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**1** *The powder nozzle measuring system L1sec scans powder jets leaving the nozzle.*



## L1sec

### SYSTEM INTEGRATED POWDER NOZZLE MEASURING SYSTEM FOR ADDITIVE MANUFACTURING APPLICATIONS

The measuring system L1sec (short for "light section") generates a laser light section, which analyses all relevant powder nozzle characteristics for many Laser Metal Deposition (LMD) processes, directly before the process starts. This ensures faultless operation.

#### Initial situation

In modern industrial component production, reproducibility of processes and precise knowledge of all relevant process parameters provide the basis for efficient and cost-effective component manufacturing. While in subtractive processes such as milling, the tool calibration prior to process start corresponds to the state of the art, in laser powder buildup welding it is a fundamental problem to determine the exact position and extent of the Tool Center Point (TCP).

#### Equipment integration

Thanks to its small dimensions of 210 mm x 150 mm x 60 mm, the L1sec measuring system can be integrated into many existing LMD systems. For correct operation, it is only necessary to align the system with the machine coordinate system. For fully automated measurement of the assembled powder nozzle, Fraunhofer IWS integrates the system's application interface (API) into the system's software. The operator can also perform manual measurements. A Power-over-Ethernet connection with the system is needed for correct system operation. The optical components used enable operation within an illuminated system.

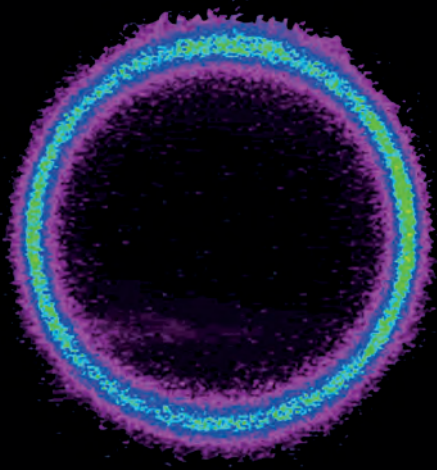
#### Fraunhofer Institute for Material and Beam Technology IWS

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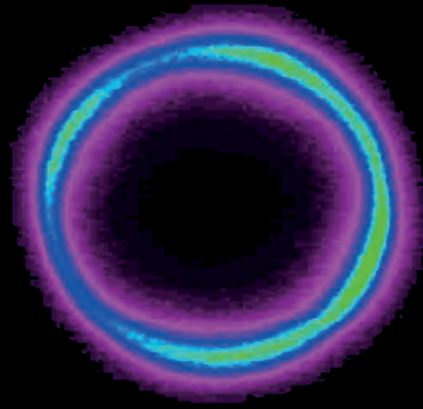
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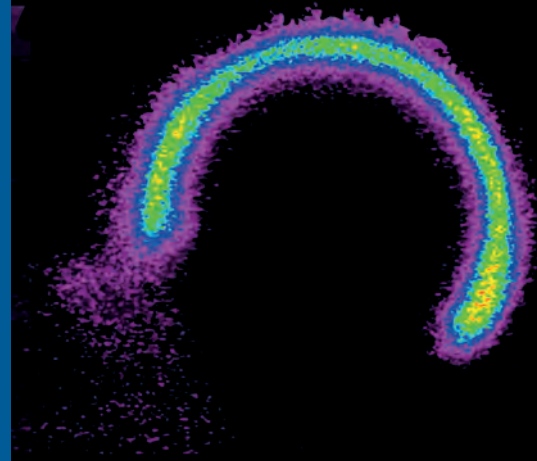
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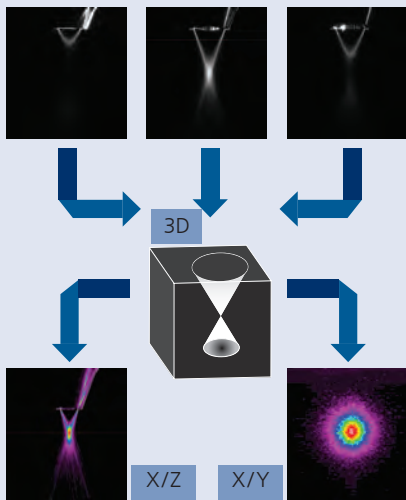


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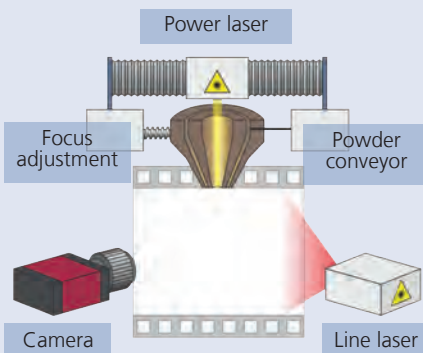
**Error detection:**

- 1 Intact nozzle.
- 2 Incorrectly installed nozzle.
- 3 Defective nozzle.

**Coating measurement**



**Software surface**



**Measuring principle**

The laser light section method divides the powder jet into a definable number of measuring planes. The precise knowledge of its position allows a three-dimensional image of the powder jet to be created. Analysis algorithms developed at Fraunhofer IWS, in conjunction with the corresponding software, calculate all relevant nozzle parameters, such as the exact position and expansion of the powder focus. IIssec enables fast and easy quantitative analysis of all relevant measurement parameters by aligning the captured image information with mathematical functions. This results in optimum comparability of different measurements.

**Analysis of measurement data**

Based on the acquired image data, an analysis algorithm reliably detects the position of the powder focus, the spot of the highest powder density within the powder jet. The comparison of the real with the theoretical focus position allows a direct statement about the further usability of the nozzle. The analysis of the shape and characteristics of the powder jet at several relevant measuring points also allows a quantitative assessment of the nozzle quality. Not only the wear of the nozzle can be observed, but also the service life increases significantly. Transferring the focus position as TCP to the machine control reduces tool change time and significantly increases the process reproducibility. In addition, IIssec ensures a better process understanding and less effort for parameter studies: In this way, the various influences of the feed parameters on the powder cone characteristics can be investigated.

**Technical data**

Height/width/depth	210 mm x 150 mm x 60 mm	
Weight	1 kg	
Measuring range	50 x 50 mm <sup>2</sup>	
Measuring resolution	X/Z (image)	30.6 µm / Px
	Y (minimum number of levels)	50 µm
Power supply	Power over Ethernet (PoE)	12 V
Communication	Gigabit Ethernet	