
- (4) Horizontal position is preferable.

Table 2. Guide for GTA Welding Current

Base Metal \ Rod Dia	1/8" (3.2mm)	5/32" (4.0mm)	3/16" (4.8mm)	1/4" (6.4mm)
Mild Steel/Low Alloy Steel	70~110A	90~130A	130~170A	170~220A
Austenitic Stainless Steel	80~120A	100~140A	140~180A	180~230A

NOTE: Use direct current straight polarity

Electrode: Thorium-Tungsten 3.2 to 5.0 mm dia Ar Flow Rate: 10 to 15 litres per minute

●METAL ARC PROCESS

When it is necessary to hardface in exposed field conditions, the metal arc process is usually appropriate. Recommended nominal current settings are shown in Table 3.

- (1) Direct current reverse polarity is preferable.
- (2) General guide for this process is the same as GTA.
- (3) If the information in Table 1 is inadequate, Table 4 provides additional information.

Table 3. Guide for Metal Arc Welding Current

Electrode Dia.	Direct Current	Alternating Current
1/8" (3.2mm)	80~110A	90~110A
5/32" (4.0mm)	100~160A	120~170A
3/16" (4.8mm)	130~180A	140~190A

Table 4. Pre-heating Guide for Hardfacing by Metal Arc Process

Alloy No.	Pre-Heating Temperature
MHA No.1	300~500°C 570~930°F
MHA No.6	150~350°C 300~660°F
MHA No.12	250~400°C 480~750°F
MHA No.21	150~250°C 300~480°F

●FINISHING

All of our hardfacing materials can be finished by machining or grinding. Generally alloys having hardness less than RC 55 can almost always be machined, whereas, alloys having hardness greater than RC 60 must be ground. For better surface finishes Mitsubishi Hardfacing Alloys should be ground.

●MACHINING

Information given in Table 5 serves as a general guide to machining. If the hardfaced surface is not smooth enough, manually grinding the surface before machining is recommended.

Table 5. Recommended cutting conditions

Cutting conditions	MHA No.1		MHA No.12		MHA No.6	
	Finish cutting	Medium cutting	Finish cutting	Medium cutting	Finish cutting	Medium cutting
Depth of cut(mm)	0.1~0.5	0.5~2.0	0.1~0.5	0.5~3.0	0.1~0.5	0.5~3.0
Feed(mm/rev)	0.05~0.1	0.1~0.3	0.05~0.1	0.1~0.4	0.05~0.1	0.1~0.5
Cutting speed(m/min)	10~20	7~15	15~25	10~20	20~40	15~30
Insert grade	VP05RT	VP10RT	VP05RT	VP10RT	VP05RT	VP10RT
Breaker	FJ,MS	MS,GJ	FJ,MS	MS,GJ	FJ,MS	MS,GJ

NOTE: 1. Use a shank more than 1 in. (25 mm) dia.
2. Final grinding of cutting edge shall be done by diamond grindingstone.

●GRINDING

General information for grinding is shown in Table 6. When coolant is used, it is necessary to pour sufficient coolant both for the work surface and the grinding wheel to avoid cracks in the deposit.

If cracks occur from grinding, the following techniques are recommended.

- (1) Frequent dressing for grinding wheel
- (2) Lessen grinding depth and feed
- (3) Increase work speed
- (4) Change to softer grade wheel
- (5) Decrease wheel speed
- (6) Supply enough coolant both to wheel and work

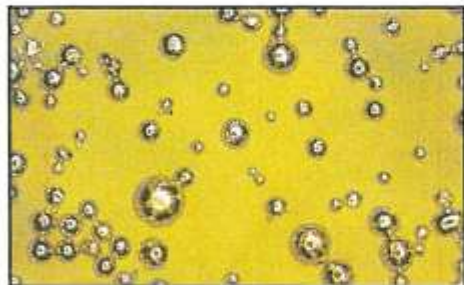
Table 6. General Grinding Guide

ABRASIVE GRAIN	ALUNDUM OR WHITE ALUNDUM
HARDNESS GRADE	G TO H
GRAIN SIZE	40 TO 80
GRINDING SPEED	900 TO 1300 MTRS/MINUTE 3000~4200 FT/MINUTE
COOLANT	DRY OR WET

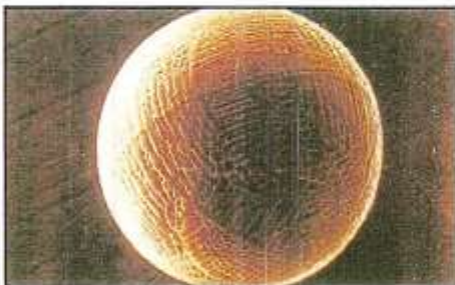
●CHARACTERISTICS OF MITSUBISHI GAS ATOMIZED POWDER

MITSUBISHI HARDFACING ALLOY POWDER has a number of advantages:

1. A high purity and a very low level of oxygen due to the inert gas atomizing process.
2. Good fluidity because of the spherical shape of each particle with the minimum of satellites.
3. A wide choice of alloy powders.
4. A full product range for Plasma Transferred Arc Welding, Thermal Spraying and the HIP process.



Appearance of Alloy Powder



SEM Image of Particle



Cross Section Micro Structure of Particle

●PLASMA TRANSFERRED ARC WELDING

Plasma Transferred Arc Welding (PTA) has come to play an important role in hardfacing.

Characteristics of PTA are;

1. Automatic welding is readily available and requires less operator skill.
2. High deposition rate (Twice that of GTAW)
3. Smooth deposit surface and fewer defects in the deposit.
4. Less dilution in deposit than GTAW
5. Alloy not available in rod or wire form can be used.
6. Blended powders can be used.
7. Controlling bead thickness is easier with PTA than with oxy-acetylene and GTAW (0.25—6.4mm, 0.010—1/4in.)

Mitsubishi PTA Powder

1. High quality and purity PTA welded beads obtained.
2. Good fluidity of powder
3. A wide range of Mitsubishi Hardfacing Alloy Powders from which to choose.

Typical Mitsubishi Hardfacing Alloy Powders

Particle Size	: 180/45 μm (80/325 Mesh), 150/45 μm (100/325 Mesh) Other Particle Size Available
Apparent Density	: >4.0g/cm ³
Flow Rate	: <18sec/50g
Unit Weight	: 5kgs/bottle or 10 lbs/bottle

●**THERMAL SPRAYING**

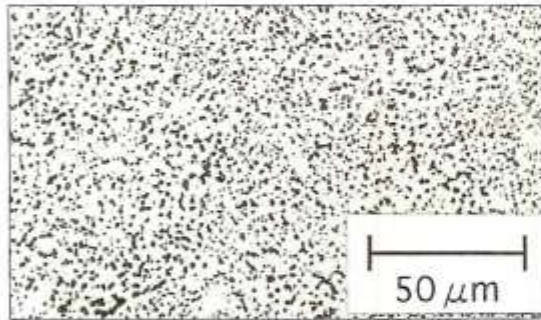
Mitsubishi Hardfacing Alloy Powders are made to suit requirements specified for different thermal spraying methods.

●**HOT ISOSTATIC PRESSING (HIP)**

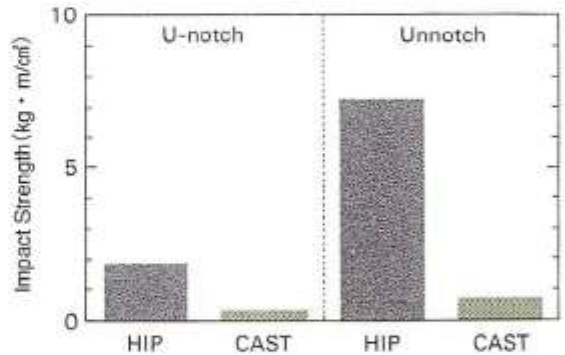
HIP is one of the metal working processes used for densifying rod or castings and manufacture of bi-metallic materials. Powders or rod are loaded into a pressure vessel after which the temperature is raised very high in an inert atmosphere. The subsequent application of high gas pressure presses on the items isostatically which increases the apparent specific density of the pressed powder.

Characteristics of the HIP Process

1. Homogeneous products free from segregation.
2. A very fine microstructure, higher toughness and strength.
3. Manufacture of bi-metal products such as bi-metal rolls and bi-metal cylinders.



Microstructure of MHA No.6 as HIP



AVAILABLE SIZES

○ Bare Cast Rod & Electrode ● Bare Cast Rod

	Diameter								Length mm (inch)
	Inches	0.079	0.094	1/8	5/32	3/16	1/4	5/16	
	mm	2"	2.4	3.2	4	4.8	6.4	8	
MHA No.1	●	●	○	○	○	○	○	○	Any Length Available
MHA No.6	●	●	○	○	○	○	○	○	
MHA No.6H	●	●	○	○	○	○	○	○	
MHA No.12	●	●	○	○	○	○	○	○	
MHA No.21	—	—	○	○	○	○	—	—	
MHA No.32	—	—	●	●	●	●	●	●	
MHA No.1016	●	●	●	●	●	●	●	●	
MHA No.190	●	●	●	●	●	●	●	●	
MHA No.694	—	—	—	—	●	●	●	●	
MHA No.501	—	—	—	—	—	—	●	●	
MHA No.502	—	—	—	—	—	—	●	●	150~360 (6.3"~14.2")

※Polished



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