



II-VI-CO2-BS-35
II-VI-CO2-BS-60

Industrial CO₂ Laser Beam Profiler

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Manual No. 11301-001
Document No. 11254 Rev C

Notice

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II-VI SPIRICON CO₂ Industrial Beam Profiler

II-VI-CO2-BS-35 (formally part number II-VI-CO2-BP-40)
II-VI-CO2-BS-60, Consult factory for price and delivery.

The II-VI industrial beam monitor is designed to sample a high power (up to 8 kW) CO₂ laser beam (up to 35 mm CA) in-line with the laser. It works by diverting a small portion of the main beam reducing the diameter and sending the reduced beam towards a Spiricon Pyrocam III camera. This precision instrument must be properly set up and aligned for optimal performance.

Specifications:

	<u>-35</u>	<u>-60</u>
Input beam clear aperture:	35mm	60mm
Maximum second moment Input Beam Width	20mm	35mm
Maximum input power with water cooling:	8kW	12kW
Maximum input power w/o water cooling:	500W	500W
Water flow rate at maximum input power:	2 l/min	3 l/min
Damage Threshold at maximum water flow rate:	10 kW/cm ²	10 kW/cm ²
Damage Threshold w/o water cooling:	5 kW/cm ²	5 kW/cm ²
Inline beam Transmission:	97-98%	97-98%
Pyrocam Beam Output Attenuation:	100,000:1	TBD
Beam dump power vs. input power:	~303:1	TBD

Replacement Components:

	Part Number
Copper mirror with water cooled ports – Input mirror:	II-VI-921314/F1
Copper mirror with water cooled ports – Output mirror:	II-VI-921314/F2
GaAs dichroic beam sampling mirror: (1 req'd)	II-VI-323467

Accessories:

- 2 – Pinhole aperture disks for aligning High Energy Section using a visible guide beam
- 2 – Crossed wire aperture disks for aligning High Energy Section using low power CO₂ energy
- 2 – Crossed wire alignment plates for internal alignment
- 1 – Key for High Energy Section
- 3 – Leveling feet
- 1 – ¼-20 Screw for mounting the Pyrocam.
- 4 – Allen Wrenches

WARNING: This instrument is designed for use with high power CO₂ lasers. Precautions must be taken to avoid exposure to direct or reflected laser energy. When in operation, the entire beam path should be enclosed. The High Energy section of the instrument must be closed whenever the High power laser is running. The High Energy section of the instrument has a key lock to prevent unauthorized access to the High Energy section and should be locked when the instrument is not being serviced. Use eye protection when working around laser beams.

CAUTION: The beam dump may become HOT during extended periods of use. The beam dump will absorb approximately 3.3 Watts for every kilo-Watt of entrance power.

NOTICE: This unit contains copper components in the water cooling circuit and therefore should not be used with cooling equipment that contains aluminum components. To avoid possible damage to the mirrors, the cooling water should be maintained at or below the dew point of the ambient environment.

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Please follow these general instructions.

Unpacking:

Remove the II-VI-CO₂ Beam Sampler and inspect for shipping damage. Verify that all accessories are present.

Place the instrument on a stable work surface in a dust free location and remove the cover from the high-energy section. This requires that you turn the 1/4-turn screws and unlock the lock with the provided key.

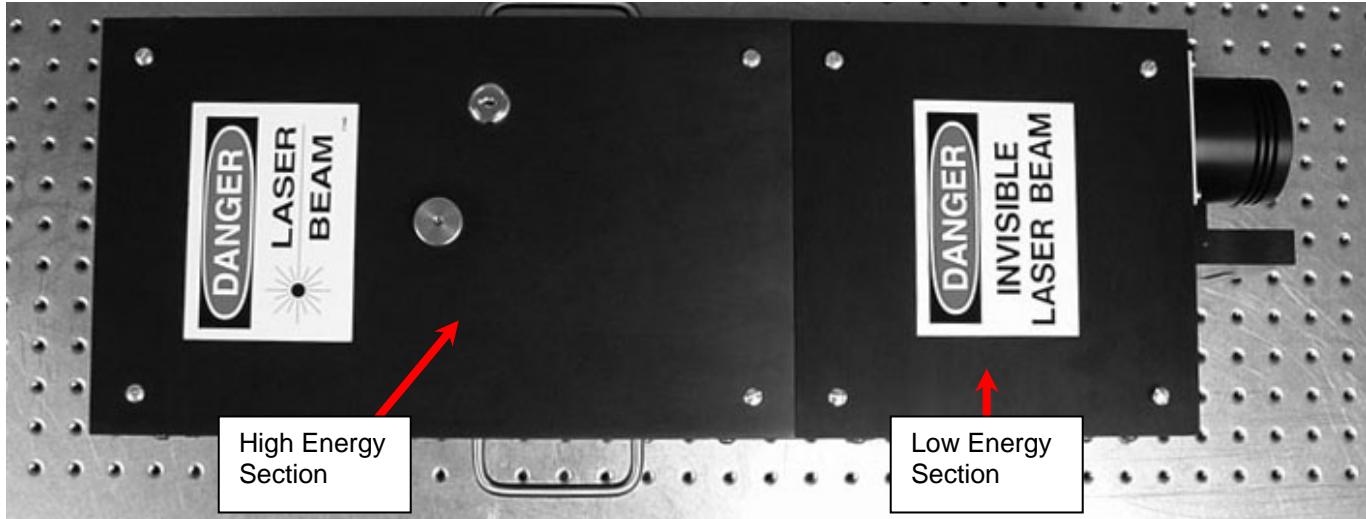


Photo 1

Caution: When working around the mirrors, take precautions to avoid touching the mirror surface.

Before operating with your laser you MUST release the lockdown bracket securing the exit mirror to its mounting base. This bracket is held in place by four (4) hex-head screws. See Photo 2. Loosen all four (4) of these screws so that the bracket is not restrained at any point.

Caution: If for any reason you need to ship by common carrier, or personally transport the II-VI-CO₂-Beam Sampler over any significant distance, you should retighten these four (4) screws. Failure to tighten this shipping bracket will likely lead to the damage of the exit mirror or its mounting base.

Inspect all optical components and verify that all mounting screws are tight. Replace the cover on the High Energy section.

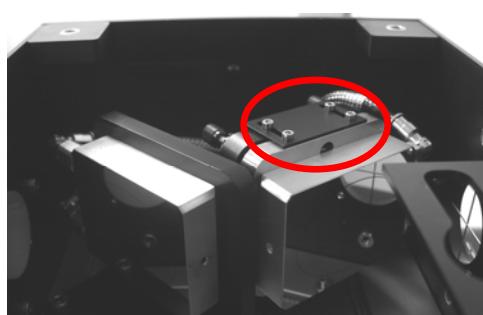
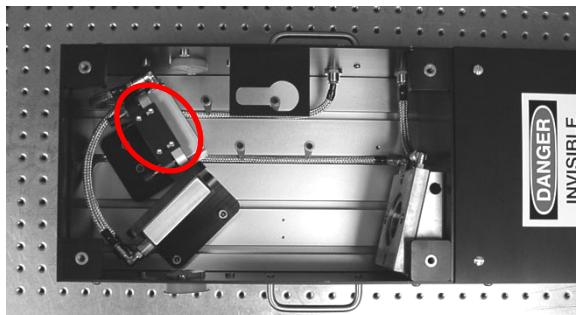


Photo 2 Mirror locking bracket location

Open the low energy section (see Photo 1) by unlocking the 1/4-turn screws and removing the cover. Inspect all optical components to make sure they are secure and the mounting screws are tight.

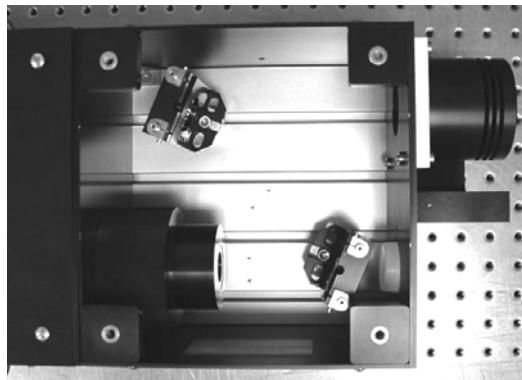


Photo 3 Low power section

Factory Alignment:

The mirrors systems within your II-VI-CO2-Beam Sampler have been pre-aligned by the manufacturer and should not need further adjustment. However it is possible that the alignment could be disturbed if rough handling has occurred during shipment. Additional adjustment can only be determined after the unit is rigidly mounted and mated into your beam delivery system. In general, an input laser beam entering orthogonal to the Input beam port will exit orthogonally from the beam Output port. A sample of the beam image will exit near the center of the Pyrocam III exit port. Excess sampled beam power will be directed to the air-cooled beam dump.

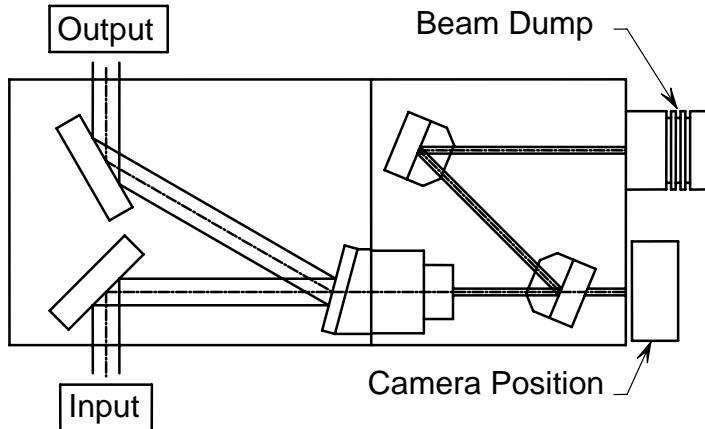


Figure 1

General Installation Principles

The II-VI-CO2-Beam Sampler is designed to be used inline with an operating laser. That is to say, it is placed into your beam delivery path and can monitor your laser beam while it is delivering laser power to your work piece. The unit can be fitted to your beam delivery tubes by mounting specially sized tube clamps at the input/output ports. A hole pattern is supplied for that purpose.

NOTE: Tube mounting clamps are not provided and must be fabricated to mate with your system requirements on an as needed basis.

You should direct your collimated input beam through the center of the Input beam port, orthogonal to the input surface. The beam should then leave the Output beam port inline with the input beam axis.

Mounting Points:

The external mounting of your II-VI-CO₂-Beam Sampler will be determined by your particular installation. The instrument must be secured firmly in place. Three (3) adjustable mounting feet are provided and can be mounted to the end of the side plate nearest to, and parallel with, the beam Input and Output ports.

In addition, four (4) M6 mounting clips are provided in channels on the bottom of the base plate.

Nitrogen Purge, High Humidity Operating Environment:

Your II-VI-CO₂-Beam Sampler is provided with 2 threaded ports for the supply of a Purge gas. If you are operating your II-VI-CO₂-Beam Sampler in a high humidity environment, moisture may condense on the three high power water cooled mirrors. This could lead to airborne particulates becoming stuck onto the mirror surface, and then burned into the mirror when your laser is switched on. For this reason it is recommended that the II-VI-CO₂-Beam Sampler be supplied with a dry nitrogen purge gas supply... or an equivalent dry air source. If your beam delivery tubes are already supplied with purge gas, and they are securely plumbed to the Input/Output ports then the addition of a purge gas into the II-VI-CO₂-Beam Sampler high energy section will not be needed.

A second purge gas port is provided in the low power section of the instrument as the two sections are isolated and purge gas from the laser will not protect the low power section.

The addition of a Nitrogen purge will under almost all conditions help to increase the useful life of the system's high power optics. For this reason it is highly recommended even if humidity is not a factor.

Making External Beam Alignment Adjustments:

The following steps assume that you are familiar with the operation of the Pyrocam III and that you have it setup to view your CO₂ laser operating in CW mode. If you do not know how to operate your Pyrocam III you should read the Pyrocam III's operators manual and become familiar with its operation before proceeding.

The next steps will require you to remove the cover from the High Energy Section of the II-VI-CO₂-Beam Sampler. See Photo 1.

CAUTION: The high power copper and GaAs mirrors are very easily damaged. In the case of the copper mirrors any mechanical contact with their mirrored surfaces will likely cause some degree of degradation in performance. Avoid coming in contact with these mirrors. If you touch them and leave a finger print it must be cleaned off before being burned into the mirror by exposure to your CO₂ laser. Likewise if dust particles land on the mirror surfaces they can be burned into the mirror when exposed to your CO₂ laser. Dust particles can be blown off of the mirror surface using a dry clean gas under pressure. See Appendix A on How to Clean your Optics.

Your beam must be aligned with the input port such that it enters the center of the input port and a sampled beam exits the Pyrocam port and appears on the Pyrocam III's imager. Do the following:

1. Remove the cover from the High Energy Section. Verify that the lockdown bracket securing the exit mirror to its mounting base is loosened so that the bracket is not restrained at any point. See Photo 2. *Read the Unpacking: section of this manual if you haven't already done so.*
2. Attach your Pyrocam III to the mounting bracket using the supplied 1/4-20 mounting bolt. See Photo 4. The angle bracket may be loosened or removed to facilitate mounting. The mounting bracket has slotted holes for both vertical and horizontal adjustment.

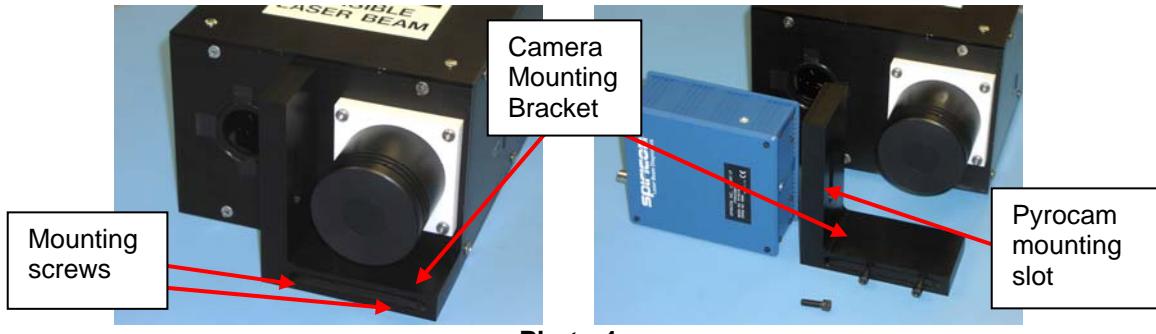


Photo 4

Place the Pyrocam's imager approximately in the center of the exit port. Connect the Pyrocam to your PC and start the Pyrocam control console running. (See the Pyrocam Users Guide.) Set the Pyrocam for CW mode, chopping at 24HZ. Set the Gain to 10x. Enable the Viewer, and click on the Calibrate button.

3. Attach water cooling lines to the Water Input/Output ports using 6-mm OD tubing. Do not use non-metric tubing. See Photo 5. Check for and repair any leaks, then turn the water off.

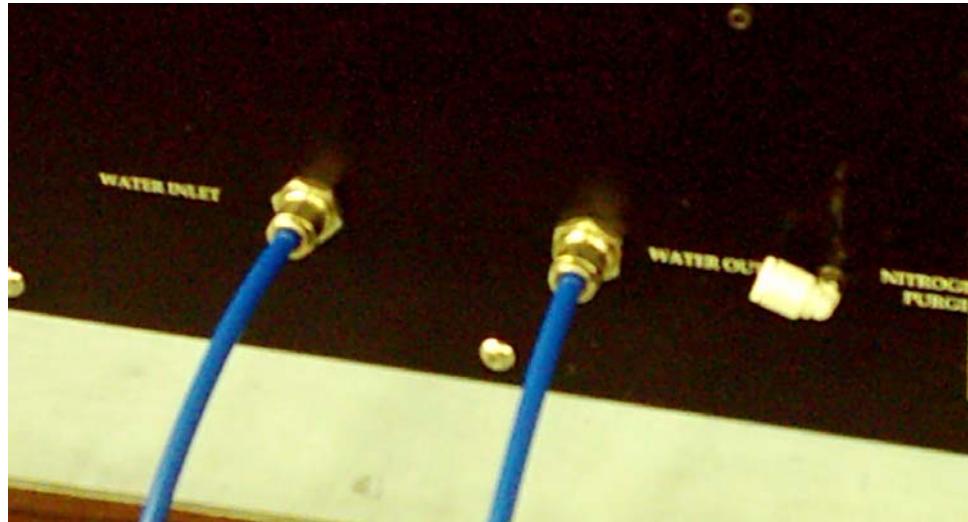


Photo 5

4. Align your CO₂ laser with the Input port.

If your laser is fitted with an alignment HeNe laser use it in combination with the two supplied pinhole aperture plates. Place one pinhole on the input port and one on the output port. Note the dowel pins provided to center them in the port openings. **Caution:** If you are mounting the Beam Sampler in a vertical orientation, secure the upper pinhole to prevent it from falling on the mirror. Align the HeNe laser such that it is centered with and passes through both the Input and Output port pinholes. Once aligned with your HeNe laser remove the pinholes. Go to step 5.



Photo 6 Aperture plate placement

If your laser is not fitted with an alignment HeNe laser you may want to use one of the crosshair steel alignment gauges that can be fitted into your laser Input and Output ports. Place one on the Input port. Note the dowel pins provided to center it in the port opening. **Caution:** If you are mounting the Beam Sampler in a vertical orientation, secure the upper pinhole to prevent it from falling on the mirror.

Up to this point you have not run your CO₂ laser. The alignment to the input port is based on the best mechanical positioning that you are aware of at the moment. If you must run your laser to find the beam do so at very low power using burn paper to center the beam into the attached crosshair. Be careful not to vaporize the paper leaving soot deposits on the mirror surfaces.

WARNING: The crosshair alignment gauges are not designed to handle the full power of a kilowatt CO₂ lasers. You should operate these with the laser running at only a few hundred Watts of output power. Hitting them with full laser power will probably melt them or at worst vaporize a part of them. This could spray metal onto things that you do not want to receive it.

5. Place a suitable beam dump or a power meter head into the beam path to collect the laser beam coming from the Output port.

The following steps should be performed with your laser set into a relatively low power output mode; 300 to 500 Watts is a good starting point. At this level you can operate without supplying cooling water to the mirrors.

6. Turn on the laser. You should observe the laser beam image on Pyrocam III's viewer. If everything is well aligned the image should be very near the center of the image. If it is not near the center and you have a high degree of confidence in your input beam alignment you may choose to readjust the Pyrocam by loosening the bracket mounting screws and/or the Pyrocam mounting screw and adjusting to bring the beam image closer to center.

If you believe that you have the Pyrocam well centered you may adjust the position of the II-VI-CO₂-Beam Sampler until the beam centers on the Pyrocam. Note that very slight adjustments of the II-VI-CO₂-Beam Sampler will yield very rapid movement of the beam in the Viewer window. This is a delicate operation considering the mass of the II-VI-CO₂-Beam Sampler. Use care.

If you still have the beam crosshair gauges in place you can use the shadow that they project to center the laser into the opening and onto the Pyrocam image center.

7. Note: Before performing this test you must reduce the laser output power to make this operation safe to perform. You can recheck that the output beam is centered in the beam Output port using burn paper in conjunction with the output crosshair.

Repeat any of the above steps until you have your laser beam input, output and Pyrocam image all well aligned and centered at the three points described above.

Before increasing the output power of your laser remember to:

- Secure the position of the II-VI-CO₂-Beam Sampler
- Remove any pinholes or crosshairs still in place.

- Turn on the cooling water.
- Check for dust or fingerprints on the mirrors and clean if necessary.
- Replace the outer cover.
- Make sure the exit beam is directed to a safe target.
- Switch the Pyrocam III to a 48Hz chopping frequency and reduce the Gain to 1x.

If you are unable to make all of the alignment adjustments described above then you will probably need to make an internal adjustment to one or more of the mirrors inside of your II-VI-CO₂-Beam Sampler. The next section will describe how to approach this issue.

Making Internal Beam Alignment Adjustments:

If you were not able to align and center your beam to the three locations described above the next step will be to make an adjustment to the Output port mirror. Before doing this repeat the above steps that create a beam aligned and centered with the Input port, and centered on your Pyrocam III. You must be able to achieve at least these two alignments before making any internal adjustments. If you can not accomplish this alignment then something serious may have happened during shipping and you should contact the Spiricon Service Department before attempting any further adjustments.

Note: The input mirror, dichroic beam sampling mirror, the beam reducing telescope, and the second dichroic mirror; are all fixed into permanent locations that do not require adjustment in order achieve the two (2) point alignment criteria described above. Failure to be able to perform alignment of these two beam locations implies that something is seriously out of position. There are no available means to adjust the first three items, and the forth only requires a ballpark alignment to achieve a beam centered in the Pyrocam view port.

If you were able to center and align the input beam to the Input port and onto the center of the Pyrocam, the only adjustment likely needed is to adjust the output copper mirror to center the output beam to the Output port. Only a very slight adjustment should be required. Since you are directing the output beam to your delivery system it may be more important that it aligns with it rather than any theoretical input vs. output beam axis. In that case you can make this final adjustment to suit your particular needs.

Once you have all of the above adjustments working to meet your requirements it may be a good idea to check one additional internal mirror setting. This is especially important if you found it necessary to make a rather large adjustment to the output copper mirror.

The low power section of the II-VI-CO₂-Beam Sampler contains a beam dump that collects the power that is reflected by the second dichroic sampling mirror. If everything is still correctly aligned this beam should reflect from this mirror, hit a second mirror, and end up in the beam dump. If you suspect that this beam is not properly aligned with the beam dump you can remove the beam dump and check that the beam coming through this port is reasonably well centered. Making this determination will require a power meter with a low power capability. The output power from this port is about 3.3 Watts per kilo-Watt input. With an input beam of 300 to 500 Watts, as described above, the reading here should be about 1-1.5 Watts. Align the power meter head with this port and use a metallic knife-edge to verify that the beam is reasonably centered in this opening. It does not need to be dead-centered, just close to center. If you need to adjust this you can use the second mirror mentioned above to bring it into better alignment.

If for some reason this beam doesn't even hit the second mirror it may be necessary to readjust the second beam sampling dichroic mirror. Before doing this make sure that everything else is aligned correctly, even going so far as to recheck the alignment of the laser to the Pyrocam. It should be very unlikely that the dichroic mirror should require adjustment. Before doing this you may want to call the Spiricon Service Department to review what you've done so far.

Appendix A

Infrared Optics Handling and Cleaning Procedures

