

Installing the Model 610015

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Installing the Model 610015 Light Arm

This section gives instructions on how to install and align the Model 610015 Light Arm in a Particle Image Velocimetry (PIV) system. The Light Arm can be used with lasers at 4.25" (83 mm) beam height.

This manual is for the installation of the 610015 Light Arm for systems shipped after June 2000. If you have an older 610015 Light Arm, refer to Manual 1990780 for installation instructions.

Scope

After completing this section, you will have done the following:

- ☐ Installed the Light Arm on the base.
- ☐ Aligned the Light Arm with the input laser beam.
- ☐ Attached the output end of the Light Arm to a traverse or other mount.

Unpacking and Checking the Packing List

Carefully unpack the other components of the Light Arm subsystem, making sure they arrived in good condition. If there are signs of damage, contact the nearest TSI sales office or representative at TSI. See "Service Policy" on the *Warranty* page at the beginning of this manual for further details.

Compare all the components you received with those listed in Table 1. If any parts are missing, contact TSI. See "Getting Help" in *About This Manual* section for the address and phone number.

Table 1
Packing List for the Model 610015 Light Arm

Qty	Model Number	Description	Part Number
1	610015	Light Arm System	
1		Light Arm & Mount Base	1098915
1	610065	Lens 10-meter FL 25 mm dia.	
1	1210261	Breadboard 18" x 30"	
1	1090012	Light Arm Kit including:	
		1 Cross Wire Tube End Mount	1098917
		2 White Input Aperture	2207013
		6 Long Clamps	2206071
		Output Mount with Shutter	1098847
		6 ¼-20 Buttonhead Screws	5151160
		6 ¼-20 x 5/8 Socket-head Cap Screws	5150180
		3 M4 x 10 mm Socket-head Cap Screws	5200000
	1098848	Light Sheet Optics with Laser	
	NW Solo;	Specific Mounting Plate	
	or		
	1098849	-15 mm Cylindrical Lens	610090
	NW Gemini;	-25 mm Cylindrical Lens	610091
	or	-50 mm Cylindrical Lens	610092
	1098850	200 mm Spherical Lens	610061
	Big Sky	500 mm Spherical Lens	610062
		1000 mm Spherical Lens	610063
		Lens Mount	2207507

Laser Safety

Read and follow the laser safety section of this manual.



WARNING

- ☐ The Light Arm allows the laser beam to be positioned and moved very easily. Use caution when using the Arm so that the output beam does not cause a hazard. Always attach the output end of the Arm so that it cannot move unintentionally.
- ☐ Make all adjustments to the Arm with the laser at minimum power to reduce the hazards.
- ☐ The light intensity is much higher at the beam-focus point. Wear laser safety goggles whenever you look at the beam (*never* look directly into the beam). The reflections may be bright enough to damage your eyes.

Assumptions

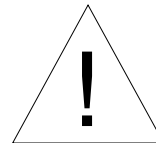
Before beginning installation TSI assumes you have read the laser manufacturer's manuals and completed the following steps:

- ☐ Installed the laser.
- ☐ The laser is setup for running at low power for installation and alignment.

Installation Overview

To install and align the laser, you need to complete the following steps:

- Step 1.** Checking the height and parallelism of the laser beam.
- Step 2.** Install the Beam Launching Arm Mount to the base.
- Step 3.** Attach the Light Arm to the Beam Launching Mount.
- Step 4.** Align the Beam to the Arm Optical Axis.
- Step 5.** Attach the Collimating Lens.
- Step 6.** Attach the Arm Output Port to the Output Shutter and attach the Light Sheet Optics.



IMPORTANT

All necessary alignment procedures may be performed by adjusting the alignment of the laser or the Light Arm Mount. **Do not** make any adjustment to the mirrors at the light arm knuckles. The alignment of the mirrors in the arm is a complex procedure and is **not** to be performed in the field.

Step 1: Checking the Height and Parallelism of the Laser Beam

Before installing the Light Arm it is important to have the laser installed and well aligned. The Light Arm separates the laser from the light sheet optics by nearly 2 meters. Small laser alignment errors, that do not affect performance when using standard light sheet optics, can be a problem when using the arm. To verify that the laser beam is at 4.25 inches (83 mm) high and parallel to the base, mount the laser on a breadboard or some other rigid, flat surface that is at least 2.5 meters long. The following steps use a pair of alignment blocks that have a pinhole at 4.25 inches from the base.

1. Place the first alignment block approximately 100 mm in front of the laser head.



Caution

Make sure the laser is at low power. The laser power can be adjusted with the Q-Switch delay time for Nd:YAG lasers.

2. With the Q-switch delay set for low laser power, turn on the laser pulsing using the INSIGHT software.
3. Slide the alignment block from side to side until the laser beam passes through the center of the pinhole. If it is impossible to align the laser beam through the center of the pinhole, the laser beam must be adjusted. Refer to the laser manual for instructions on adjusting the laser beam height.
4. With the laser beam passing through the center of the pinhole in the first alignment block, place the second alignment block at least 2 meters from the laser head.
5. Slide the second alignment block from side to side until the laser beam passes through the center of the pinhole. If it is impossible to align the laser beam through the center of the pinhole *in both alignment blocks simultaneously*, the laser beam must be adjusted. Refer to the laser manual for instructions on adjusting the laser beam.
6. When the laser beam is at 4.25 inches (83 mm) high and parallel to the base, as evidenced by the laser beam passing through the center of the pinhole in both the near (100 mm) and the far (2 m) laser alignment blocks, continue with the installation process.
7. Turn off the laser pulsing using the INSIGHT™ software.

Step 2: Installing the Beam Launching Mount to the Base

This step includes instructions on installing the Beam Launching Mount to the breadboard Base, assuming the laser head is already mounted to the breadboard.

1. Turn off the laser pulsing using the INSIGHT™ software.
2. Rotate the Alignment Ring on the Beam Launching Mount, to the Closed position.
3. Position the Beam Launching Mount 4 inches in front of the laser. Loosely clamp the mount to the base. It will be positioned more accurately in the next few steps. This

Light Arm

4-inch separation allows room for the light tube to be inserted between the laser and Beam Launching Mount.

4. Screw the white pin hole aperture into the threaded hole in the input port of the Beam Launching Mount.



Caution

Make sure the laser is at low power. The laser power can be adjusted with the Q-Switch delay time for Nd:YAG lasers.

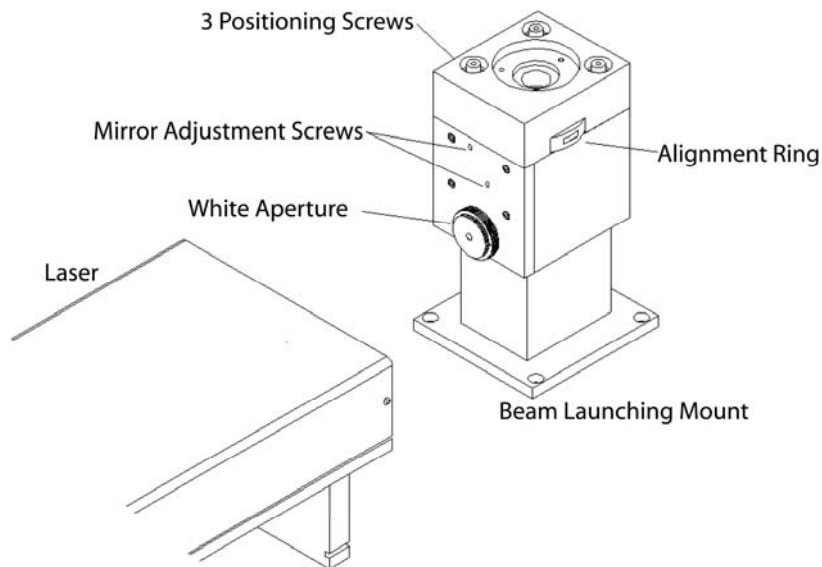


Figure 1. Installing the Beam Launching Mount with the Laser



WARNING

The beam comes up out from the top of the Beam Launching Mount. Even in the mirror position, enough light is emitted through the top hole to cause permanent eye damage.

5. Turn on the laser pulsing at low power using the INSIGHT software.
 6. Align the Beam Launch Mount with the laser beam. If the laser beam is not vertically centered on the alignment hole, go back to the laser installation and mount the laser at the correct beam height and parallel to the base.
- The Beam Launching Mount is aligned when the laser beam is centered on the input alignment aperture and the mount is square to the laser and base. Tighten down the mounting screws to the base.
7. Turn off the laser pulsing using the INSIGHT software.
 8. Remove the white pinhole aperture from the Beam Launching Mount. Place it in the upper cavity of the Beam Launching Mount where the laser beam exits.



DANGER

Laser beam exiting from top of base.

9. Place a nonreflective, fireproof target a few feet above the Beam Launching Mount output. Make sure it is in a position from which the laser beams, when projected onto this target, can be easily viewed.

Light Arm

10. With the white pin hole aperture in the Beam Launching Mount upper cavity, where the beam exits, adjust the Mirror Adjustment Screws (Figure 1) until the beam is centered on the pinhole. Judge the beam position by looking at the spot on the target.
11. If it is impossible to center the beam on the pinhole, loosen the three positioning screws on the top plate of the Beam Launching Mount and center the pinhole on the beam.
12. Tighten the three positioning screws.
13. Verify the position of the beam into the base using the pinhole. If necessary, loosen any clamps and reposition the Beam Launching Mount. Verify the beam angle with the mirror.
14. Verify the Alignment with the pinhole in the Alignment Ring. For fine adjustment without misaligning the base, loosen the three socket-head cap screws and move the alignment ring mount on the base. Tighten the three screws.



WARNING

The beam is very bright. Wear your safety glasses when looking at the beam on the mirror mount.

15. Turn off the laser pulsing using the INSIGHT software.
16. Remove the pinhole from the base input.

Step 3: Mounting the Light Arm on the Beam Launching Mount

Follow these steps to attach the Light Arm to the Beam Launching Mount:

1. Place the Light Arm assembly on the beam exit port of the Beam Launching Mount. Attach the Arm in place with three M4 socket-head cap screws.
2. Attach the counterweight to the Light Arm (see Figure 2). The clamp assembly for the counter weight is set in the correct orientation at the factory. Do not remove or change the position of the clamp assembly.

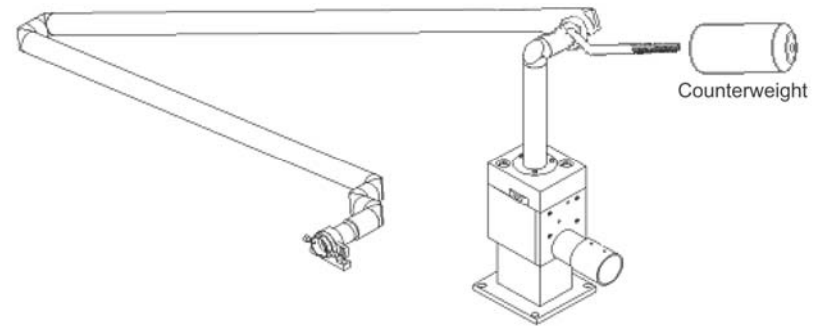


Figure 2. Light Arm Counterweight

3. Make sure the arm is installed as shown in Figure 3. Since the arm is constructed from pre-stressed carbon fiber, it is imperative for alignment purposes, that the second joint (the first joint after the counterweight) turns left. If the second joint turns right, the arm is upside-down and you need to reposition the arm.

Light Arm

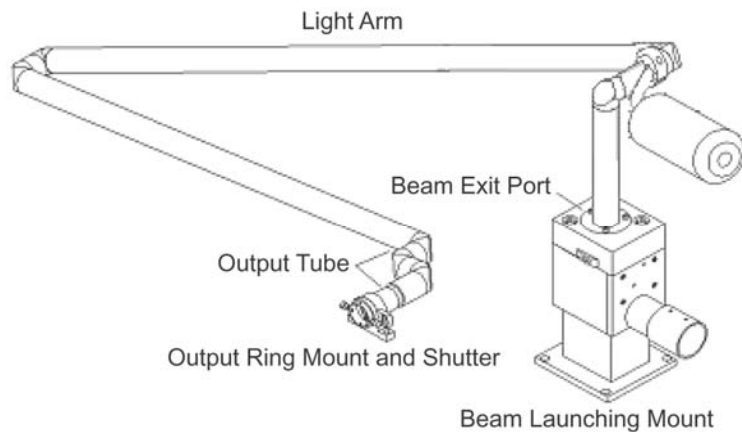


Figure 3. Attaching the Light Arm to the Beam Launching Mount

4. Attach the output ring-shutter assembly to the Light Arm output.
5. Fasten the output shutter securely to the breadboard or some other solid mounting arrangement, so that the laser beam will not accidentally move. The balance of the arm is achieved by screwing the extension of the counterweight in and out. It is best if the middle joints 3 and 4 are not lying on the optical bench, but instead are freely supported by the counterweight.
6. Attach the cross wire tube to the output port of the Light Arm.



WARNING

The Light Arm can direct the laser beam in any direction. Always firmly fasten the Light Arm output port so the beam does *not* go in an unintentional direction if bumped.

7. Place a nonreflective, fireproof target a few feet away from the Light Arm output. Make sure it is in a position from which the laser beams, when projected onto this target, can be easily viewed.

Step 4: Aligning the Beam to the Light Arm

In this step the laser beam is aligned with the optical axis of the Light Arm. It is necessary to accurately align the beam to the Arm so that the beam is not clipped and is transmitted properly. An Nd:YAG laser beam can be 8-mm in diameter and the Light Arm has a clear aperture of 16.8 mm so the beam must be well aligned so it is not clipped. The Beam Launching Mount has a mirror for beam steering and the beam can be centered on the light arm tube by loosening the three positioning screws on the Beam Launch Mount top plate and moving the plate. The beam position is checked with alignment cross wires at the output. At the end of this step, the beam will be transmitted down the center of the Light Arm.

Light Arm

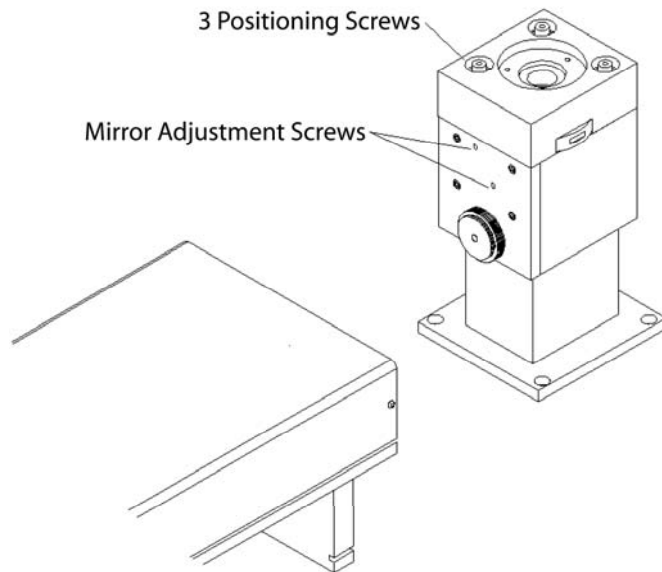


Figure 4. Beam Launch Mount Adjustments



WARNING

Make sure you complete all the following steps. You can cause severe damage to your system by not completing all the steps.

1. Put on your laser safety goggles.
2. Make sure the Light Arm output is pointed at the target. Turn on the laser pulsing using the INSIGHT software.



WARNING

Never look directly into the laser beam. Do **not** look into the Light Arm. Work with the laser at minimum power for alignment.

3. Look at the beam shape on the target. When the beam is aligned, you should see a beam with the shadow of the cross wires at the center of the beam.
4. Adjust the Beam Launching Mount Mirror Adjustment Screws with a 2-mm ball driver (Figure 4). Try to center the beam on the cross wires.
5. If it is not possible to center the beam in the output port, the base of the arm may not be centered on the laser beam. Rotate the alignment ring into the pinhole position. Loosen the three socket-head cap positioning screws and slide the alignment mount until the beam exits from the arm. Tighten the three socket-head cap screws. Repeat the mirror alignment.
6. Turn off the laser pulsing using the INSIGHT software.



WARNING

The laser beam will exit from the Light Arm. Where safety goggles when aligning the light arm.



Caution

Keep flammable objects away from the laser beam that is exiting from the Light Arm.

7. When the beam is aligned, continue to step 5.

Step 5: Attaching the Collimating Lens

The Light Arm has a 16.8-mm clear aperture, and the laser beam diameter may be 9 mm at the laser. After the beam has diverged through the 1.8-meter Arm it may be too large to pass through the Arm without clipping. A collimated lens with a 10-meter focal length is included to control the divergence and prevent clipping.



WARNING

The Nd:YAG laser generates very powerful pulses of light. The glass used in the cylindrical and spherical lenses may be damaged if the pulse has too much intensity.

Note: Only use this collimating lens if the beam diameter is larger than 6 mm at the Light Arm output with the lens installed.

If the beam diameter is less than 6 mm, the intensity can be high enough to damage the lenses.

To measure the beam diameter, use the laser burn paper and measure the size of the burn mark on the paper.

1. Remove the white aperture from the Beam Launching Mount input port.
2. Screw the 10-meter focal length lens in the Beam Launching Mount input port.
3. Screw the telescoping beam tube into the Beam Launching Mount input port.
4. Slide the outer tube out so that the area between the laser and the beam launching mount is covered.

5. Fix the beam tube in position using the set screw in the outer tube.

Step 6: Attaching the Light Sheet Optics and Beam Tube

In this step you will attach the light sheet optics to the Light Arm.

1. Remove the cross wire target tube from between the Light Arm and the shutter.
2. Firmly attach the shutter assembly to a breadboard or traverse.
3. Attach the Light Arm to the shutter.
4. Select the cylindrical and spherical lenses for the your experiment and attach them to the Ring Mount. See the Laser operation manual for details about the light sheet optics.

Next Step

You need to install the Image Capturing components of the PIV system. See *Image Capture* next, for details.