

## PS-Series Plasma Jets

### Characteristics

- **Atmospheric plasma at 2.45 GHz for power levels up to 250 W**
- **Plasma jets with concentrated or broad plasma beam**
- **Well suited for hand held or automated applications**
- **Applicable in activation, cleaning or rapid heating of different materials**
- **Very low energy consumption/ self heating**
- **Potential-free, maintenance-free and wear-free**

### Overview

The plasma jets of the PS-series, in combination with our PlasMaster PCU generators, are the first commercially available 2.45 GHz atmospheric plasma sources in the power range between 40 W and 250 W. The physical advantages of the 2.45 GHz plasmas (microwave plasmas) have been verified in many scientific publications. These new jets now offer practical users and scientists these advantages for a variety of implementations.

HHF offers three different jets over large power ranges and different beam patterns.



Abb. 1: PS-series plasma jets (top to bottom: PS and PS-Ar).

## Product Overview of PS-Series Plasma Jets

The plasma jets consist of a stainless steel housing, Teflon and various temperature-resistant copper alloys as electrode feed, inner high-voltage transformer network, as well as electrodes. There is no tungsten implemented, alloying oxygen and air to be used as process gas. These jets principally can cope with all non-aggressive gases as process gas. The electrodes are wear-free and maintenance-free. Spectroscopic measurements confirm that no electrode material is to be found in the plasma, guaranteeing a pure gas plasma.

The jet PS types are available for power levels up to 250 W, whereas the PS-Ar is only available for 100 W. The various jets of the PS class are presented below:

1. Jets optimized for surface activation and heating (label *PS*) requiring **air** as process gas. The plasma beam hereby is broader and relatively cooler.
2. Jets optimized for activation at lower temperatures (label *PS-Ar*) requiring **argon** as process gas. The plasma beam hereby is also relatively concentrated.

## Specifications of the Plasma Jets of the PS-Series

The general specifications of the jets are summarized in Tab. 1:

Parameters	Min	Typ.	Max	Unit	Comment
Frequencies of ignition and operation	2.4		2.5	GHz	In the ISM frequency band
Process gas					
- PS	10		30	sl / min	Air or nitrogen (oil-free)
- PS-Ar	0.5		2	sl / min	Argon
Power required for ignition					Depending on gas flow
- PS		150		W	
- PS-Ar		70		W	
Microwave power for operation					
- PS	40		250	W	
- PS-Ar	10		100	W	
Dimensions			20	mm	Diameter, without connection for gas
- PS		135		mm	Length
- PS-Ar		115		mm	Length
Weight		110		g	
Connector					N connector

Tab.1: Specifications of the plasma jets of the PS-series.

## Technical Descriptions

The process gas (Gas 1) flows in the jet housing around the inner electrode. The kind of gas implemented and the actual flow rate have a major influence on the process characteristics and determine the resulting temperature of the plasma, which is directly proportional to the microwave input power and inversely proportional to the gas flow rate.

Although the plasma temperature of the PS jets can be well above 3,000 °C, even temperature sensitive sheets can be successfully treated by optimizing the process parameter:

- Process velocity,
- Distance between jet and object,
- Microwave power,
- As well as the gas flow.

Replacing air through nitrogen normally leads to a higher level of activation and reduces the burnt effect (darkening) caused by oxygen.

Using the process parameters, the plasma temperature of the PS-Arg jets can be varied from below 100 °C to a few hundred degrees.

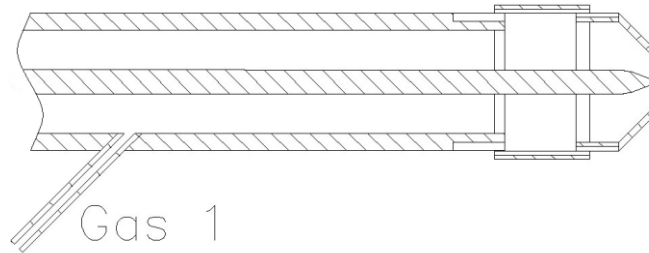


Abb. 2: Gas flow in the PS jets.

## Comments and Safety Issues

- 1- The plasma jets are hand-tuned.  
Do not disassemble! Assembling is only possible using hot S-parameter measurements.
- 2- At higher power levels, the housing of the jet may turn very hot. Do not hold the jets in your bare hands.  
Since the radiated microwave power also increases, automated operation is recommended. Keep a 50 cm distance from the jets. To monitor the radiated power, a simple hand held device (e.g. EME Guard 3140 from ANTENESSA) can be used.
- 3- For longer usage, a good ventilation is essential.
- 4- The plasma is very bright. Refrain from looking at it directly.
- 5- Please ensure that the air flow is sufficiently high (PS jets). At too low flow levels, the plasma may turn yellowish or red, carrying with it traces of the inner electrode.

## Overview of the Characteristics of the PS Series Plasma Jets

- High-purity atmospheric 2.45 GHz plasma with power ratings up to 250 W (CW operation)
- Activation / cleaning / rapid heating of diverse materials and shapes including plastics and thin foils
- Can be used for a variety of gases (two classes of jets: inert gases (argon) and air or nitrogen)
- Well suited for hand and robot applications (100% potential-free)
- Extremely low energy requirements
- Extremely handy (even shorter models available upon request)
- Robust jets in stainless steel housing
- Very low maintenance and wear

The following pictures show typical plasma of the PS-series.

For more pictures, please refer to <http://www.hhft.de/index.php?page=invent>.



Fig. 3: PS plasma jet at 250 W for surface cleaning.

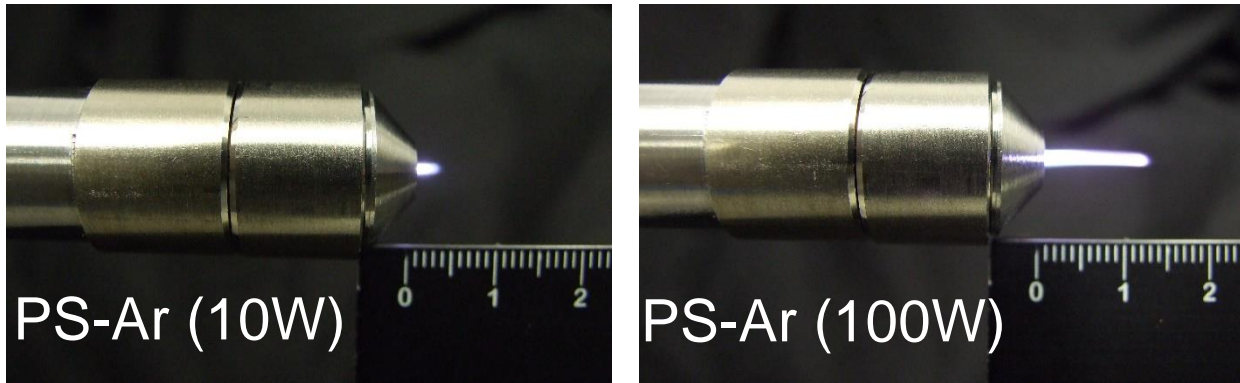


Fig. 4: PS-Ar plasma jet with argon as process gas, at 10 W with 0.5 sl/min (left) and 100 W with 2 sl/min (right).

## Mounting recommendations

The operating frequency of the jets can be detuned if residues from the treatment process gather on the inner conductor, leading to a degraded performance. For this reason, we recommend installing the jets in a downward position as shown in Fig. 5.




Downwards	Lateral	Upwards
		
Recommended		Inadvisable

Fig. 5: Recommended assembly of the PS jets for optimal performance.

## Ordering information

Please contact us for price information for the corresponding PS jet.

## Guaranty

The guaranty period is 1 years after delivery.  
 The guaranty does not cover defects based on wrong operation or improper usage, such as connectors not being properly attached or insufficient gas flow.

## Contact

Heuermann HF-Technik GmbH  
 Auf dem Anger 29, D-52076 Aachen, Germany  
 Mail: [info@hhft.de](mailto:info@hhft.de) ; Internet: <http://www.hhft.de/>  
 Tel.: +49 2408/9379019 Fax: +49 2408/9379952