3.9 Additive Manufacturing Systems

Additive manufacturing (AM) has restructured how prototype, developmental and advanced design mechanical components are made. Direct Laser Melting, Selective Laser Sintering or 3D Metal Printing is quickly becoming the standard for designs that could not be fabricated with traditional metal removing techniques. To create consistent, strong structures using laser-based additive manufacturing processes that meet aviation DOD standards or medical device FDA requirements, the metallurgy must be consistent, and a laser beam of known dimension, power density and focal spot location is required. Quality 3D laser printed processes require a laser delivering the correct amount of power, distributed correctly and focused at the correct location. To insure consistent and structurally sound parts these parameters should be directly measured before and after any critical part is made.

As AM systems have gained in popularity for the mass production of metallic parts, the components produced are becoming larger in size while having finer details.

This requires increasing AM chambers, having larger powder platforms and longer laser focal lengths. Simultaneously, they are equipped with more powerful lasers having smaller focal spots.

Ophir instruments designated for AM systems meet the accuracy requirements of modern AM chambers and lasers, allowing accurate measurement of focal spot size and position, laser profile, and power distribution. They measure how those parameters change with time as well, to assist maintenance of quality and repeatability of the manufactured parts.

BeamPeek

BeamWatch AM

Model	BeamPeek™	BeamWatch® AM
Wavelengths (nm)	532, 1030-1080	1060-1080
Maximum power (Watt)	1000	1000
Minimum Focal Spot (µm)	34.5	50
Cooling	Passive	Fan
Analysis		
M^2 (Caustic)	√	√
Rayleigh length	√	√
Focal Spot location	√	√
Beam Profile	√	√
Power	√	√
Software	BeamPeek Software, BeamGage Pro	BeamWatch
Part Number	**SP90609**	**SP90655**

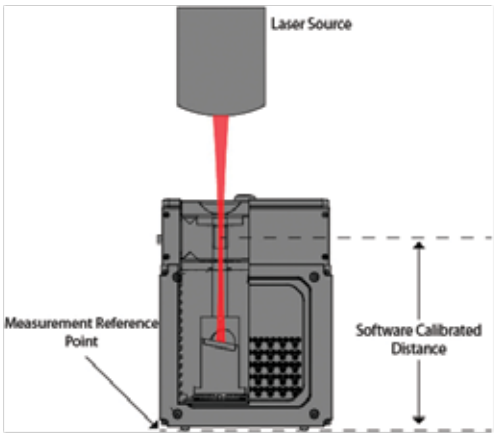
3.9.2 BeamWatch® AM

BeamWatch AM provides simultaneous measurements of multiple profiles along the beam caustic in the camera field-of-view (FOV). Real-time measurements are performed at video rates.

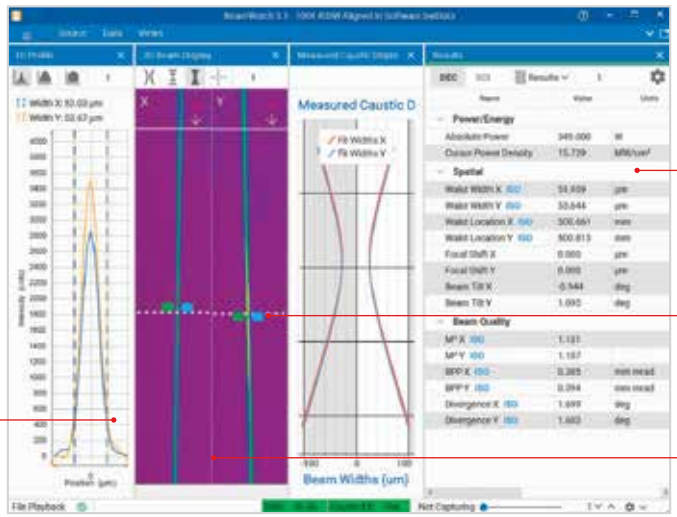
They include:

- Waist (focus spot) width and location
- Focal shift
- Centroid
- M^2 or K
- Divergence
- Beam Parameter Product
- Rayleigh length
- Absolute power
- Tilt angle

Real-time performance also allows for measurement of dynamic focal shift during laser startup. BeamWatch AM measurement technique is based on Rayleigh scattering of laser light by oxygen and nitrogen molecules in the air as the beam propagates through the medium. Measurement of this scattered light provides an equivalent slit-scan of the laser beam in the direction of the observed view. The scattered light is measured using a conventional camera and image capture systems. BeamWatch AM includes a camera for spatial measurements and a NIST-traceable power sensor that will provide a complete analysis of the laser power density profile. The camera is simultaneously, and real-time, viewing the beam caustic including the near/ focus/and far field of the beam. This measurement technique includes Propagation and M^2 measurements adhering to the ISO 11146 standards. In addition, and because all measurements are made in real-time, any focal shift occurring during the critical start up seconds is measured and reported. BeamWatch AM has USB connectivity to Windows personal computers for data acquisition, analysis, and display.



Calibrated beam path for precise focus spot location



Specifications

Model	BW-AM-3	
Beam Profiling		
Wavelengths	1060-1080 nm	
Minimum power density	1.5 Megawatts/cm^2	
Minimum focus spot	50 microns	
Maximum beam diameter at entrance/exit	6 mm (4.5 mm using the Halo Aperture)	
ISO 11146 measurements	Self monitoring; will display ISO next to the measurement	
Power Meter/Beam Dump		
Measured power	50 W to 1000 W	
Maximum power exposure	1000 W for 2 minutes	
Precision	NIST traceable calibration, ±3%	
Cool-down time	20 minutes with fan cooling if used to maximum exposure	
Software		
BeamWatch AM software	To run on user supplied PC	
	Data is saved in ASCII and HDF5 formats	
	Print-out of critical measurements and graphics	
Calibration Certificates		
Power sensor	NIST traceable	
JUNO USB converter	NIST traceable	
Camera	Certification	
Distance from bottom of unit to focus location	NIST/National Lab traceable	
General		
Communication to PC	USB 2.0 & USB 3.0	
Power	110 - 220 Volts AC 50/60Hz	
Particulate purge	Clean dry gas	
Weight	17 lbs	
Dimensions	7.03in x 4.96in x 7.16in	
	178.57mm x 126mm x 181.92mm	
Compliance	CE, UKCA, China RoHS	
Ordering Information		
Part Number	**SP90655**	
Accessories		
Turning Cu mirror & springs	Replacement mirror	**SP90611**