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LS 785

High Throughput Lens Spectrograph
User Manual

Ver. 1.3

Table of Contents

Figures

Chapter 1 -- General

Description

The Acton LS 785 is an 85 mm focal length high throughput lens spectrograph specifically designed and optimized for near infrared (NIR) applications. The system features fast f/2 lenses for maximum light gathering power and proprietary anti-reflection coatings for exceptional throughput from 750-1050nm. The unique multi-element f/2 lenses provide a flat 2D focal plane optimized for a wide variety of Princeton Instruments CCD detectors up to 8 mm x 27 mm.

Gold-coated plane reflection gratings are used in the LS 785 providing resolution capability of 5cm-1. Each grating is provided on a kinematic mount to enable easy interchanging when required. The standard LS 785 also features micrometer-controlled grating rotation which allows the user to change wavelengths in order to explore different spectral regions of interest.

Features and Benefits

- Highest Light Throughput, Exceptional Image Quality, Greatest Versatility
- Easy wavelength adjustment allows use of Raman excitation lasers from 785nm to 830nm
- Fast f/2 optical system is ideal for direct fiber optic coupling. No additional f# matching optics required.
- Use with a wide variety of Princeton Instruments CCD detectors, including our back-illuminated deep-depletion NIR CCD detector for unmatched signal-to-noise performance.
- When purchased with a Princeton Instruments CCD detector, the LS 785 is normally focused and aligned at the factory and shipped as a complete system, ready to operate.

Recommended Detectors

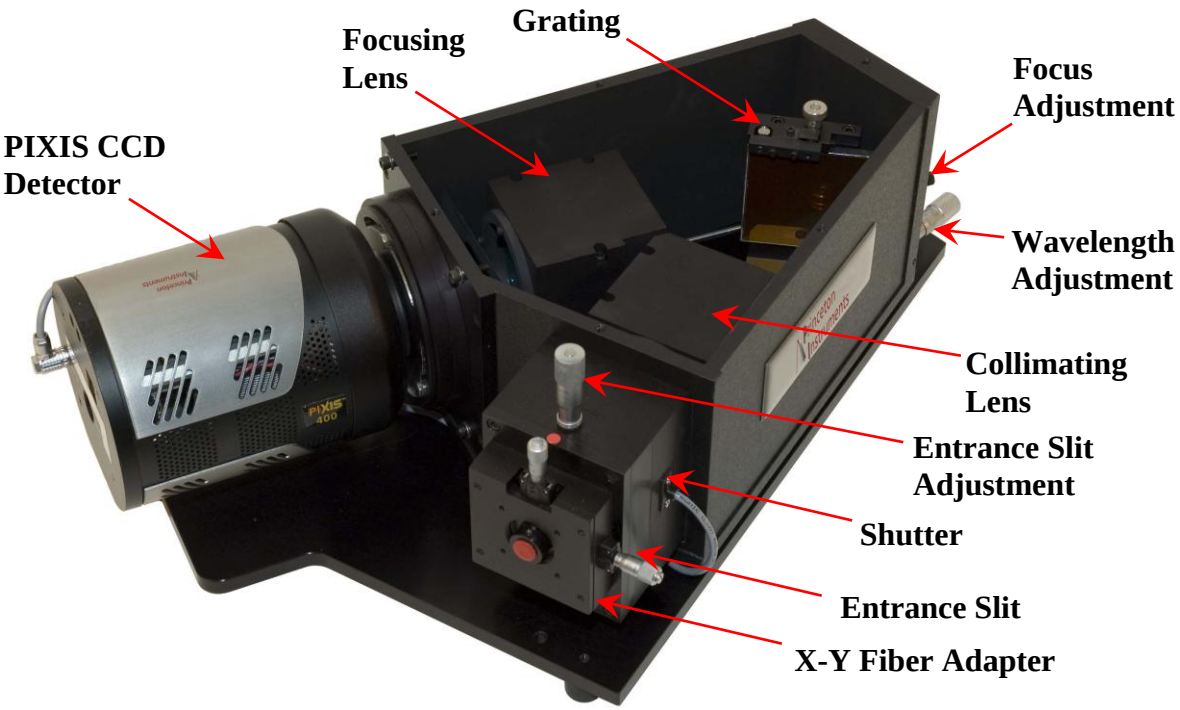
Sensitivity is a critical issue in NIR Raman spectroscopy. Not only is the Raman signal weak due to the longer excitation wavelengths, the efficiency of CCD-based detectors fall off very quickly in the NIR. Princeton Instruments recommends that back illuminated deep depletion sensors be used in this region. The following models will give you the highest sensitivity in the NIR.

- PIXIS 100/400 BR: 100/400 x 1340 20 x 20um pixels back illuminated deep depletion CCDs
- PIXIS 256 BR: 1024 x 256 26x26um pixels back illuminated deep depletion CCD

Optionally available detectors: (shipped in separate packaging – see Appendix B for CCD adapters)

- Spec-10 100LN BR: Liquid nitrogen cooled version of the PIXIS 100 BR
- Spec-10 256LN BR: Liquid nitrogen cooled version of the PIXIS 256 BR

Inside the LS 785



Chapter 2 -- Operation

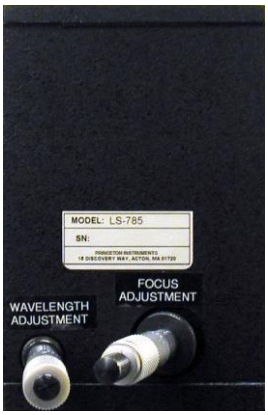
Hardware Installation

Mounting the Detector to the LS 785

Optional adapter flanges are available with this LS 785 for the following Princeton Instrument CCD detectors:

1. PIXIS with spectroscopy flange and without shutter.
2. Spec 10 LN w/o shutter
3. Spec 10 LN w/ integrated shutter

Each detector adapter flange is labeled with the name of the CCD detector for which it was designed. Refer to Appendix B for detailed instructions for mounting the detector to your spectrometer.



Note: Due to variation in the distance from the mounting surface to the focal plane in the detectors, it may be necessary to re-adjust the focusing lens for optimum resolution. Also, when changing center wavelength of the LS 785, check the focus. The lens focus micrometer is located on the back of the instrument and is labeled "FOCUS ADJUSTMENT". A black knurled nut on the micrometer housing locks the micrometer spindle. A clockwise rotation locks the spindle and a counter-clockwise rotation unlocks the spindle.

Making the Cable Connections

The following information briefly describes the cabling connections required for detector operation. For detailed instructions, refer to the user manual supplied with the detector.

PIXIS (without shutter) Detectors:

1. Connect the detector to your computer's USB port.
2. If there is an external shutter mounted to the spectrometer, plug the shutter cable into the rear of the detector.
3. Connect the power supply to the detector and a power source.
4. Turn on the detector.

Spec-10 LN Detectors:

1. Connect the detector to the ST-133 Controller shipped with the detector.
2. Connect the controller to your computer's interface card (TAXI or USB).
3. Connect the controller to a power source.
4. If there is a Princeton Instruments 25 mm external shutter mounted to the spectrometer and the Spec-10 does not have an internal shutter, plug the external shutter cable into the Shutter Control "Remote" connector on the rear of the controller.
5. Turn on the controller.

WinSpec Software and the LS 785

Software Installation

1. Verify that the detector (and controller) is connected to the computer and that the detector is turned on.
2. Turn on your computer.
3. If WinSpec/32 was purchased with the LS 785, install WinSpec/32 using the installation disk and password supplied.
4. When prompted to “Select Installation Type, select “Complete” to insure installing necessary components.
5. If using a previously installed version of WinSpec, check the “Tools” pull down menu and insure that “HTS Calibration” is present. If it is not present and the version of WinSpec is 2.5.23 or greater, reinstall WinSpec and select “Complete” install. If the version number is less than 2.5.23, contact Princeton Instruments to purchase an upgrade to the latest version of WinSpec.

LS 785 Calibration

1. Start WinSpec and select “HTS Calibration” from the “Tools” menu. If not already set up, set the grating to 1200 g/mm and enter the center wavelength you are using.
2. Set the CCD Information parameters to match the ones for your detector. For example, if you are using a PIXIS detector, set the pixels to 1340 and the pixel width to 20.

   Note: “Load Defaults” will load the pixels and pixel width information for the currently active detector.
3. Under HTS Calibration Data Directory, use the button beside the window to browse to the LS 785 calibration disk supplied. Click on "Calibrate". Based on the Center Wavelength you entered, this loads the WinSpec calibration values.

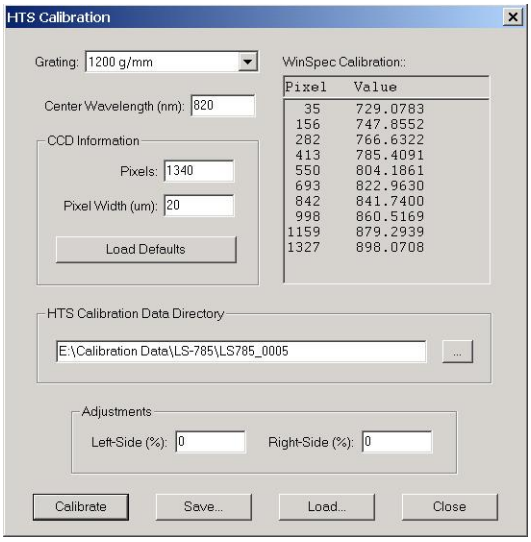


Figure 2-1. HTS Calibration dialog

4. Now, select "Setup" from the WinSpec "Calibration" menu. On the Default Calibration Setup dialog, set the units to nm and the calibration method to Polynomial, Order 2. Check the calibration points listed and compare them to the ones in the HTS Calibration dialog from above. The pixel values will have greater resolution in the Default Calibration Setup dialog, but other than that, they should match. If they do match, click “OK” to close the Calibration Setup window and click “Close” to close the HTS Calibration window. If they do not match, set the default calibration values in the Default Calibration Setup dialog to match those of the HTS Calibration dialog.

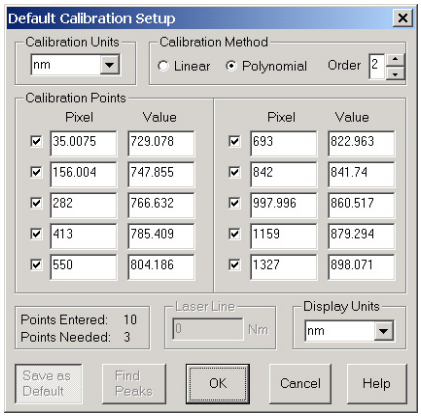


Figure 2-2. Default Calibration Setup dialog

Focus Adjustment

When purchased with a Princeton Instruments CCD detector, the LS 785 is normally focused and aligned at the factory and shipped as an integrated system ready to operate. In this instance no further adjustments are required. We do recommend focus adjustments in the following instances:

1. The grating has been adjusted to a new wavelength position.
2. A CCD is purchased separately from the LS 785 and is being installed at the customer's facility.
3. The CCD has been removed from the LS 785 and is being re-installed.
4. The user wishes to check or optimize focus.

For focus adjustments, locate the lens focus micrometer on the back of the instrument labeled "FOCUS ADJUSTMENT".

Figure 2-3. Focus Adjustment Micrometer

Procedure:

1. Mount a light source to the entrance port and turn the light source on.
2. Power on the CCD detector (and its external controller if there is one) and start WinSpec.
3. Begin running the software in Focus mode.
4. Rotate the locking nut counter-clockwise to unlock the micrometer spindle.
5. Rotate the focusing micrometer until best focus (image quality or spectral resolution) is obtained at the CCD detector.

   CAUTION: Do not apply excessive force to the knob.

6. Lock the micrometer in place by rotating the locking nut clockwise.

Wavelength Adjustment

For wavelength adjustments, the LS 785 includes a micrometer which is located on the rear of the housing labeled "WAVELENGTH ADJUSTMENT" (see Figure 2-4). Please note that we refer to Wavelength Adjustment as moving (rotating) the grating to a new center wavelength position on the CCD detector. To help with wavelength adjustments, a table showing micrometer settings for different center wavelengths is provided with the LS 785.

Figure 2-4. Wavelength Adjustment Micrometer

Procedure:

1. To move to a new center wavelength, the user simply rotates the micrometer clockwise or counter-clockwise until the desired micrometer setting is reached.
2. If desired, the micrometer can be locked into position by rotating the locking nut 1/8 turn clockwise.

LightField Software and the LS 785

Software Installation

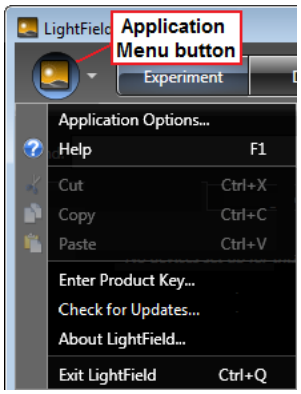


Figure 2-5. Application Menu

1. Verify that the detector (and controller) is connected to the computer and that the detector is turned on.
2. Turn on your computer.
3. Verify that your computer can be connected to the Internet. Internet connectivity is required for product activation.
4. If LightField was purchased with the LS 785, install LightField using the installation disk and product key supplied.
5. Reboot your computer after completing the installation.
6. Start LightField, click on the **Application Menu** button, select **Enter Product Key…**, enter the number and click on **Activate**.

LS 785 Calibration

Figure 2-6. LightField Product Key dialog

1. Mount the PI Acton USB-Hg-NeAr light source to the entrance port.
2. Switch the light source to NeAr.
3. With the LS 785, CCD detector, and light source powered on, start LightField.
4. After the LS 785 and CCD detector are detected, move their icons into the **Experiment Devices** area.
5. Click on the **View** tab on the **Experiment** workspace.
6. Open the **Sensor Readout Region** expander and set the **Rows Binned** to Center 1
7. Open the **Common Acquisition Settings** expander and set the **Exposure Time**. You may want to acquire a spectrum just to confirm that the NeAr spectrum appears and that the intensity levels are not clipped or too low.
8. Open the **Spectrometer** expander and enter the **Center Wavelength**.
9. LightField will report the Wavelength and Focus values to use for setting the micrometers for that center wavelength. Make those adjustments.
10. Click on the **Display Reference Spectrum** button to display a Neon/Argon Standard spectrum in View 1. If the two spectra do not appear very similar, adjust the Wavelength and Focus micrometers until the observed spectrum most closely matches the Reference Spectrum. Pressing the **Find Center Wavelength** button will adjust the center wavelength to more accurately match the observed spectrum.
11. For greater accuracy, you may want to acquire a background file before proceeding with the calibration. See **Background Correction for Calibration** in the LightField Help file for more information.
12. If there is a CCD detector shutter or a detector-controlled shutter, open the **Trigger/Shutter** expander and set the **Shutter Mode** to **Always Open**.

13. Click on the **IntelliCal** button to open IntelliCal.
14. Select the **Target Accuracy** and then click on **Start Calibration**.
15. The calibration process will start and continue to completion without any further actions required from you. Calibration can take several minutes, especially if you have selected Fine for the target accuracy. Be patient.
16. When the calibration has finished, the **Accuracy** (residual value is shown relative to the target value), **Center Wavelength**, and **Error** (in Δ nm) are reported. The buttons displayed when calibration stops depend on the reason the calibration stopped and the error value.
    - If IntelliCal determines that the error value is too high (the icon is displayed), you will not be allowed to use the calibration.
    - If you stop the calibration before it has finished, you have the choice of resuming the calibration (the **Resume Calibration** button will be displayed) or discarding it.
    - If calibration has finished and the error is high (the icon is displayed), you will have the choice of resuming calibration, using the current calibration, or discarding it.
17. If you click on **Resume Calibration**, the dialog will remain open and the calibration process will continue from the point at which it stopped: this gives IntelliCal additional time to refine the calibration. If you click on **Use** or **Discard**, the dialog is closed. If you selected **Use**, the X axis in the viewer will be changed to Nanometers (if these are the default wavelength units).
18. Reset the **Shutter Mode** to **Normal**.
19. You may want to take a single spectrum to confirm the calibration.
20. Turn off and remove the light source.

Focus Adjustment

When purchased with a Princeton Instruments CCD detector, the LS 785 is normally focused and aligned at the factory and shipped as an integrated system ready to operate. In this instance no further adjustments are required. We do recommend focus adjustments in the following instances:

1. The grating has been adjusted to a new wavelength position.
2. A CCD is purchased separately from the LS 785 and is being installed at the customer's facility.
3. The CCD has been removed from the LS 785 and is being re-installed.
4. The user wishes to check or optimize focus.

Figure 2-7. Focus Adjustment Micrometer

Procedure:

1. Mount a neon light source to the entrance port and set the entrance slit width to 20 µm.
2. Locate the FOCUS ADJUSTMENT micrometer at the rear of the LS 785.
3. Rotate the Focus Adjustment locking nut counter-clockwise to unlock the micrometer spindle.
4. Power on the LS 785, CCD detector, and neon light source.
5. Start LightField and after the LS 785 and CCD detector are detected, move their icons into the **Experiment Devices** area.

6. If the CCD detector has a shutter or is controlling a shutter, open the **Trigger/Shutter** expander and set the **Shutter Mode** to **Always Open**.
7. Click on the **View** tab on the **Experiment** workspace and then click on the **Preview** button to begin continuous live data acquisition.
8. Rotate the focusing micrometer until the best focus (image quality or spectral resolution) is obtained.

CAUTION: Do not apply excessive force to the knob.

Note: The data acquisition rate is determined by the Exposure Time (set on the Common Acquisition Settings expander). A shorter exposure time will update the viewer more frequently.

9. Lock the micrometer in place by rotating the locking nut clockwise.
10. Stop data acquisition.
11. Turn off the light source.
12. If a shutter was set to **Always Open**, return its setting to **Normal**.

Wavelength Adjustment

For wavelength adjustments, the LS 785 includes a "WAVELENGTH ADJUSTMENT" micrometer located on the rear of the housing. Please note that we refer to Wavelength Adjustment as moving (rotating) the grating to a new center wavelength position on the sensor.

Figure 2-8. Wavelength Adjustment Micrometer

Procedure:

1. With the LS 785, CCD detector, and neon light source powered on, start LightField.
2. After the LS 785 and CCD detector are detected, move their icons into the **Experiment Devices** area.
3. If the CCD detector has a shutter or is controlling a shutter, open the Trigger/Shutter expander and set the **Shutter Mode** to **Always Open**.
4. Click on the **View** tab on the **Experiment** workspace and then click on the **Preview** button to begin continuous live data acquisition.
5. Open the **Spectrometer** expander and enter the **Center Wavelength**.
6. Under the **Micrometer Values** heading, note the Wavelength micrometer setting displayed.
7. Rotate the micrometer clockwise or counter-clockwise until the desired micrometer setting is reached. If desired, the micrometer can be locked into position by rotating the locking nut 1/8 turn clockwise.
8. Stop data acquisition.
9. Turn off the light source.
10. If a shutter was set to **Always Open**, return its setting to **Normal**.

Manual Slit Width Adjustment

The slit width of the bilateral slit assembly is adjustable from 0.010 millimeters to 3 millimeters (10 to 3,000 µm) by a micrometer located on the top of the slit housing. The micrometer knob is graduated in 0.010 millimeter (10 µm) increments.

Each clockwise revolution of the micrometer knob increases the slit width 0.25 millimeters (250 µm). For maximum reproducibility, the slit width should be set in a clockwise direction (increasing slit widths) each time it is changed. Refer to the drawing below.

The micrometer knob should not be rotated below a reading of 0.00 or above 3.00. A micrometer setting of less than 0.010 millimeters (10 µm) should not be used, because a stop is provided to prevent the slit jaws from contacting each other.

WARNING Damage may be done if the slit jaws are opened more than 3.0 mm.

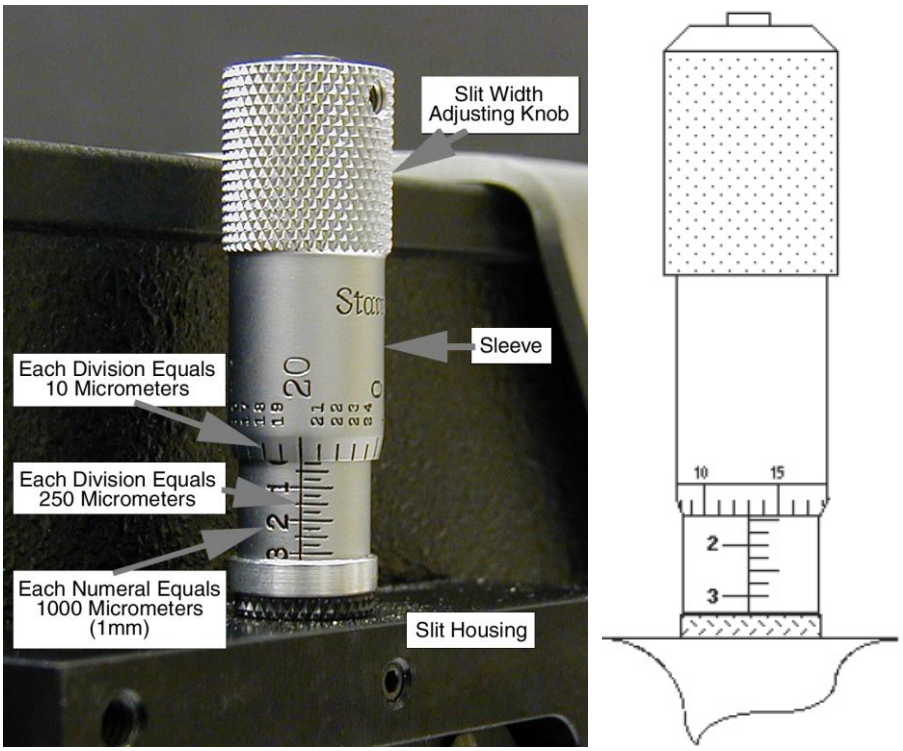


Figure 2-9. Slit Width Settings of 0.200 mm and 1.38 mm.

Grating Assembly Interchange

The LS 785 grating assembly is initially aligned at the factory and kinematically mounted in the instrument to enable easy interchange without requiring realignment. Note that if a grating is purchased later, it will require alignment to the LS 785 and instructions will be provided with the purchased grating assembly.

Tools:

Powderless gloves
5/64" hex wrench
9/64" hex wrench

Procedure:

CAUTION: Optical surfaces of gratings and lenses are extremely delicate and can be permanently damaged by contact with anything. Do not touch, talk, or breathe on or over the gratings or optical surfaces inside the spectrometer.

1. Locate the container holding the new grating assembly.
2. Using a 9/64" hex wrench, remove the five socket screws from the LS 785 cover. Refer to the Caution above.
3. Grating assemblies are held in position by two captive screws at the base of the grating assembly (one at the front and one at the rear of the grating assembly) plus a single screw with a knurled knob located at the top of the assembly (see picture). Loosen the two captive screws first using a 5/64" hex wrench and then turn the knurled knob in a counter-clockwise direction until it disengages from the kinematic mount. The screw is spring-loaded and captive in the turret. At this point the grating assembly is loose and ready to remove.
4. Lift the grating assembly straight out of the housing, taking great care not to allow anything to make contact with the grating. Grasp the knurled knob and/or top portion of the grating assembly when handling grating assemblies.
5. Place the removed grating assembly on a clean, dry surface.
6. Remove the cover from the grating assembly storage container. Remove the grating assembly from the storage by loosening the two captive screws and the knurled screw. This is similar to Step 3 above.

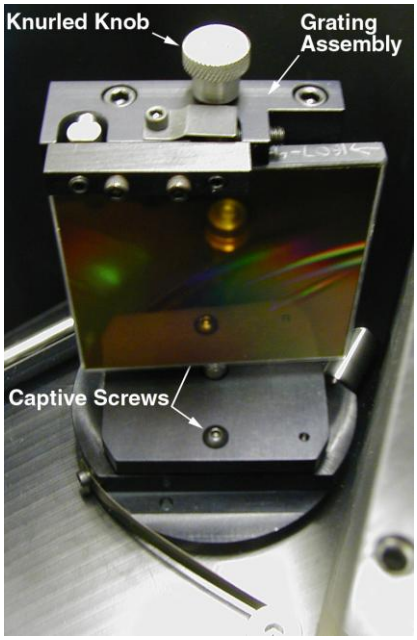


Figure 2-10. Grating Assembly

CAUTION: Do not contact the grating surface or permanent damage will result.

7. With extreme care, place the new grating assembly on the kinematic mount inside the LS 785 housing. The kinematic mount will only accept the assembly in one orientation.
8. Using your index finger and thumb, simultaneously push straight down and turn the knurled knob clockwise to engage the kinematic mount. When the screw engages the tapped hole, continue to turn it clockwise until the grating assembly is secured. **Do not over-tighten!**
9. Tighten the two captive screws at the base of the grating assembly.

10. Replace and secure the LS 785 cover. Place the previously removed grating assembly in the storage container and secure it using the knurled screw. Tighten the two captive screws to secure the grating assembly in the storage container and then replace the lid.
11. At this point you must tell the WinSpec software what grating is currently installed and load the appropriate calibration. Refer to Steps 6-9 on page 8 for more information.

Shutter Replacement

The following instructions apply if the LS 785 was shipped from the factory with an installed external shutter. Because a shutter has a finite lifetime, it may become necessary to replace a shutter.

Tools:

9/64” hex wrench

Procedure:

1. Remove any accessories attached to the entrance slit.
   - Using a 9/64” hex wrench, remove the four screws holding the X-Y Stage.
   - Using a 9/64” hex wrench, remove the four screws holding the manual slit. (see Figure 2-11)

     Note: In addition to the four mounting screws, the manual slit assembly is located by two pins on the shutter adapter that mate with holes on the back of the slit adapter.
2. Using small flat blade screwdriver, loosen the two screws on the side for the shutter adapter (see Figure 2-12) until the collar slides on the shutter cable.
3. Slide the plate off.
4. Using a 9/64 hex wrench, remove the four shutter assembly mounting screws (Figure 2-12)
5. Remove the shutter and cable assembly.
6. Mount the new shutter assembly in the adapter. Slide in the plate and secure the collar to the plate.

   Note: If it is necessary to operate without the shutter in place, the shutter may be removed as described above, however, the housing in which the shutter was mounted must remain in place and the area where the cable entered the housing must be covered and sealed with an opaque material. Removing and replacing this housing will affect calibration.
7. Remount the manual slit and/or X-Y stage.

Figure 2-11. Manual Slit

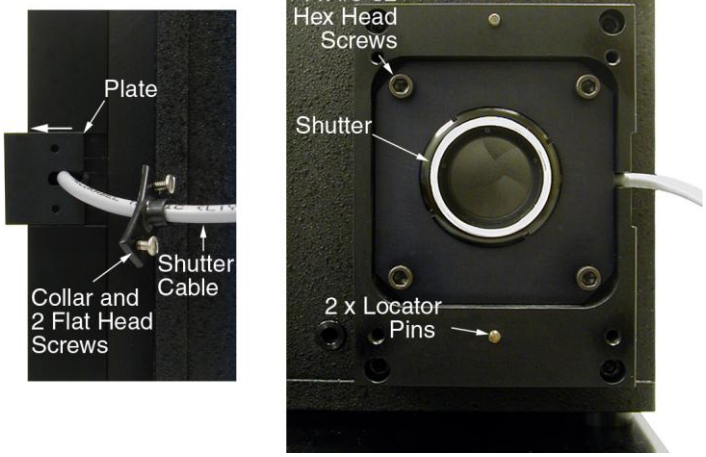


Figure 2-12. Shutter Assembly

X-Y Fiber Adapter

The universal XY fiber adapter allows an optical fiber which is terminated in a 10mm ferrule, SMA connector or FC connector to be positioned horizontally and vertically over a 5mm range in each direction to correctly position the end of the fiber on the center of the slit or optical axis.

Tools:

1/16" hex wrench
9/64" hex wrench

Procedure:

1. If using an optical fiber with a 10mm ferrule at the input of the LS 785, use a 1/16" hex wrench to loosen the set screw in the XY adapter barrel. Slide the 10mm adapter insert into the barrel of the XY adapter and re-tighten the set screw. Loosen the set screw in the XY adapter insert using a 1/16" hex wrench.

   The picture below shows the fiber inserted into the 10mm adapter insert for illustration purposes only. Normally, the adapter insert is first inserted into the XY adapter barrel before installing the fiber.

Figure 2-13. 10 mm Insert with Fiber

2. Insert the fiber with the 10mm ferrule into the XY adapter insert and carefully slide the fiber in until it just touches the slits and then back it out a very short distance until it is no longer touching the slits.

   NOTE: Do not force the fiber against the slit blades.

3. If the fiber assembly is a single fiber in the center of the ferrule, then secure the fiber in position by tightening the set screw in the top of the XY adapter barrel as shown in the photograph. If fiber assembly has a vertical array of fibers in the 10mm ferrule, set the vertical position of the fiber by aligning the mark on top of the fiber barrel with the set screw in the top of the XY adapter barrel. The vertical alignment may be fine tuned later by observing an image of fibers on the CCD.

4. If using an optical fiber terminated in an SMA or FC adapter, use the appropriate adapter insert as shown below and screw fiber coupling into the XY adapter insert. Loosen the set screw in the XY adapter barrel and slide the XY adapter insert into the barrel. Carefully slide the adapter insert into the barrel until the end of the fiber just touches the slits and then back it out a very short distance until the fiber is no longer touching the slits.

   NOTE: Do not force the fiber against the slit blades.

Figure 2-14. SMA Insert with Fiber

Figure 2-15. FC Insert with Fiber

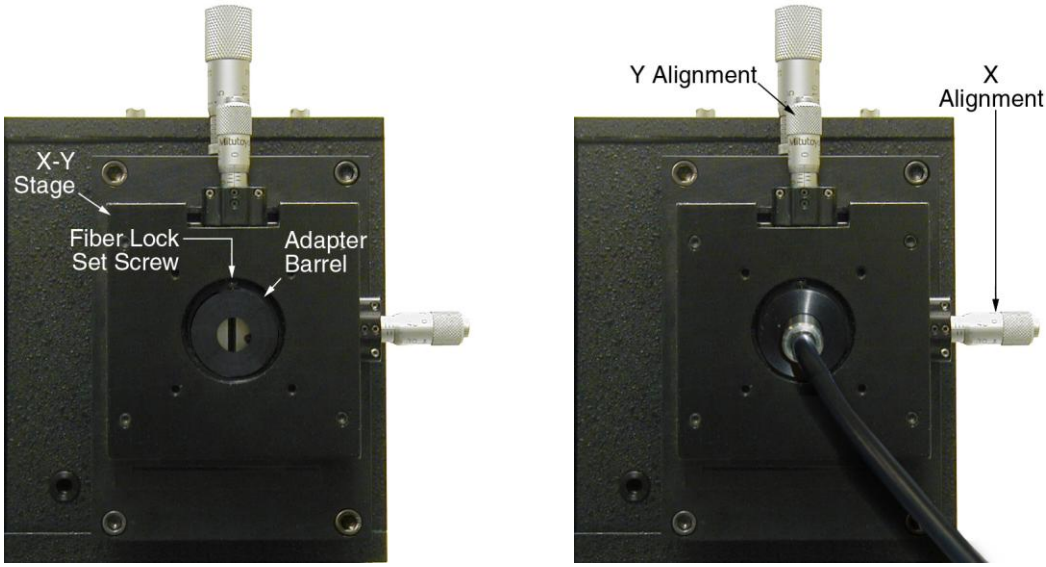
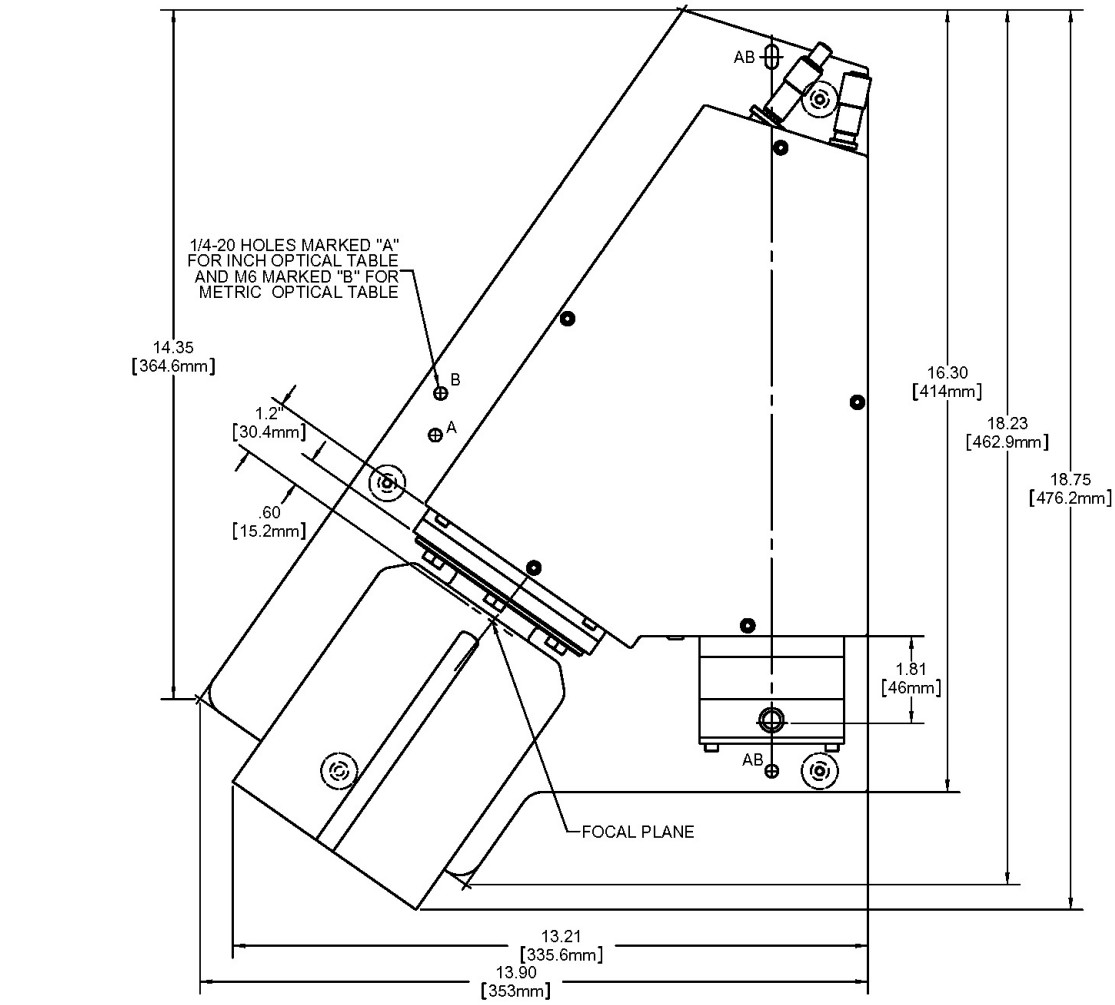


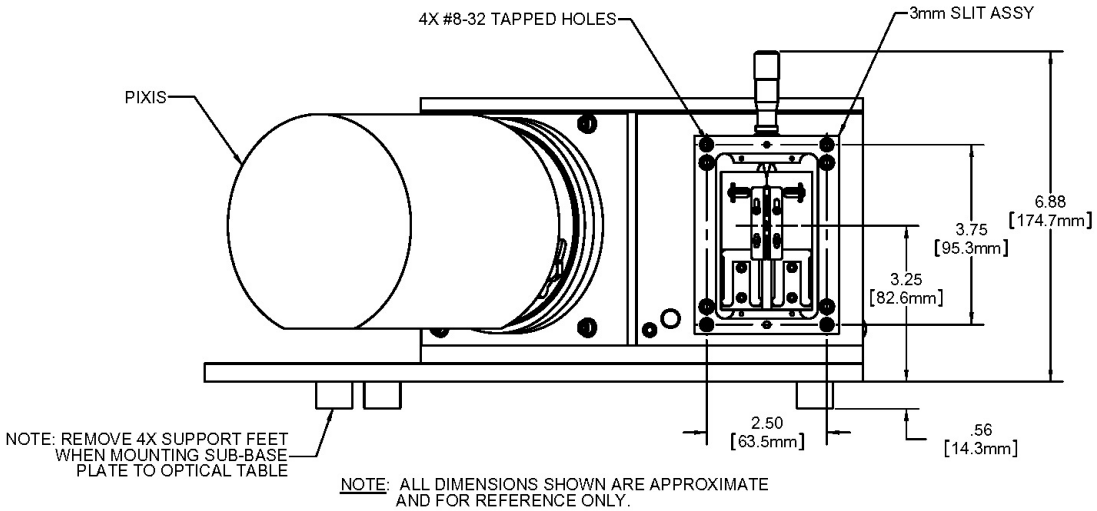
Figure 2-16. X-Y Stage Adjustment

5. Take a full image while running the CCD detector in Focus mode.
6. Identify a suitable peak (for example, Neon at 837.6 nm).
7. Zoom in on the peak into a window approximately 25 pixels x 25 pixels.
8. Click on the Autoscale button at the bottom of the window so that only the brightest pixels can be seen.
9. Make sure the brightest pixel is not saturating the CCD detector. It may be necessary to adjust the exposure time to bring the intensity below the saturation level. As a rule of thumb, do not exceed 50,000 counts while imaging in the medium analog gain setting.
10. Place the cursor on the brightest pixel of the peak.
11. Turn the micrometer on the side of the stage (see Figure 2-16) to move the fiber in the X direction. While watching the peak intensity, move the fiber back and forth until the peak reaches maximum intensity. It may be necessary to adjust the intensifier gain and/or exposure time once again if you exceed the 50,000 count limit. When the peak has reached maximum intensity, you are properly aligned in the X direction.
12. Turn the micrometer on the top of the stage (see Figure 2-16) to move the fiber in the Y direction. Move the fiber up or down as required.

Appendix A – Specifications

Outline Drawing





NOTE: ALL DIMENSIONS SHOWN ARE APPROXIMATE AND FOR REFERENCE ONLY.

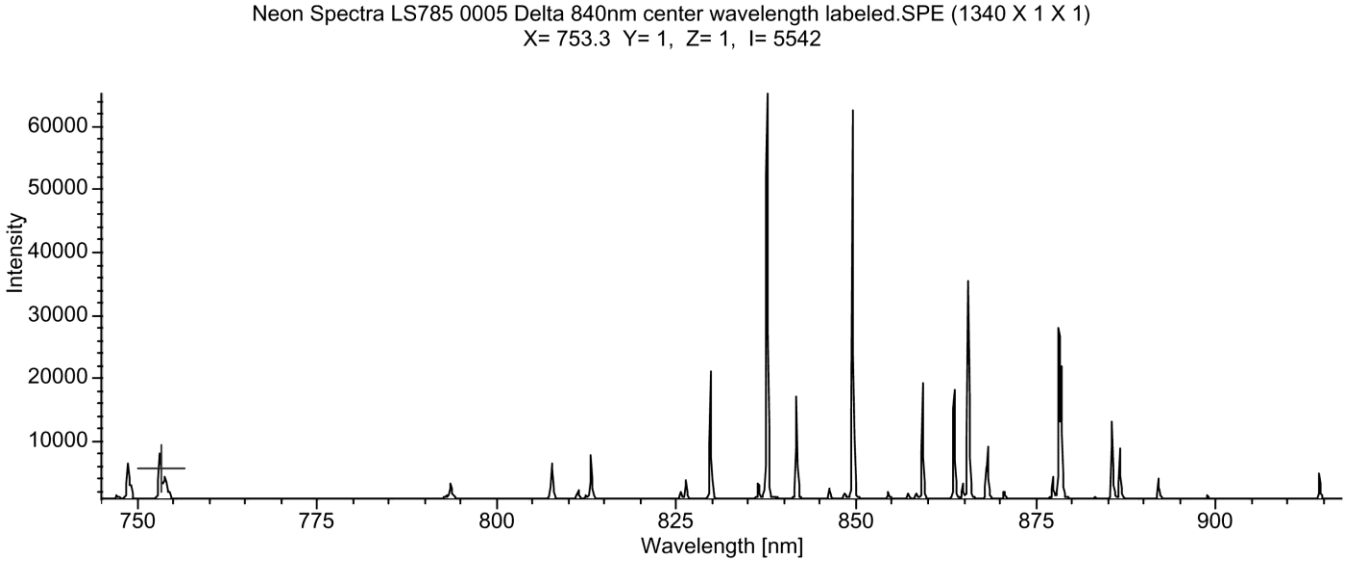
Relative Wavelength Coverage with 1200 g/mm Grating

Laser (nm)	Working range (cm-1)*	Coverage (cm-1)**
785	120 - 3215	1985
805	120 - 2898	1884
830	120 - 2524	1768

*Lower working range for Raman Spectroscopy applications is ultimately limited by the selection of the optional notch or edge filters. The upper wavelength range of 1050 nm is limited by practical detection wavelength of Si-based CCD detectors.

** With 26.8mm focal plane width

Typical Neon Spectra from LS 785



Appendix B -- Mounting the Detector

The following procedures are recommended for mounting detectors and their associated adapters to the LS 785. Refer to the photographs for additional information.

1. Determine the detector to be attached to the LS 785.
2. Locate the correct adapter flange or adapter flange assembly for the detector to be attached to the LS 785.
3. If the correct adapter is not attached to the LS 785, refer to the photograph of the adapter attached and remove it.
4. If the adapter flange to be installed is for a PIXIS, the four #8-32 socket head screws and washers used to secure the other adapters must be re-installed into the instrument housing to prevent light leaks!

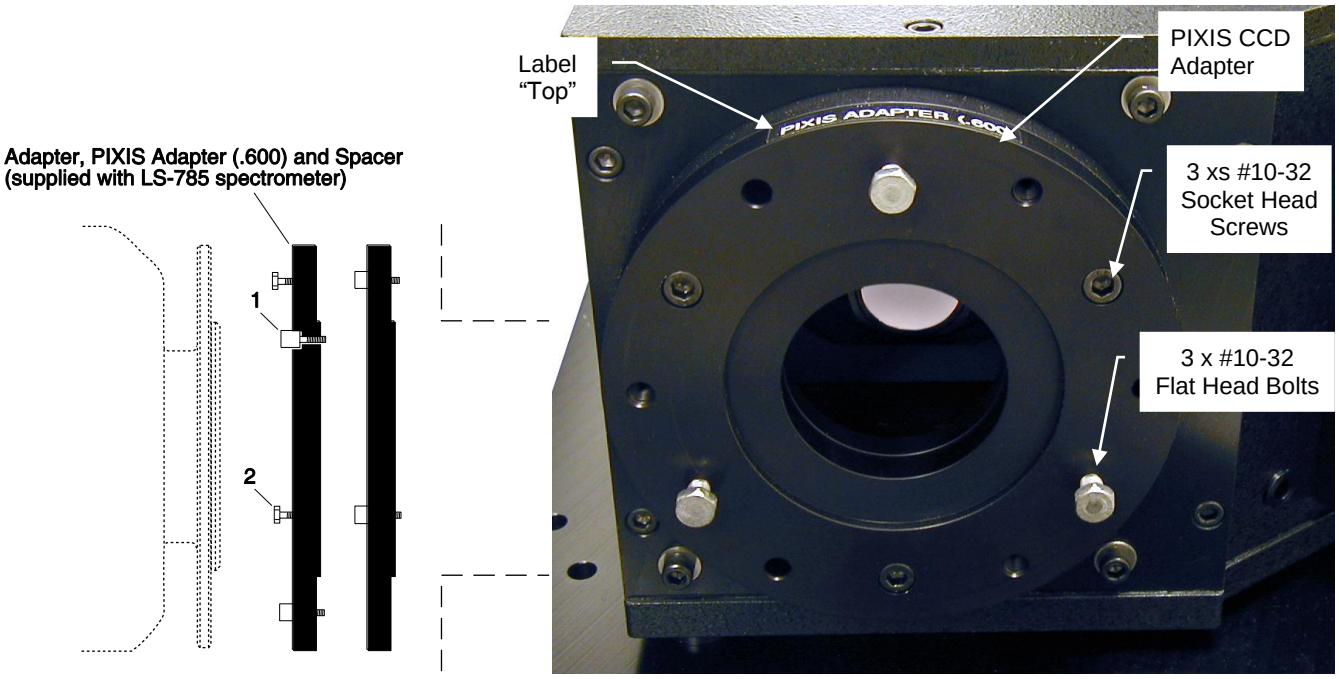
PIXIS

Tools:

5/32” hex wrench
5/16” wrench

Procedure:

1. If detector other than a PIXIS was previously mounted to the LS 785, re-install the four #8-32 socket head screws and washers used in the instrument housing to secure the other adapter.
2. If the spacer is not installed, mount it to the face of the LS 785 with three (3) #10-32 socket head screws (5/32” hex wrench).
3. Attach the PIXIS adapter to the LS 785 with label at the top with three #10-32 socket head screws (5/32” hex wrench).
4. In three locations (indicated), screw in three 3/8”x#10-32 screws provided with the detector. Leave approximately 3/16” thread exposed.
5. If an O-ring is supplied with the PIXIS, insert it into the groove in the outside face of the PIXIS flange.
6. Mount the PIXIS detector to the adapter and tighten bolts.



Spec 10 LN with Integrated Shutter

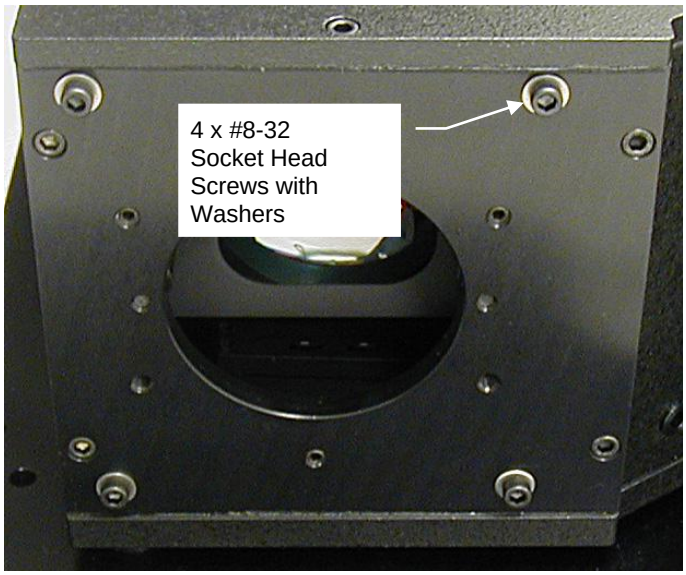
Tools:

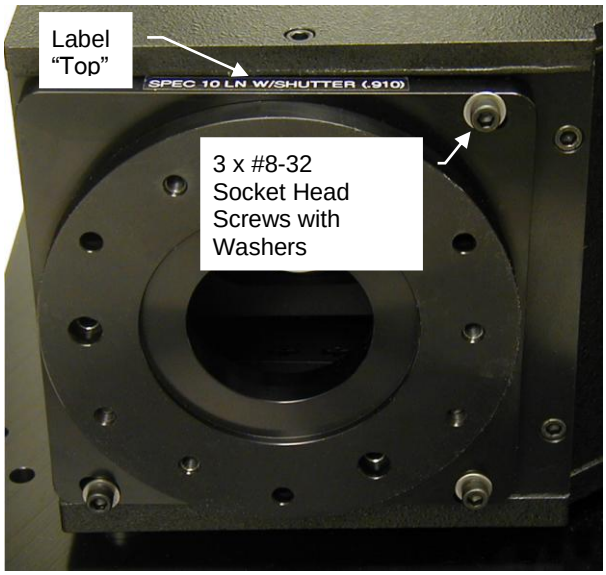
9/64” hex wrench
5/32” hex wrench

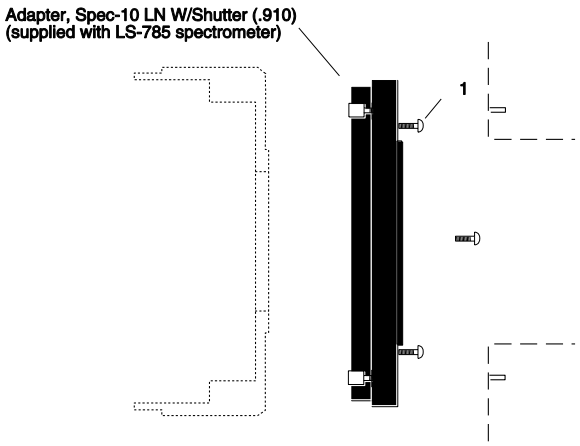
Procedure:

1. Locate the Spec 10 LN detector with an internal shutter and its adapter flange.
2. If another adapter is mounted to the LS 785, remove that adapter (and, in the case of the PIXIS, the adapter and spacer).
3. Using a 9/64” hex wrench, remove the four #8/32 socket head screws with washers from the face of the LS 785.
4. Using a 5/32” hex wrench, attach the adapter to the Spec 10 mounting flange with three #10-32 socket head screws.
5. Using a 9/64” hex wrench, attach the Spec 10 LN and adapter to the LS 785 with three #8-32 socket head screws and washers as shown in the photograph. Store the fourth socket head screw and washer since all four screws and washers will be needed if you change over to a PIXIS detector.

Note: If an external shutter is installed on the LS 785, it must be held open by a separate controller.







Spec 10 LN without Shutter

Tools:

9/64” hex wrench for removing 4 screws with washers.
5/32” hex wrench for removing three socket heads holding spacer on.

Procedure:

1. If another adapter is mounted to the LS 785, remove that adapter (and, in the case of the PIXIS, the spacer).
2. Using a 9/64” hex wrench, remove the four #8/32 socket head screws with washers from the face of the LS 785.
3. Locate the Spec 10 LN detector without a shutter and mark the top of its mounting flange.
4. Remove the mounting flange from the Spec 10 LN without a shutter.
5. Align the tops of the Spec 10 mounting flange and the adapter flange. Attach the Spec 10 mounting flange to the adapter with six #10-32x 1/8” flat head screws.
6. Re-attach the Spec 10 mounting flange and adapter assembly to the Spec 10 by installing the four screws through the four clearance holes in the adapter.
7. Attach the Spec 10 and adapter to the LS 785 with the four #8-32 socket head screws and washers where shown in the photographs.