

# PTA

## PLASMA TRANSFER ARC MACHINE



# Professional Surfacing

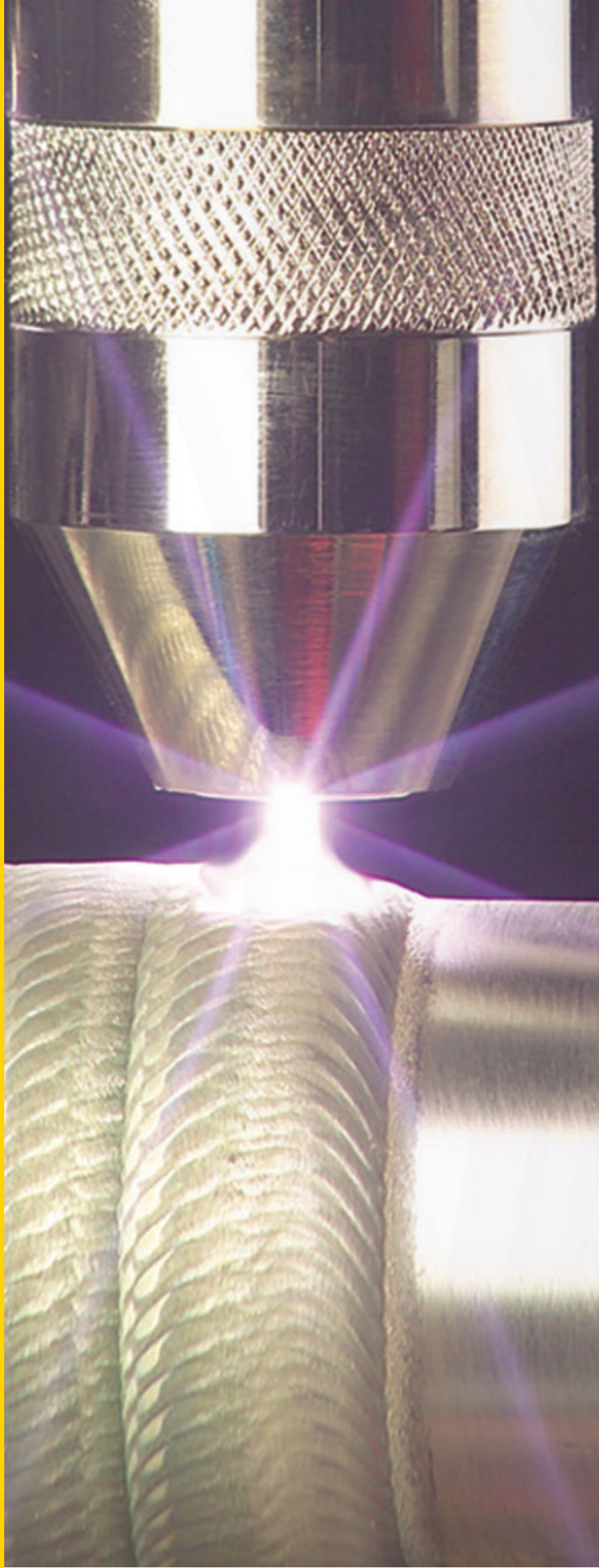
Kennametal Stellite is a global provider of solutions for wear, heat, and corrosion problems, and is a world-class manufacturer of Cobalt- and Nickel-based materials, coatings application equipment, and components.

Solid Cobalt- and Nickel-based alloy castings, coatings, and overlay materials provide protection for critical components in the operations of our customers in virtually all industries where high temperatures and wear are present. Our coatings application equipment may be added to your production facilities for added operational flexibility and control.

## Industries Served

Kennametal Stellite offers its proven heat, wear, and corrosion experience and customized solutions to a broad range of industries, including:

- **Aerospace**
- **Oil & Gas**
- **Automotive**
- **Power Generation**
- **Steel**
- **Lumber**
- **Glass**
- **Other Process Industries**



# Kennametal Stellite Professional Surfacing

Kennametal Stellite brings you the most competitive professional surfacing solutions with state-of-the-art hardfacing equipment and high quality component surfacing services. Together, Kennametal and Kennametal Stellite offer the ultimate in component surfacing competence, providing customers with efficient and effective surfacing solutions. By adding value to our customers' components and process equipment, we support their increased performance, quality, and productivity.

We bring over 100 years of experience to bear on your difficult high heat, wear, and corrosion problems. We have direct experience in a broad range of industry segments, and we have the knowledgeable staff standing by who can help to reduce your problem-to-solution cycle. Kennametal Stellite coatings provide:

- **Extended component life.**
- **Reduced friction, wear, and corrosion.**
- **Increased production equipment productivity.**
- **Improved engine efficiency.**
- **Reduced service cost for power generation equipment.**

## Plasma Transferred Arc Welding (PTA)

### Benefits of buying Kennametal Stellite PTA Systems.

Kennametal Stellite are unquestionably the leaders in the world in PTA technology, performance, reliability, after-sales service, build-quality and development. This is to some extent reflected in their prices owing to the extra costs associated with this type of quality for example:

- Use of custom built inverter power supplies for both pilot arc and main arc. 100% duty cycle rating.
- Electronic gas controller offering highest level of repeatability and accuracy (Where applicable)
- Use of Siemen's PLC's and associated equipment offering worldwide support. Very simple and easily learnt programming functionality (Where applicable)
- Application driven software specifically written for PTA applications holding up to 500 programmes (Where applicable)
- All driven axes using AC-servo technology for greater accuracy and control. All AC drives connected using Profibus interfaces. (Where applicable)
- Heavy duty mechanical slides for movement of all axes (covered in welding area).
- All positioning, handling equipment precision built in Switzerland.
- Latest technology and widest range of PTA torches including hand, internal and machine torches.
- Precision powder feeder with no moving parts offering most accurate and repeatable powder feeding.
- Robust, reliable and long-life fabrication and components.
- Long experience in after-sales service world-wide.

Whilst not inexpensive the above features ensure a system of the highest quality in both build and performance resulting in long-term reliability and operation. There are undoubtedly other systems available which would be cheaper but these systems do not have the features and benefits of the Kennametal Stellite systems.

### Typical Components





Plasma transferred arc (PTA) hard facing is a versatile method of depositing high-quality metallurgically fused deposits on relatively low cost surfaces. Soft alloys, medium and high hardness materials, and carbide composites can be deposited on a variety of substrates to achieve diverse properties such as mechanical strength, wear and corrosion resistance, and creep. PTA hard facing has several significant advantages over traditional welding processes such as oxyfuel (OFW) and gas tungsten arc (GTAW) welding.



*PTA Process*

### **The PTA process:**

- PTA is easily automated, providing a high degree of reproducibility.
- PTA allows precise metering of metallic powder feedstock. As a result a lesser quantity of material is used when compared to other traditional welding processes.
- PTA permits precise control of important weld parameters i.e. powder feed rates, gas flow rates, amperage, voltage, and heat input, ensuring a high degree of consistency from lot to lot. Controlled heat input ensures weld dilutions that can be controlled from 5-7% in most cases.
- PTA produces deposits of a given alloy that are tougher and more corrosion resistant than counterparts laid down by GTAW or OFW processes. Weld deposits are characterized by very low levels of inclusions, oxides, and discontinuities.
- PTA produces smooth deposits that significantly reduce the amount of post weld machining required.
- PTA parameters can be adjusted to provide a variety of deposits in thicknesses from 1.2 to 2.5 mm (0.05 to 0.10 in.) or higher. These can be deposited by a single pass at a rate of 1 kg/h up to 13 kg/h depending upon the torch, powder and application.

### **APPLICATIONS**

The PTA process is used in instances of extreme demands on wear resistance. A high strength metallurgical bond is formed between the superalloy coating overlay and the underlying component, ensuring that the coating does not become compromised even under the highest of stresses.

### **TYPICAL SYSTEMS**

Kennametal Stellite's typical systems are very versatile and efficient. From systems that produce high volume output to the ultimate in flexibility and automation.

### **EQUIPMENT**

Kennametal Stellite is one of the leading worldwide manufacturers of PTA hard facing equipment. Our knowledge and experience in materials enables us to provide customers with customized coating equipment to satisfy specific requirements.

### **PTA TORCHES**

Kennametal Stellite offers a variety of Plasma Transferred Arc torches with innovative design features, low maintenance and unsurpassed reliability.

## PTA Applications

### Oil & Gas

Oil is a finite resource and it is important that the process of extraction be carried out economically and efficiently. Various components of the drilling hammers used in oil extraction experience abrasion from mud, metal-to-metal wear and erosion. To combat excessive wear drilling hammers are hard-faced with composite alloys of tungsten carbide dispersed in a nickel or cobalt based matrix. Plasma transferred arc deposits of Ni-Cr-B-Si alloys are used to combat wear on plungers, sleeves, sucker rods and seals of mud pumps and submersible pumps.

In the refining sector, cobalt based alloys applied by PTA are used extensively to combat wear, erosion, abrasion and corrosion.



*Investment cast parts for down-hole oil and gas exploration operations*

### Engine Valves

The hard facing of engine valve seats, which is a high volume process, was originally done using Oxyfuel welding (OFW) and gas tungsten arc welding (GTAW) processes. However since the 1980's hard facing of engine valves has gone steadily toward PTA due to its consistently repeatable quality, productivity and enhanced deposit characteristics.

Engine valve seats experience a variety of wear modes such as erosion, adhesion, galling, corrosion and fatigue. Demands like fuel efficiency, power-to-volume rating increase, and fuel quality impose further strains on the valves. Cobalt-based alloys, such as Stellite® F and Stellite® 6, have proven to be effective under such circumstances and a host of cobalt based alloys are now used in the automotive industry for wear resistance.



*Engine Valves*

Internal combustion engine valve manufacturers are big consumers of cobalt alloys for hard facing applications. Precise control of the hard facing alloys that go into each valve is of paramount importance from a cost standpoint. The metering of the alloy must be controlled to a fraction of a gram, and PTA offers the advantage of precise feed stock delivery, consistent hard face quality, and low rejection rates.

In addition to cobalt-based alloys, several nickel-based alloys that depend on borides and carbides for hardness are also used for hard facing engine valves.

## Power Generation

The steam cycle of power generators contains steam generators, turbines, and pumps that handle steam and water. This requires a variety of control, safety, and shut off systems. The main area of wear is in steam and water valves, which experience high-pressure steam, high temperatures, and metal-to-metal wear at seating areas. The valve seats and spindles also need to inhibit oxidation on the surface, which otherwise can cause sticking. PTA deposits of cobalt based alloys are used extensively on valve seats and faces to take advantage of their high resistance to metal-to-metal adhesive and erosive wear. Cobalt alloys also retain their hardness at temperatures in the range of 550°C or higher, which is the temperature of super-heated steam. Cobalt alloys are deposited on the leading edges of turbine blades to combat the effects of liquid droplet erosion due to condensing steam. Cobalt based alloys also are reported to perform well on high-pressure steam turbine nozzles and induced draft fan blades.



*Steam turbine*

## PTA Typical Systems

### Manipulator Systems

Kennametal Stellite PTA systems can be supplied with a variety of torch manipulators and part positioning devices for semi-automatic welding. A wide range of devices can be provided to suit for almost any size, weight or configuration of work piece. These can be equipped torches with a range of sizes suitable for either inside or outside diameter work.



### Beam and Carriage Systems

For parts with long lengths requiring support at both ends beams and moving weld carriages are most appropriate. These can be supplied with lathe type positioners or combined with tilting positioners for increased versatility. Almost any length and weight capacity can be accommodated.



(Information provided is to be used as a guide only and actual systems may vary on the customer requirements)

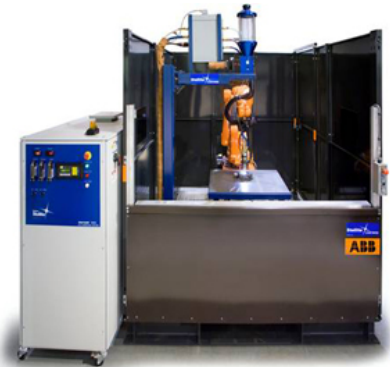
## Valve star Systems

Valve star systems are specifically designed for high volume production of gas or diesel engine valves. They are integrated with automated load and unload systems and can be installed directly in automated production lines.



## Robotic Systems

For the ultimate in flexibility and automation Kennametal Stellite PTA units can be integrated into robotic cells allowing complete control of the part positioning and weld process directly through the robot controller.



### KENNAMETAL STELLITE PTA 350 C

can operate manipulation equipment with maximum 8 axis. Cooler not included.

Dimensions (w x h x d) 700 x 1300 x 1300 mm  
 Weight about 600 kg

Main Power Source INV 350  
 Line Voltage 3 x 400 V  $\pm$  10%  
 Duty Cycle 350 A, 100%  
 Welding Current 15 – 300 A  
 Line Frequency 50 – 60 Hz O  
 pen Circuit Voltage 85 V  
 Welding Voltage 10 – 40 V

External Gas Supply Unit GT-S 5-10-30  
 Mass Flow Controlled  
 Pilot Gas 0.25 – 5 l/min  
 Shielding Gas 1.5 – 30 l/min  
 Working Pressure 3.5 bar  
 Transport Gas 0.5 – 10 l/min  
 Accuracy  $\pm$  1%

Pilot Power Source INV 100  
 Continuous Output 100 A  
 Pilot Arc Voltage 10 – 40 V  
 Pilot Current 5 – 100 A

External Ignition Cabinet ZS 350  
 with all necessary connection cables (standard length: 5 m)  
 Automatic Control of the Welding Process and Manipulation  
 SIEMENS Simatic S 7-300  
 External Operating Panel with MP 277  
 for input and storage of all relevant welding parameters, Storage  
 Capacity: approx. 250 parameter sequences



(Information provided is to be used as a guide only and actual systems may vary on the customer requirements)



## KENNAMETAL STELLITE PTA 250 JS

The economic PTA welding system PTA 250 Junior Star is equipped with a cooling water unit and can be operated with an external manipulation device from Kennametal Stellite's range.

Main Power Source INV 250  
 Line Voltage 3.0 x 400 V / 460 V  
 Line Frequency 50 / 60 Hz  
 Duty Cycle 250 A, 100%  
 Welding Current 3.0 – 250 A

Pilot Power Source INV 50  
 Duty Cycle 50 A, 100%  
 Pilot Current 3.0 – 50 A

Gas Supply Unit GT-R 5-10-30  
 with Manual Flow Controller  
 Pilot Gas 0.5 – 5 l/min  
 Transport Gas 1 – 10 l/min  
 Shielding Gas 3 – 30 l/min

Control for the Welding Process SPS FX3G  
 Internal Touch Panel G 1000 for input of all relevant welding parameters  
 Internal Ignition Cabinet ZS 190



## CHILLY Compact Water Chiller

- Water level control outside
- Stainless steel coil evaporator
- High tech. scroll compressor / low noise
- High efficiency air cooled condenser
- Digital thermostat hysteresis +/- 1,0 K
- Refrigerant circuit with TÜV approved high pressure switch
- Chiller IP 44
- Operating temperature max. 42° C ambient
- Plastic water tank
- Draining through water level control
- Environment friendly refrigerant R 407 c
- Internal by-pass for pump protection
- Non ferrous water circuit
- CE-Standard / ISO 9001 / EN 60204
- Grundfos/Speck pumps
- Water connection quick coupling

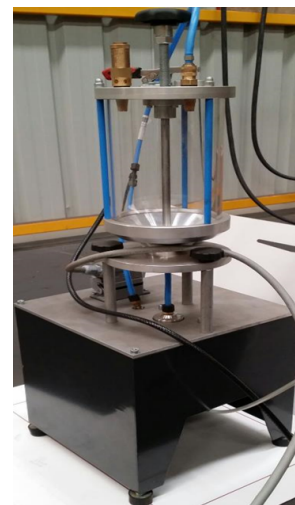


(Information provided is to be used as a guide only and actual systems may vary on the customer requirements)

## Powder Feeder

Powder feeder available from 12 to 25kg powder capacity.

- It is design to offer easier & faster replacement of powder .
- It has speed controlled motor gas pressurised for better control of powder flow.
- Upslope time powder 0,0 - 60,0 Seconds.
- Powder set point value: 1,0 - 100,0 g/min
- Down slope time powder: 0,0 - 60,0 Seconds.
- Step with powder value: 1 – 5 g/min.



## PTA Torches

### HPH 80 Torch

The HPH 80 Torch is used with the Kennametal Stellite Micro star self-contained, hand-held Plasma Transferred Arc (PTA) welding system.

Current Capacity: 80A, 100% ED

Pilot Current: Max 15A, 100% ED

Max Deposition Rate: 3 lbs/hour

Weight: 5 oz

### HPH 150 Torch

The HPH 150 Torch is used with the Kennametal Stellite Micro star self-contained, hand-held Plasma Transferred Arc (PTA) welding system.

Current Capacity: 120A, 100% ED

Pilot Current: Max 20 A, 100% ED

Max Deposition Rate: 4 lbs/hour

Weight: 1 pound

### Model 200 Torch

The Model 200 Plasma Powder Surfacing Torch is a low profile plasma transferred arc torch that meets Wear Technology's standards for minimum replacement parts, optimum nozzle life, low cost parts replacement, and unsurpassed reliability. The Model 200 Torch will coat internal bore surfaces down to 3-1/2" diameters. The nozzle design provides efficient cooling for applications requiring preheat at high as 800 °F. An insulated shroud covers the service tubes to further aid torch cooling.

(Informtion provided is to be used as a guide only and actual systems may vary on the customer requirements)

The Model 200 Torch features:

- A small size (1-3/4" diameter x 2" high) allowing for surfacing of internal bores as small as 3" in diameter. Optional 24" and 36" reach models are available
- Efficient cooling allowing for preheats as high as 800°F. The unique design promotes rapid heat dissipation contributing to maximum nozzle life
- Precise, reliable, efficient (up to 95%) material delivery using a 4-jet powder injection system
- Complete encapsulation of the torch's gas and water service tubes
- Deposition rates up to 4 lbs./hour at 150A continuous cycle

Model 200 Torch Operating Parameters:

Current:	50 to 200 Amps
Voltage:	20 to 25 volts DC
Duty Cycle:	200A @ 60%, 150 A @ 100%
Water Flow:	0.5 gpm @ 60 psi, 120°F maximum (1.89 lpm @ 4.1 bar, 49°C maximum)
Powder Gas:	4 to 16 cf/h @ 20 psi (113 to 453 slph @ 1.38 bar)
Shield Gas:	16 to 24 cf/h @ 20 psi to 680 slph at 1.38 bar)
Plasma Gas:	2 to 8 cf/h @ 20 psi (56.5 to 226 slph @ 1.38 bar)
Electrode Setback:	0.060" (0.015 mm) Use tool provided
Maximum Preheat:	800°F (427°C) at 100% Duty Cycle



## HPM 250 Torch

Current capacity:	250A, 100% ED
Pilot current:	Max. 35A, 100% ED
Deposition rate:	4 kg / h
Tungsten electrode	3.17-40°, 4.76-10°
Plasma nozzle	3.17, 3.96, 4.76
Cooling requirements:	min. 3 l/min (20° C)
Weight:	3 kg



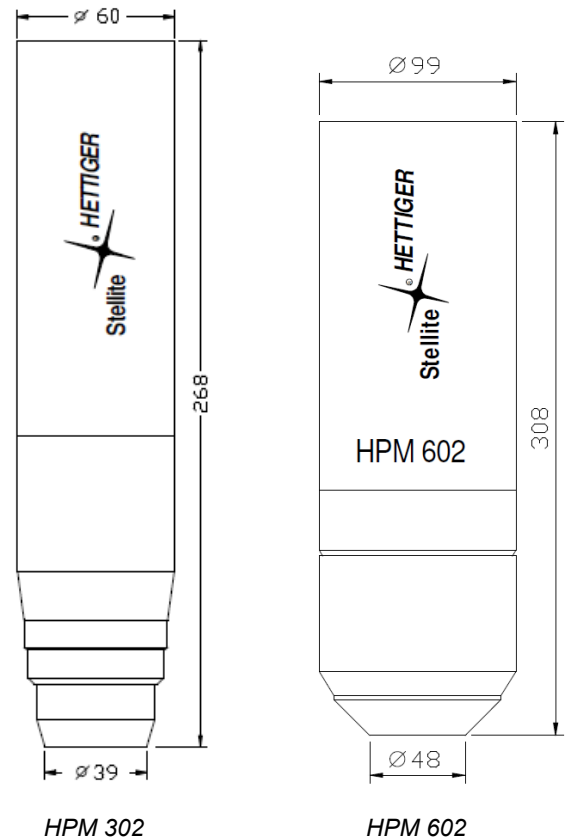
(Information provided is to be used as a guide only and actual systems may vary on the customer requirements)

### HPM 302 Torch

Current capacity:	250A , 100% ED
Pilot current capacity:	100A , 100% ED
Deposition rate:	5 kg / h
Tungsten electrode:	4.0 mm / 45°
Plasma nozzle:	1.5 – 4.0 mm
Cooling requirements:	min. 2 l / min
Weight:	3 kg

### HPM 602 Torch

Current capacity:	450A, 100% ED
Deposition rate:	12 kg / h
Tungsten electrode:	6.0 mm / 40°
Plasma nozzle:	4.0 / 5.0 mm
Cooling requirements	min. 5 l / min
Weight	6 kg



### Model 600 Torch

The Model 600 torch can be installed on any Kennametal Stellite PTA System and features:

- Increased cooling capacity
- Longer nozzle life
- Improved service life.
- Sturdy, compact design-1.5" diameter body
- Improved welding with nickel based alloys
- Decreased overlay
- Orifice diameter available in 1/8", 5/32" and 3/16"
- Better arc control
- Connection points that are color-coded to facilitate ease of installation
- Removable powder tubes
- Self-centring electrode
- Extended nozzle for hard-to-reach corner areas.

(Information provided is to be used as a guide only and actual systems may vary on the customer requirements)



### Model 600 Torch Parameters:

Current:	20-250 Amperes
Voltage:	20-32 Volts
Water:	1-1.5 gpm at 60-90 psi, 65°F
Powder Gas:	2.5-8.5 SCFH at 25 psi
Shield Gas:	16-40 SCFH at 25 psi
Plasma Gas:	2.5-8.5 SCFA at 25 psi
Deposition Rate:	1.5 to 10 pounds an hour

### Excalibur Torch

The Excalibur Torch employs innovative design features for high efficiency performance with low maintenance and operating costs.

#### The Excalibur Torch features:

- High efficiency nozzles with a choice of multi-powder ports. Powder efficiency has been measured at 99.5% recovery with a 1/8 inch (3.2 mm) nozzle
- Standard nozzles with two powder ports
- 12 inch electrodes in 1/8 and 3/16 inch diameters
- Self-centring electrode which does not require gas distributor
- Fully machined construction to precise standards
- Torch parts which are all replaceable
- Fully sealed internal powder feed to eliminate losses and contamination
- Quick change nozzles that do not require securing screws
- An available heavy duty large shield

#### Excalibur Torch Specifications:

Welding Current: 10-250 Amperes  
Water Cooled Nozzles: 1/8, 3/16 diameter  
Electrodes: 1/8, 3/16 dia. x 12 inch long  
Water: 1-1.5 gpm at 60-90 psi, 68°F  
Powder Gas: 2.5-8.5 SCFH at 30 psi  
Plasma Gas: 2.5-8.5 SCFH at 30 psi  
Shield Gas: 16-40 SCFH at 30 psi

#### Torch Dimensions:

Overall Length: 12 inch (280 mm)  
Body Diameter: 1.6 inch (40 mm)  
Weight 2.2 lbs. (1 kg)

The Excalibur Torch can be used on most existing brands of PTA equipment.



(Information provided is to be used as a guide only and actual systems may vary on the customer requirements)

**■ PTA Weld Deposition Alloys**

Alloy	Typical H.R.C.	Typical U.T.S. KSI	Typical ELONG. %	Typical Applications
<b>Cobalt-Based Alloys</b>				
Stellite™ 1	50–54	80	<1	Valve seat inserts, bearings, cutter edges
Stellite™ 3	51–58	80	<1	High-temperature with severe abrasion
Stellite™ 4	45–49	136	<1	Corrosion with erosion on pump parts
Stellite™ 6	39–43	121	1	Some wear and corrosion with ductility
Stellite™ 6B	33–43	140	11	Stock product with wear and corrosion resistance, excellent ductility
Stellite™ 6K	40–50	176	4	Excellent wear and corrosion resistance for knives and scrapers
Stellite™ 12	47–51	100	<1	High-temperature with wear resistance
Stellite™ 19	51–53	105	<1	High-temperature with abrasion
Stellite™ 20	53–59	80	<1	Pump sleeves, rotary seal rings, bearing sleeves
Stellite™ 21	25–30	105	9	Good ductility and corrosion resistance
Stellite™ 25	<20	134	5	High-temperature nitric acid
Stellite™ 31	28–35	107	10	Aerospace engine parts
Stellite™ 33	53–58	55	<1	High-temperature with severe wear and abrasion
Stellite™ 250	19–29	80	8	High-temperature oxidation resistance
Stellite™ Star J	53–60	62	<1	Severe high-temperature wear
Stellite™ 694	48–54	120	1	Gas turbine parts, such as turbine blade interlocks
Stellite™ 706	39–43	116	1	Wear and corrosion with ductility
Stellite™ 712	47–51	121	<1	High temperature with wear and corrosion resistance
Stellite™ 720	53–60	62	<1	High-temperature corrosion, severe wear and abrasion
Tribaloy™ T-400	51–58	100	<1	Good wear and corrosion resistance
Tribaloy™ T-400C	48–56	95	<1	Improved oxidation corrosion and abrasion resistance
Tribaloy™ T-401	45–50	94	1	Enhanced ductility with superior corrosion and wear resistance
Tribaloy™ T-800	50–58	100	<1	High-temperature with severe corrosion, wear, and abrasion
ULTIMET®	<25	105	15	Valve parts, forging dies, incinerator nozzles
<b>Nickel-Based Alloys</b>				
Deloro™ 50	42–58	77	<1	Wear and corrosion resistance
Deloro™ 60	57–62	70	<1	Extrusion press, screw barrel, pump impeller, plunger
Nistelle™ B-2C	20–25	90	20	Resists hot hydrochloric acid
Nistelle™ C	17–27	80	4	Hot metal stamping, piercing points, drop forging dies
Nistelle™ Super C	17–27	100	15	Similar to Nistelle™ C with improved wear and corrosion resistance
Nistelle™ X	90 HRB	55	8	High-temperature and corrosion resistance
Tribaloy™ T-700	42–48	NA	<1	High-temperature, wear, and corrosion resistance
Tribaloy™ T-745	37–46	87	<1	Similar to T-700 with better corrosion resistance
<b>Nickel-Based Super Alloys</b>				
INCONEL® 713	30–42	110	3	Vacuum melted high-temperature Ni-based superalloy
INCONEL® 718	25 max.	110	5	Vacuum melted high-temperature Ni-based superalloy
INCONEL® 625	90 HRB	85	25	Vacuum melted high-temperature Ni-based superalloy
<b>Iron-Based Alloys</b>				
Delcrome™ 90	51–55	65	<1	Severe cold abrasion
NoCo™ 02	40–44	150	8	Nuclear valve trim
Tribaloy™ T-506	31–38	94	2	High-temperature oxidation and wear resistance

ULTIMET® is a registered trademark of Haynes International.  
 ICONEL® is a registered trademark of Special Metals Corporation.



**WORLD HEADQUARTERS****Kennametal Inc.**

1600 Technology Way

Latrobe, PA 15650

USA

Tel: 800.446.7738 (United States and Canada)

E-mail: [ftmill.service@kennametal.com](mailto:ftmill.service@kennametal.com)

**EUROPEAN HEADQUARTERS****Kennametal Europe GmbH**

Rheingoldstrasse 50

CH 8212 Neuhausen am Rheinfall

Switzerland

Tel: 41.52.6750.100

E-mail: [neuhausen.info@kennametal.com](mailto:neuhausen.info@kennametal.com)

**ASIA-PACIFIC HEADQUARTERS****Kennametal Singapore Pte. Ltd.**

3A International Business Park

Unit #01-02/03/05, ICON@IBP

Singapore 609935

Tel: 65.6265.9222

E-mail: [k-sg.sales@kennametal.com](mailto:k-sg.sales@kennametal.com)

**INDIA HEADQUARTERS****Kennametal India Limited**

8/9th Mile, Tumkur Road

Bangalore - 560 073

Tel: 91.80.2839.4321

E-mail: [bangalore.information@kennametal.com](mailto:bangalore.information@kennametal.com)

**AUSTRALIA OFFICE****Kennametal Australia Pty. Ltd.**

Suite 3, 3974 Pacific Highway

Loganholme, Queensland, 4129

Tel: 61.7.3801.5844

E-mail: [k-sydney.service@kennametal.com](mailto:k-sydney.service@kennametal.com)

**[www.kennametal.com](http://www.kennametal.com)**