

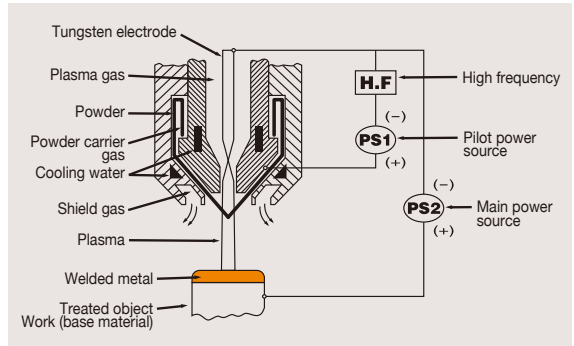
Plasma Powder Welding

Plasma arc welding goes beyond the limits of general arc welding. Powder selected according to the improvement objectives is welded with outstanding separation resistance.

PPW is a surface modification technology created by Daido by integrating powder application technologies at optimal levels. Compared to general arc welding (TIG, coat arc), this plasma arc welding technique makes possible cladding by a layer with outstanding wear resistance, heat cracking resistance, and separation resistance, providing components long life spans even when used under harsh conditions.

Principles of the PPW System

A powder that serves as the filler materials is injected into a plasma arc with good heat concentration in an inert atmosphere to form a welded metal film (layer) on the treated object.



Cladding Alloy Powders

Type	Cladding hardness HRC	Composition (%)									Properties			
		Co	Si	Ni	Cr	W	Mo	Fe	C	Corrosion resistance	Wear resistance Hot work	Wear resistance Cold work	Impact	
Cobalt alloys	KCM1 (equiv. to Stellite 21)	30	Bal.	1.0	3	26	—	5.5	<1.5	0.25	◎	○	○	◎
	KCW2 (equiv. to Stellite 6)	43	Bal.	1.0	—	30	4	—	<1.5	1.20	◎	○	○	◎
	KCW5 (equiv. to Stellite 25)	25	Bal.	1.0	10	20	15	—	<1.5	0.08	◎	○	○	◎
Nickel alloys	KCW3 (equiv. to Stellite 12)	47	Bal.	1.0	—	30	8	—	<1.5	1.50	◎	○	○	◎
	NCS2 (equiv. to Colmonoy No. 6)	60	—	4.0	Bal.	15	—	B3.0	3.0	0.70	◎	◎	◎	x
	NCS3 (equiv. to Colmonoy No. 5)	50	—	3.5	Bal.	12	—	B2.5	3.0	0.50	◎	○	○	△
	NCS4 (equiv. to Colmonoy No. 4)	40	—	3.0	Bal.	10	—	B2.0	3.0	0.30	◎	○	○	△
	R625 (equiv. to Inconel 625)	—	—	—	Bal.	21.5	—	9	—	≤0.10	◎	○	○	△
Powdered high-speed steel	DEX20	62	—	—	—	4	6.5	5	V3	1.30	△	○	◎	△
	DEX40	63	8	—	—	4	6.5	5	V3	1.30	△	○	◎	△
	DEX60	64	8	—	—	4	15	2	V5	1.70	△	○	◎	△

Other powdered materials including hardened particles (NbC, WC) and heat resistant alloys (Inconel 718) are supported; please inquire.

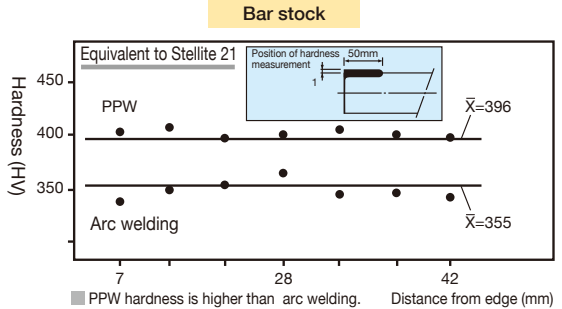
Range of Possible Machining

	Round stock		Pipe stock		Ring & disc stock	Bar stock
	Cladding exterior diameter	Cladding interior diameter	Cladding exterior/interior diameter		Surface cladding	Cladding exterior diameter
Exterior diameter	$\phi D_{20} \sim \phi D' 1,100$	$\phi ID > \phi 40, \phi OD < \phi 490$	$\phi OD \leq \phi 400$	$\phi ID > \phi 40$	ϕD	$\phi 1,500$
Length	L 1,900	L 3,000	L 4,000	L1 1,800	—	L 1,200
Mass	3,000	1,700	230		1,300	500
Thickness	—	—	—		T500	—

Other powdered materials including hardened particles (NbC, WC) and heat resistant alloys (Inconel 718) are supported; please inquire.

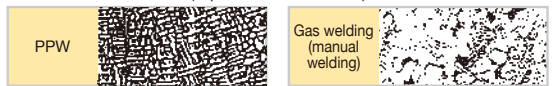
Features of PPW Treated Objects

1. Welding is possible even on difficult-to-weld materials.
 - Co-based and Ni-based alloy tool steels
 - WC, NbC, and other ultra-hard cladding
2. Two or more types of powder can be blended.
3. Welding yields with cladding material on the work (base material) is high, reducing the amount of cladding material used.
4. Computer-based, fully-automated welding is possible, providing exterior quality with a stable bead.
5. Attenuation of the work (base material) metal is minimal.
6. Cladding metal structure is dense, making it possible to achieve high hardness.



Microstructure of Cladding Layer

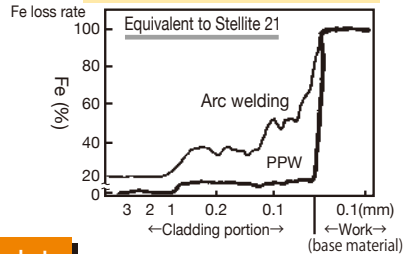
(Equivalent to Stellite 21)



Comparison of Welding Methods

	Exterior	Thermal impact range	Structure	Blending	Cladding uniformity
PPW	Small variation	Small	Fine crystal grains	Yes	Excellent
Arc welding	Medium variation	Large	Coarse crystal grains	No	Good
Gas welding	Large variation	Large	Coarse crystal grains	No	Good

Fe Transfer to Cladding Portion



Examples of PPW Treatment Effects on Hot and Warm Forging Products



Application/product	Work (base material)	Cladding Material (thickness examples)	Size	Effects
Axle rollers	SNCM439	KCW2 (equiv. to Stellite 6) (t 1.5)	<L1000	2-4 times greater than earlier treatments
Piercing punches	SKD61, DH71	KCM1, KCW2 (equiv. to Satellite 21, 6) (t 1.5)	Various	2-4 times greater than earlier treatments
Piercing dies	SKD61	KCM1 (equiv. to Satellite 21) DEX20 (t 1.5)	ø60 × L400	2-4 times greater than earlier treatments
Knockout pins	SKD61	KCM1 (equiv. to Satellite 21) (t 2.0)	ø20-ø60	2-4 times greater than earlier treatments
Moving and fixed blades	SKD61	KCM1 (equiv. to Satellite 21) (t 3.0)	For materials ø20-ø60	4-6 times greater than earlier treatments

We are available for consultations concerning work (base) materials, cladding materials (thickness), and other issues.