

### 3.8.3 BeamWatch® AM - Beam profiling system for Additive Manufacturing Systems

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
- M2 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.

Additive manufacturing 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.

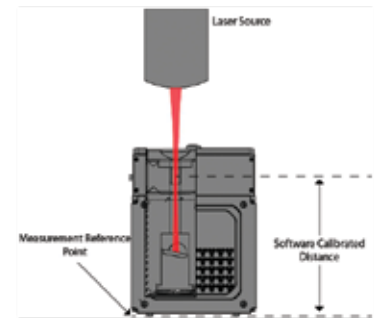
To create consistent, strong structures using laser-based additive manufacturing processes that meet flyable DOD standards or medical device FDA requirements, the metallurgy must be consistent, and a laser beam of known dimension, power density and focal spot location is required.

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.

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 M2 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.



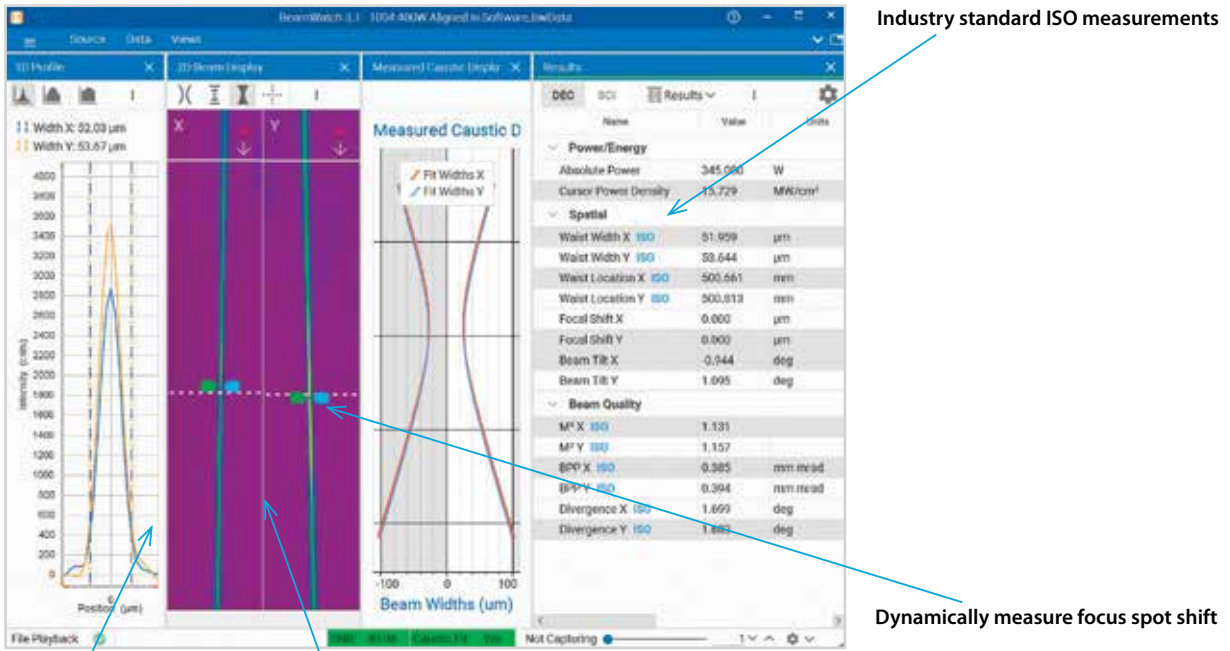
Calibrated beam path for precise focus spot location

#### Specifications

Beam Profiling	
Wavelength	1060-1080 nm
Minimum Power density	1.5 Megawatts/cm <sup>2</sup> (50µm spot at 30 W)
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	30 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

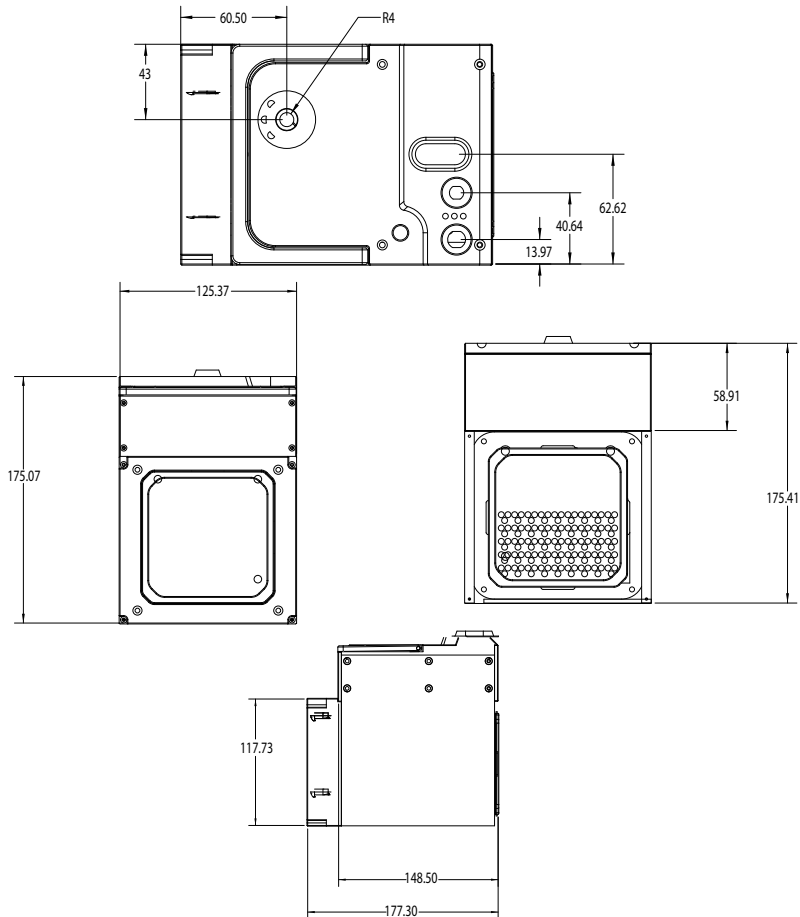
Calibration Certificates	
Power Sensor	NIST traceable
JUNO USB Converter	NIST traceable
Camera	Certification
Distance from bottom of unit to focus location	NIST traceable
General	
Communication to PC	USB 2.0 & USB 3.0
Power	110 - 220 Volts AC 50/60Hz
Particulate Purge	Clean dry gas
Weight	17 lbs
Dimensions	7.03in x 4.96in x 7.16in 178.57mm x 126mm x 181.92mm

3.8.3 Beam Analysis



Both X & Y views of the beam

1D and 2D representation of spatial distribution of the power within the beam



**Ordering Information**

Item	Description	P/N
BW-NIR-2-50-AM	Beam profiling system for Additive Manufacturing Systems	SP90470