



## CERTIFICATION OF POWDER NOZZLES FOR LASER METAL DEPOSITION

### Task

When laser radiation is used for Laser Metal Deposition (LMD), the powder feed in the melt pool plays a decisive role. To a large extent, this determines the degree of powder use, the oxidation by the surrounding atmosphere as well as the geometry and roughness of the layer. Therefore, there is a great necessity to characterize the powder gas stream in order to secure process quality. To date, no standardized process is available for certifying powder nozzles.

### Method

Important parameters that need to be monitored are the symmetry of the gas stream, the position and size of the powder focus as well as the particle density distribution. In order to measure and capture the required parameters, the powder gas stream is illuminated with a laser line from the side and observed using a camera arranged coaxially through the powder nozzle. A high frame rate allows the individual powder particles to be captured in number and position. Through step-by-step movement along the powder gas stream, individual layers are recorded in order to reach the particle density distribution with corresponding algorithms.

From this distribution, key figures can be derived for certification of powder feed nozzles. This information allows the adjustment and wear state of a nozzle to be documented and the processes to be set-up reproducibly.

### Result

The measurement process opens up, for the first time, the possibility to characterize a powder gas stream completely. The process could be qualified for different powder nozzles and powder grain fractions. A testing stand for automated and standardized measurement of powder feed nozzles is available to certify individual powder nozzles.

### Applications

Among potential applications count all activities in the sector of LMD by which the exact knowledge of the powder gas stream is required. This knowledge can be used for process development, nozzle development and for the production of components with high requirements upon quality.

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1 Powder gas stream of a three-stream nozzle.

2 Particle distribution of a three-stream nozzle.