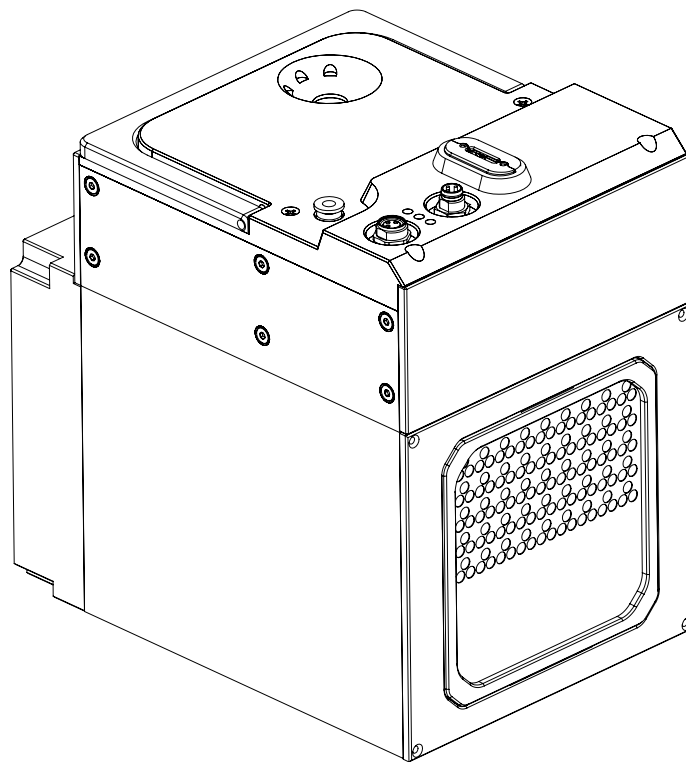




# BeamWatch<sup>®</sup> AM User Notes



## For Sales, Service, or Technical Support

Phone: (435) 753-3729

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光技術をサポートする

株式会社オプトサイエンス

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E-mail : [info@optoscience.com](mailto:info@optoscience.com)



Dear Ophir-Spiricon Customer,

Thank you for your recent purchase of your BeamWatch AM system.

At Ophir-Spiricon we strive to provide the highest level of leading edge photonic measurement technology and service possible. We hope that your experience with us is a pleasant one, and anticipate the relationship we build will serve your photonic measurement needs for years to come.

As a valued customer, your comments and opinions are always very important to us. If you have any concerns, questions or comments, we sincerely hope that you will bring them to our service department's attention. We are ready to help with everything from basic setup, to working with you to find solutions for your most complex photonics measurement needs.

Thank you once again for your business and please let us know if we can be of assistance.

Sincerely,

Ophir-Spiricon, LLC

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# Safety

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While BeamWatch itself does not present the user with any safety hazards, this instrument is intended for use with laser systems. Therefore, the user should be protected from any hazards that the laser system may present. The greatest hazards associated with laser systems are damage to the eyes and skin due to laser radiation.

## Optical Radiation Hazards



BeamWatch is designed for use with high power lasers and therefore safety precautions must be taken. Users must be protected against accidental exposure. Exposure to personnel other than the user must also be considered. Hazards include direct beam exposure and reflected radiation. Protective eye shields and clothing must be worn.

## Electrical Hazards



BeamWatch utilizes only low voltages, derived from the USB and camera power supplies. Thus there is little risk of electrical shock presented to the user.

When installing or removing any hardware from a PC, the power to the computer should always be disconnected.

The computer should always be operated with its covers in place and in accordance with its manufacturer's recommendations.

The computer should always be operated with a properly grounded AC power cord.

# Chapter 1 General Information

---

## 1.1 Introduction

BeamWatch AM is the next version in Ophir-Spiricon's family of non-interfering beam monitoring systems. Designed specifically for the additive manufacturing industry, BeamWatch AM has a new compact design and provides real-time measurement of the beam at the working plane location. Measurement of the beam's caustic is taken by imaging the Rayleigh scatter of the beam from the side. A dust shutter is implemented to prevent contamination of internal components and can only be opened when the purge gas is flowing. A light trap and power sensor are also included in the design to fully contain and provide absolute power measurement of the beam.

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:

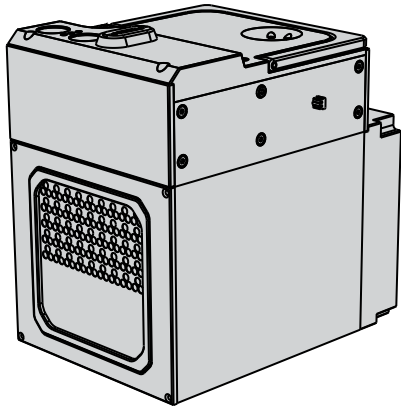
- waist (focus spot) width and location
- focal shift
- centroid
- $M^2$  or K
- divergence
- Beam Parameter Product
- Rayleigh length
- absolute power

Real-time performance also allows for measurement of dynamic focal shift during laser startup.

The technique is based on Rayleigh scattering of laser light by oxygen and nitrogen molecules in the air as the beam propagates. Measurement of this scattered light provides an equivalent slit scan of the laser beam in the direction of the view observed. The scattered light is measured using conventional CCD cameras and image capture systems.

BeamWatch AM has USB connectivity to Windows personal computers for data acquisition, analysis, and display.

## 1.2 Equipment

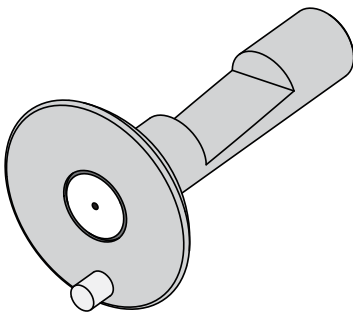


BeamWatch AM

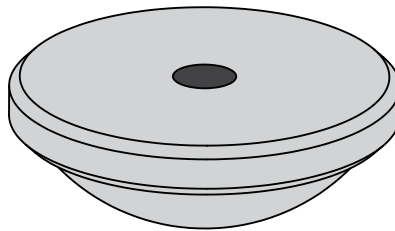


User documentation:

- BeamWatch AM User Notes
- Alignment tool User Notes
- Calibration Certificate
- Quick Start Guide



Alignment Tool



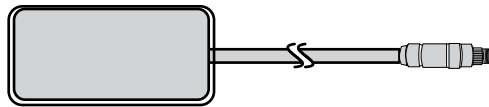
Halo Aperture



Software Installation Disc



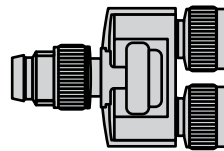
Power Supply Cable



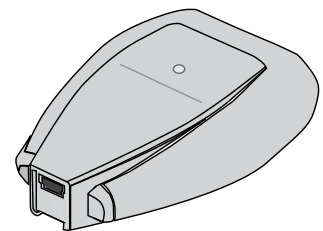
Power Supply Adapter



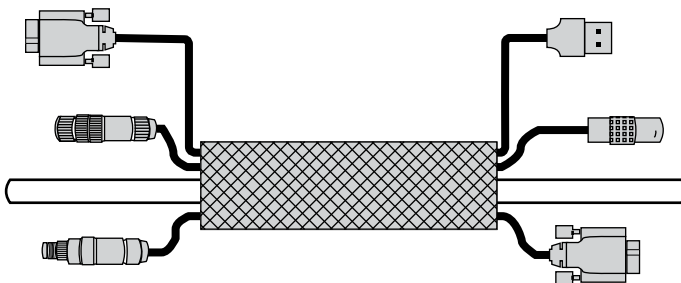
Interlock Cable



Y-Distributor for Interlock



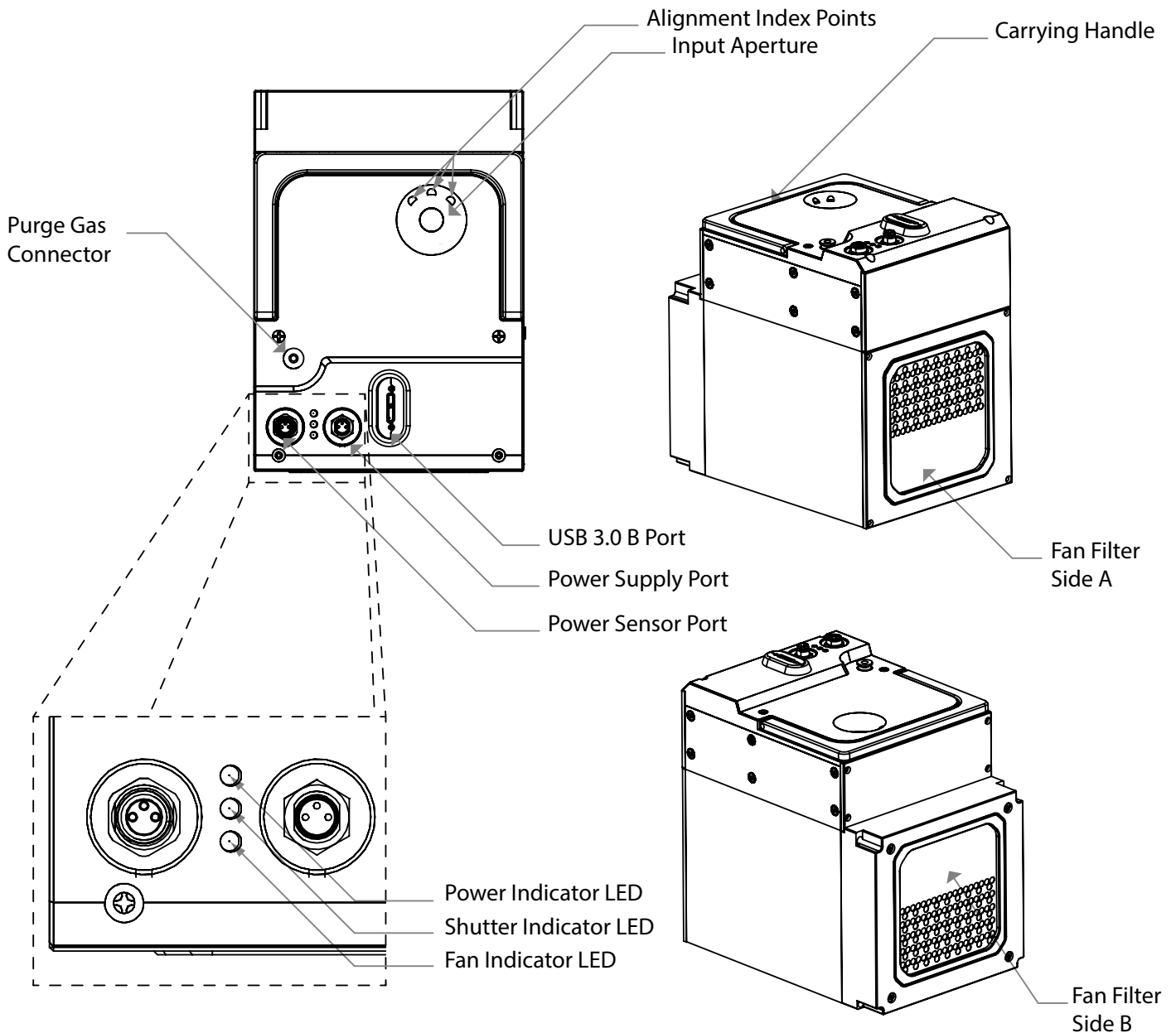
Juno USB Interface



Wiring Harness:

- Power Sensor Cable
- Polyurethane Tubing
- Power Cable
- USB 3.0 Cable

## 1.3 Getting to Know BeamWatch AM



### 1.3.1 LED Notification Lights

Three LED lights on the top of the BeamWatch AM unit provide information at a glance about operation.

The top light is the Power Indicator LED. The LED shines green when the unit is receiving power.

The middle light is the Shutter Indicator LED. The LED shines green when the shutter is open, and red when the shutter is closed. The shutter will not open if the purge gas is not connected and flowing. *Never apply the laser when the shutter is closed.*

The bottom light is the Fan Indicator LED. The LED shines green when the fan is active and red when the fan is inactive. The fan is the primary method of cooling when the unit gets too hot. When the unit gets too hot a warning appears in the software. The fan can only be turned on from the software.

*Note: The shutter cannot be open when the fan is running and vice-versa.*

## 1.4 Specifications

<b>Beam Profiling</b>	
<b>Wavelength</b>	1060-1080 nm
<b>Minimum Power density</b>	1.5 Megawatts/cm <sup>2</sup> (50µm spot at 30 W.)
<b>Minimum Focus Spot</b>	50 microns
<b>Maximum Beam diameter at entrance/exit</b>	6 mm (4.5 mm using the Halo Aperture)
<b>Communication to PC</b>	USB 2.0 & USB 3.0
<b>Power</b>	110 - 220 Volts AC 50/60Hz
<b>Particulate Purge</b>	Clean dry gas varies by operations, see section 2.1.1 Connections

<b>Power Meter/Beam Dump</b>	
<b>Measured Power</b>	30 W to 1000 W
<b>Maximum Power Exposure</b>	1000 W for 2 minutes
<b>Precision</b>	±3%
<b>Cool-down Time</b>	20 minutes with fan cooling if used to maximum exposure

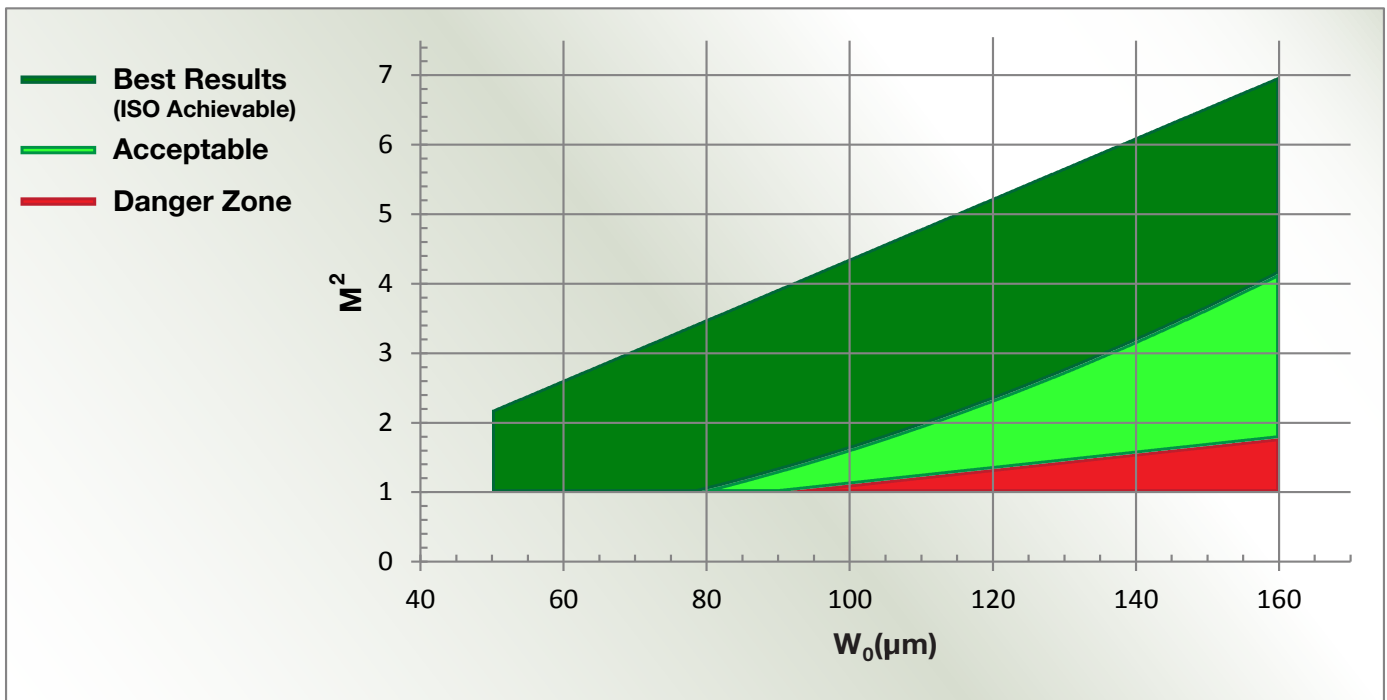
<b>General</b>	
<b>Weight</b>	17 lbs
<b>Dimensions</b>	7.03in x 4.96in x 7.16in 178.57mm x 126mm x 181.92mm

## 1.5 Operating Space

The graphic below gives a visual indication of the recommended operating space for BeamWatch AM. If BeamWatch is operated outside of this space, it may be more difficult to see the curvature of the caustic or the beam may be large enough at the edges of the image that it is out of focus.

- Best results yield the strongest measurements and may be ISO when 3 Rayleigh lengths can be seen by the camera's detector.
- Acceptable results do not meet ISO requirements, but can still be strong, accurate measurements.
- Avoid applying lasers that fall within the Danger Zone as these results may lead to damaging fine components in the BeamWatch AM unit.

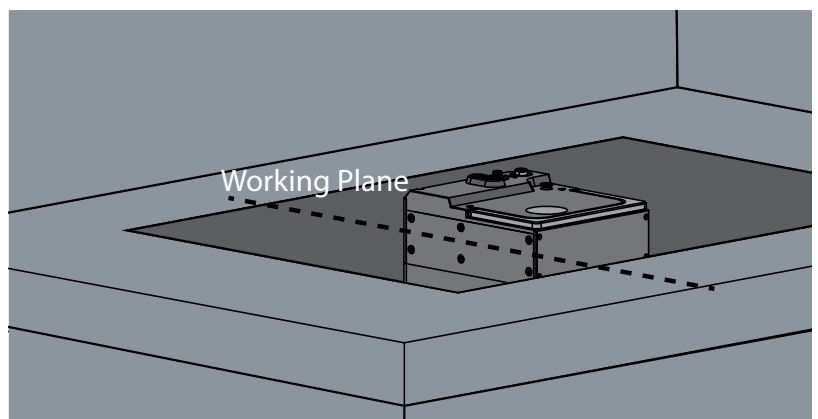
# BWAM Operating Space



The build plane can be adjusted  $\pm 5\text{mm}$  to find ISO results or a focal shift out of view due to the detector's FOV being 11mm.

In some cases results may fall within the Best Results plot, but not state ISO. If this occurs, the build plane can be moved so that the appropriate amount of Rayleigh lengths can be seen. Best Practice is to lower the build plane so the beam doesn't focus on the focusing mirror.

The build plane can also be moved if the focal shift falls outside of the camera's detector as well.





# Chapter 2 Setup

## 2.1 Mounting Hardware

Place the BeamWatch AM unit on a flat stable surface approximately where the beam can enter the input aperture unobstructed.

In most instances the weight of the unit should keep the unit in place. The user is responsible for any other means of securing the unit on the build plane.

Lower the build plane to the exact distance of the calibration sticker on the unit. This distance will ensure that the Camera Axis and the Working Plane are level.

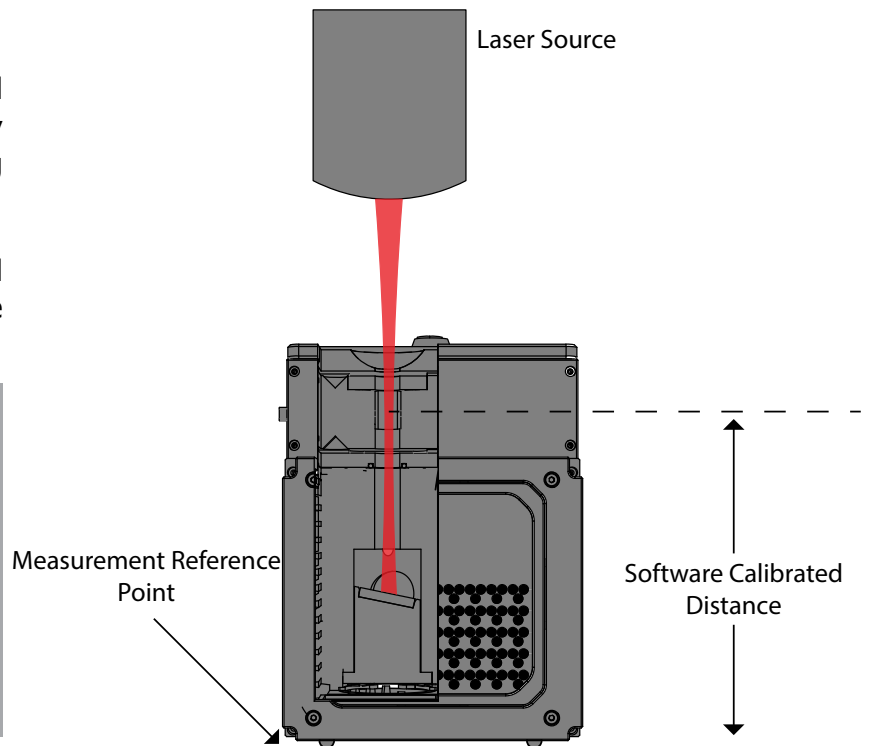
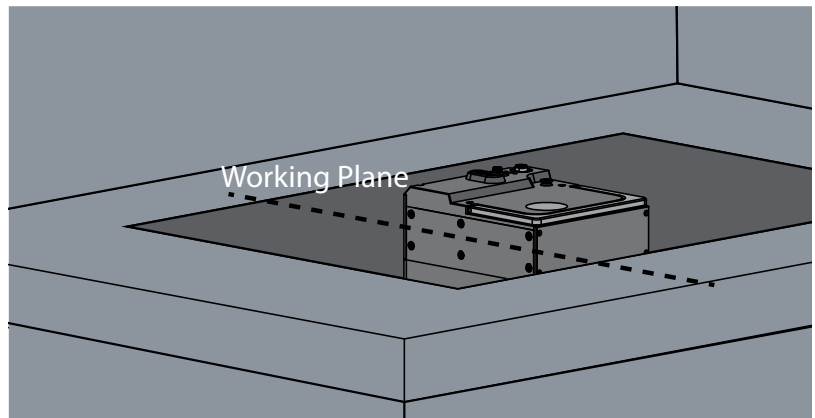
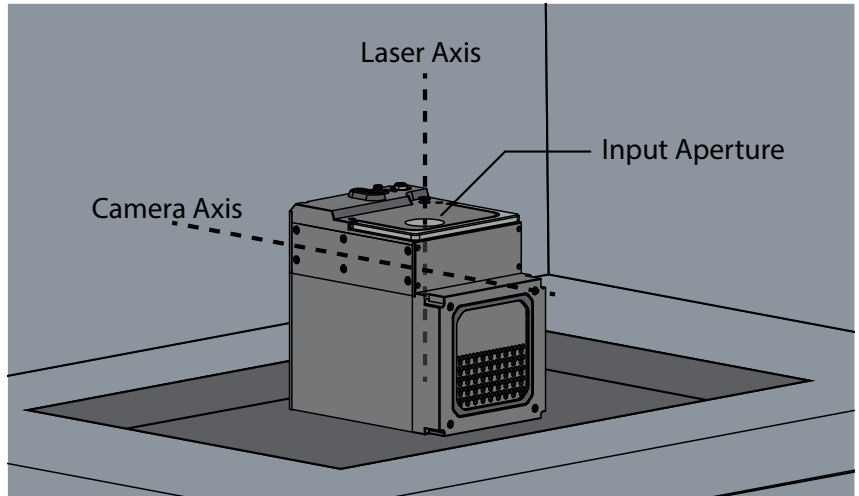
BeamWatch AM employs three ball bearings at its base to maintain three points of contact to keep the unit level. Some build planes have holes for mounting. Make sure that none of the ball bearings fall into these holes. The unit may be rotated slightly as needed.

BeamWatch AM is spatially calibrated which allows the software to automatically calculate the distance between the working plane and the waist location of the beam.

The measurement reference point is based on where the ball bearings rest on the build plane.

**Warning:**

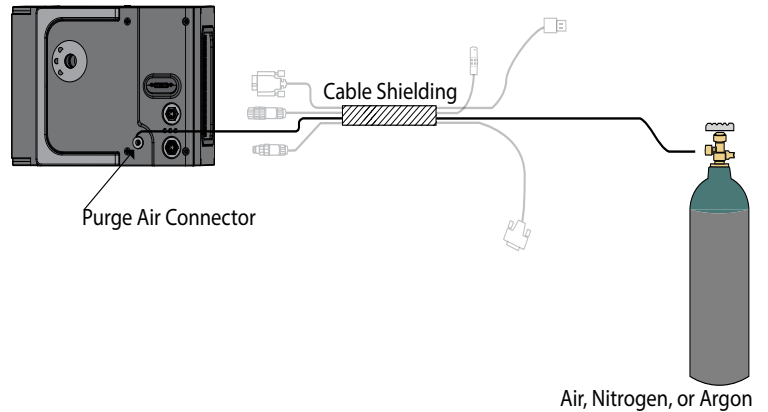
*Never apply the laser when the dust shutter is closed. The dust shutter can only be opened from inside the software when the purge gas is flowing. See 2.1.2 Laser Setup.*



## 2.1.1 Connections

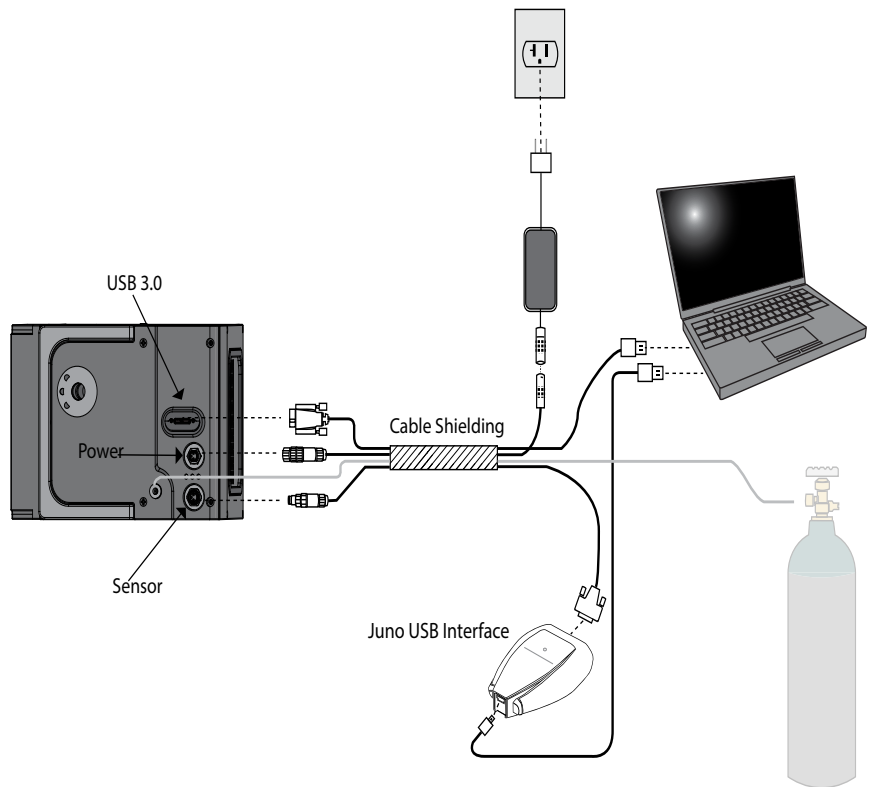
Additive manufacturing powder beds have high levels of particulates that must be removed from the camera FOV to obtain accurate results. With BeamWatch AM, this is accomplished by generating a laminar flow region at the camera FOV using a clean, dry gas source. Air, Nitrogen, or Argon are recommended.

Connect the provided tubing to the gas source as shown.



After connecting the purge gas, connect the electrical connections.

1. Connect the provided power cord to the power port on the BeamWatch AM unit.
2. Connect the remaining end into a surge protected 100-240 VAC outlet.
3. Connect one end of the provided USB 3.0 cable into the data source on the BeamWatch AM unit.
4. Connect the remaining end into a USB port on the PC.
5. Connect the provided Power Sensor cable to the Sensor port on the BeamWatch AM and the remaining end to the Juno USB Interface.
6. Connect the provided USB mini-B cable to the port on the Juno and connect the other end to the PC.



**Important:** Calibration information is stored inside the wiring harness. **Never** use a different wiring harness than the one shipped with the unit.

**Note:** Route all cables safely outside of the chamber before operation.

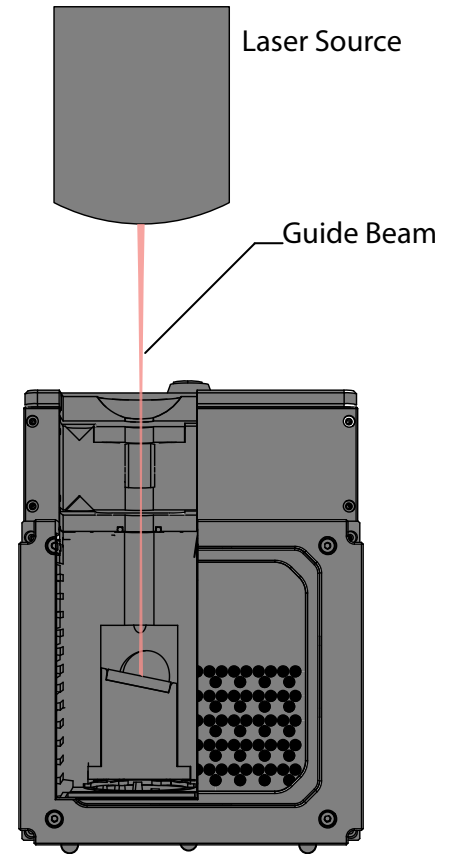
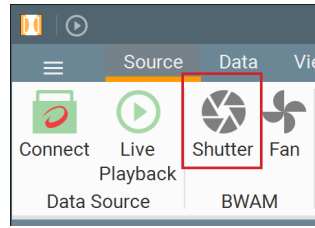
### **2.1.2 Interlock (Optional)**

Additive manufacturing powder beds have high levels of particulates that must be removed from the camera FOV to obtain accurate results. With BeamWatch AM, this is accomplished by generating a laminar flow region at the camera FOV using a clean, dry gas source. Air, Nitrogen, or Argon are recommended.

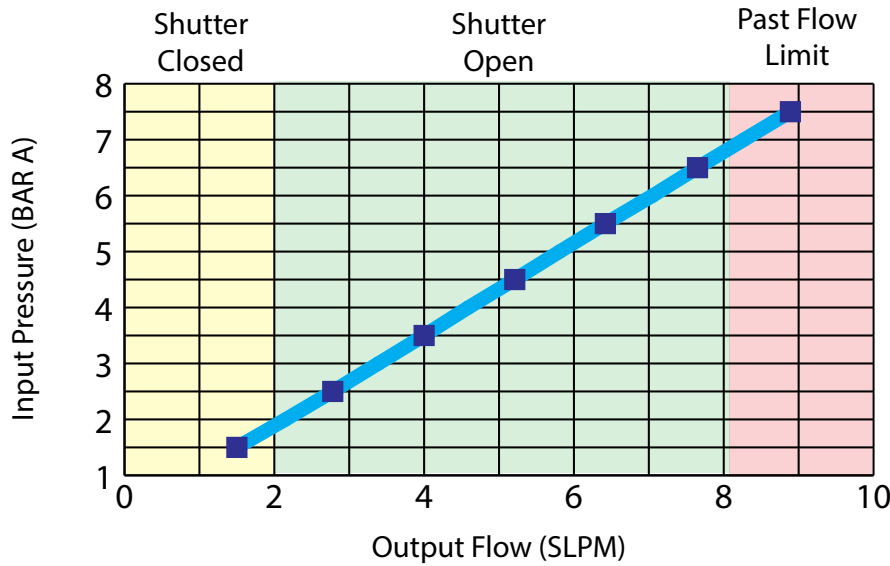
Connect the provided tubing to the gas source as shown.

### 2.1.3 Laser Setup

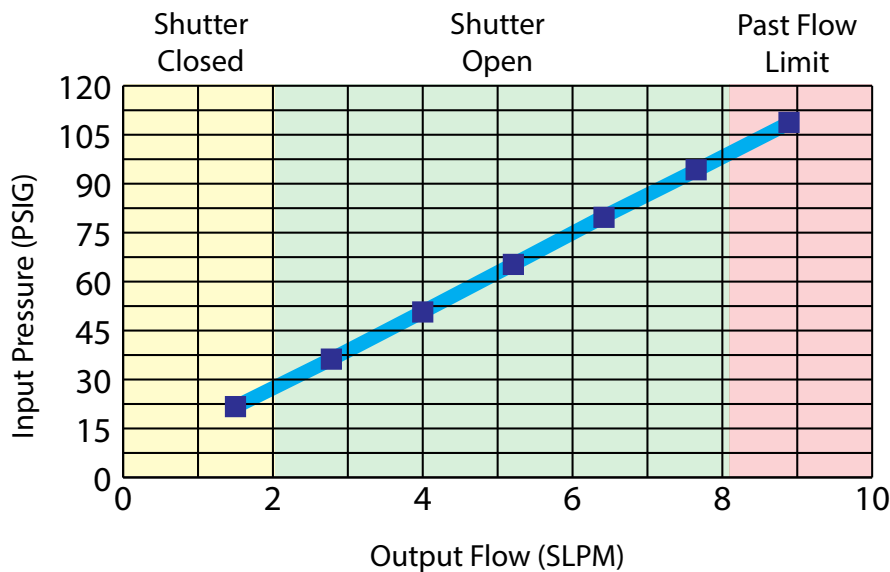
1. After installing and launching the software supply enough gas and select Shutter in the software (See chart below).
2. Apply the guide beam and align the beam in the input aperture **See BeamWatch AM Alignment Tool User Notes**. The beam alignment must be within 1.5°.




BeamWatch AM Pressure to Flow Conversion BAR A



BeamWatch AM Pressure to Flow Conversion PSIG

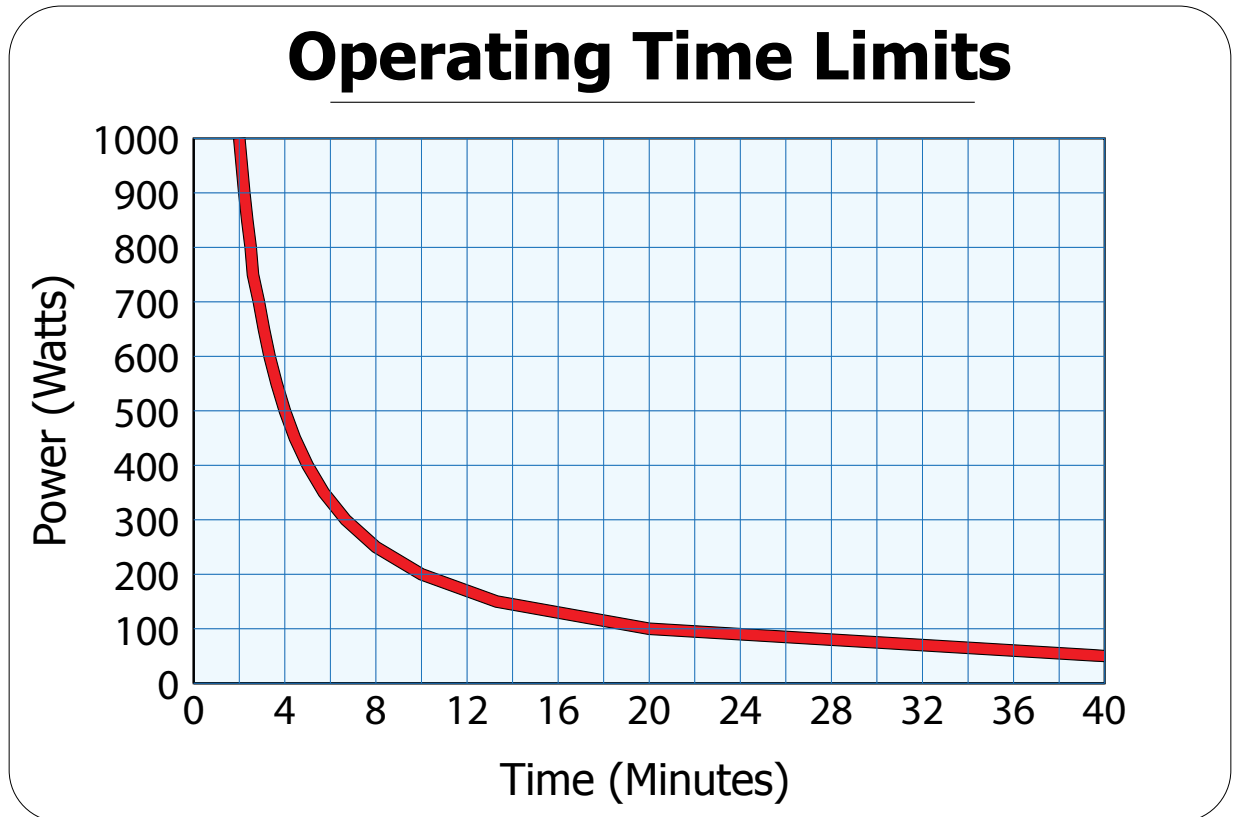
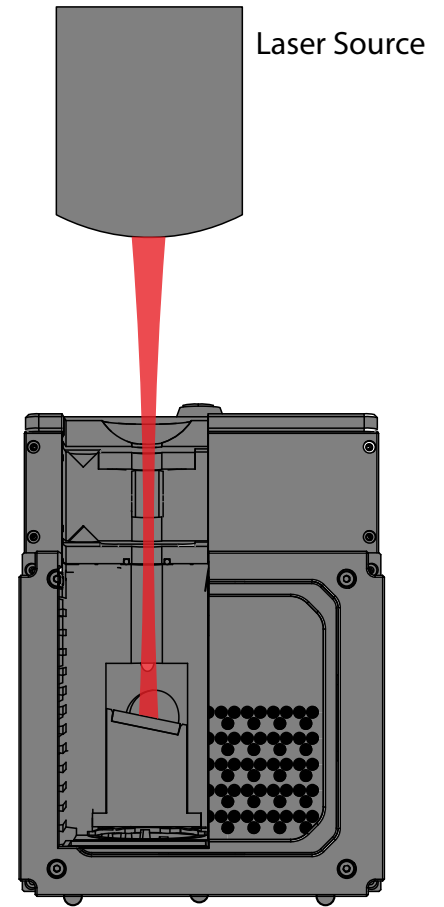


3. Once the beam is aligned switch from the guide beam to the high power beam.
4. Enable Live Playback  from the Source ribbon in the Software.
5. Adjust the gas level until a minimum amount of particulates can be seen in the 2D Beam Display window. Reference the charts on the previous page. This may be an iterative process.

Particulates may appear as a streak of high intensity light when viewing the beam, often saturating the image.

**Do not exceed a flow of 8.16 SLPM.**

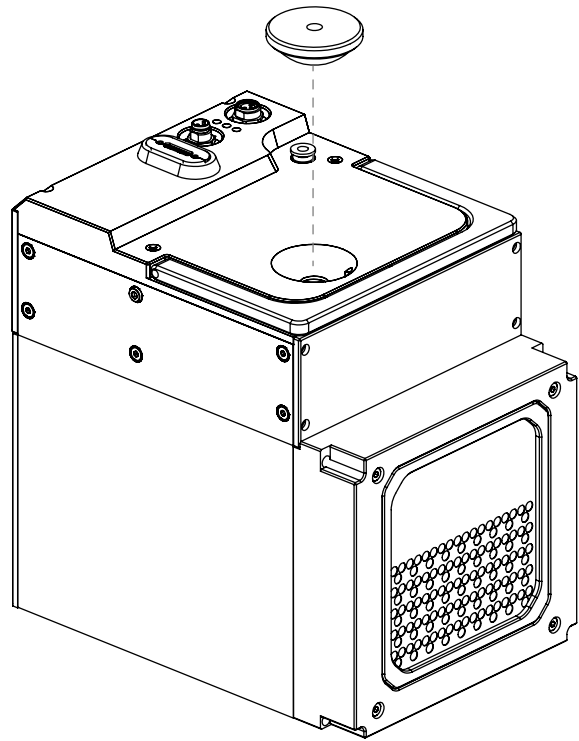
The high powered lasers used in additive manufacturing generate a large amount of heat which limits how long measurements can be taken. See the chart below to see how long measurements can be taken based on Power levels.



## 2.1.4 Halo

In some applications extra light besides the main beam can enter the BeamWatch AM and cause an increase in background signal. This makes it difficult to see the beam and can reduce measurement accuracy. To minimize this effect insert the Halo aperture into the input aperture after the beam has been properly aligned.

Make sure that the beam diameter does not exceed 4.5 mm as it enters the Halo Aperture.

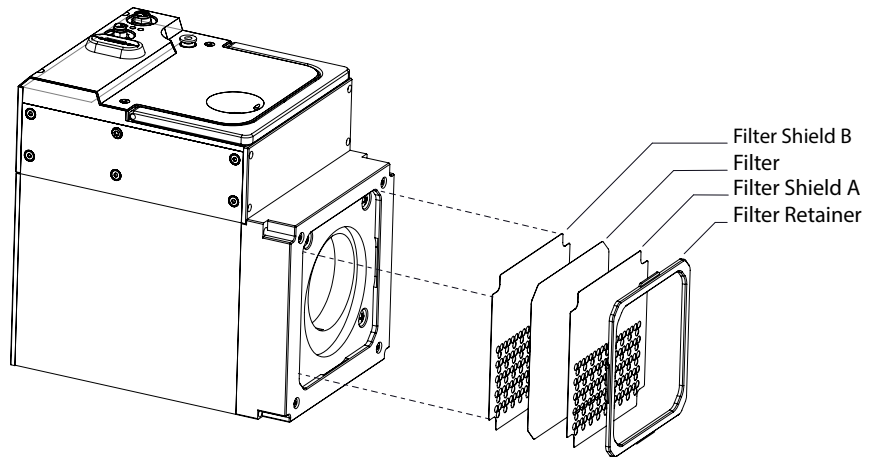


# Chapter 3 Maintenance

## 3.1.1 Replace Air Filters

Air filters should be changed every 10 hours of operation.

1. Use a flat tool, like a flathead screwdriver, to remove the Filter Retainer.
2. Remove the Filter Shields as well as the filter that is interposed between the shields.
3. Insert the new Filter between the filter shields.
4. Insert the Filter and Filter Shields back into the BeamWatch AM unit.
5. Replace the Filter Retainer by applying gentle pressure.

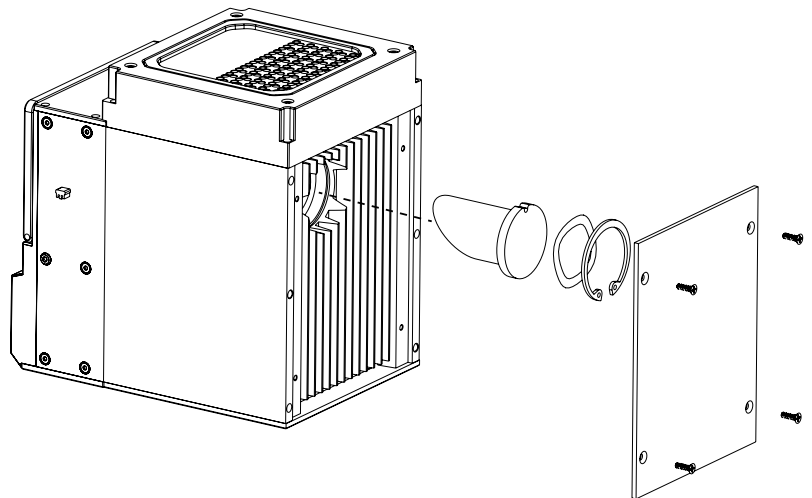


Air filters are a replaceable part and can be purchased under the part number XXXXXXX

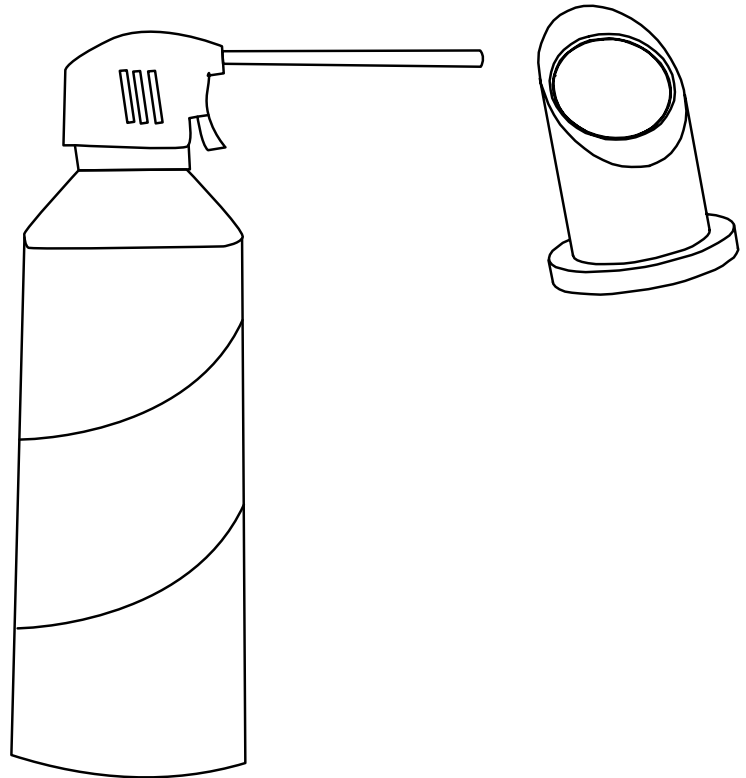
## 3.1.2 Cleaning the Mirror

If dust gets on the mirror it can either increase the background signal in the measurement or more likely can burn off the mirror coating which can lead to more components getting severely damaged. The Beam Dump Mirror should be cleaned every five hours of operation.

1. Wear clean gloves to prevent damage to fine components.
2. Use a screwdriver to remove the four screws located on the Base Plate. Set aside and do not lose.
3. Remove the Base Plate.
4. Use the provided retaining ring pliers to remove the exposed Retaining Ring.
5. Remove the Wave Ring.
6. Place a clean optical quality tissue on the table and gently tilt the BeamWatch AM unit to catch the Beam Dump Mirror Assembly.



7. Blow a clean, dry gas onto the mirror to remove any dust buildup (If using canned air keep the can as vertical as possible to prevent any liquid getting on the mirror assembly.)
8. Replace the Beam Dump Mirror Assembly. Make sure the index lines up with the notch on the assembly.
9. Replace the Wave Ring, Retaining Ring, and Base Plate
10. Secure the plate with the four screws.



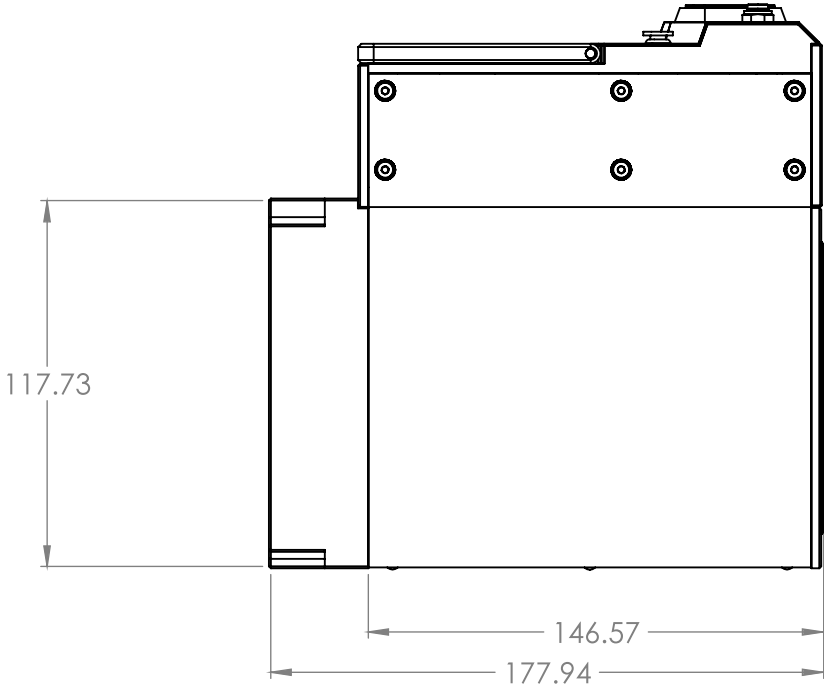
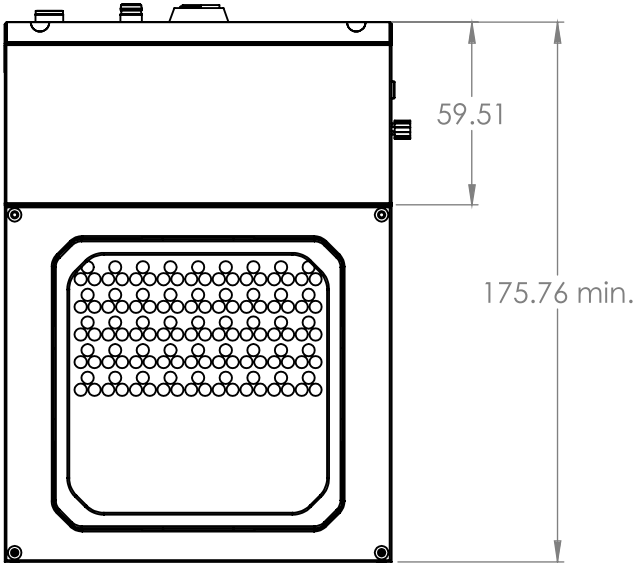
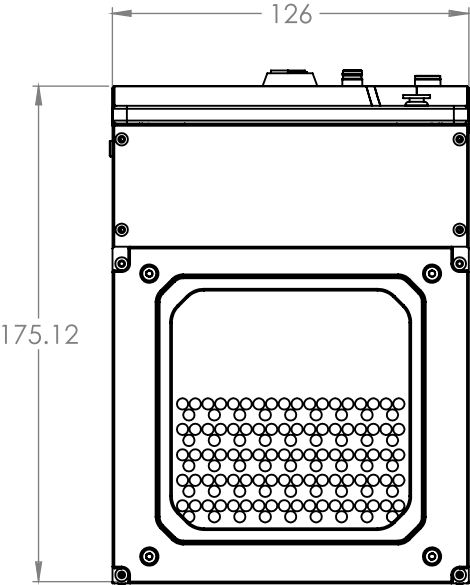
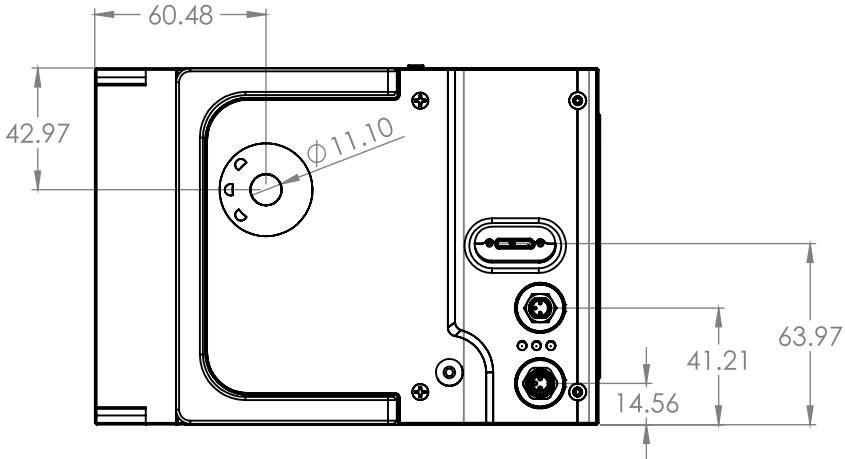
In the event of damage a replaceable part and can be purchased under the part number 12386-001

### 3.1.3 Recalibration

BeamWatch AM needs to be sent to Ophir-Spiricon annually for recalibration to maintain accurate readings. Because the calibration is stored in the wiring harness, it must be included when shipped. Please contact the Ophir-Spiricon Service Department at (435) 753-3729 to schedule calibration.



# Dimensions





### Notice

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