a subsidiary of EIC Laboratories, Inc.

RS2000-3B
RS2000-1
Raman Spectrometer

Installation Manual
(Version 1.0)

RS2000-3b-785
RS2000-3b-532
RS2000-3b-670

RS2000-1-785
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RS2000-1-670

111 Downey Street
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I. Unpacking the System

The RS2000 spectrometer may be shipped in numerous separate boxes or crates. Verify that the number of boxes received matches the number specified on the packing list. Prior to opening any of the packages, visually inspect them and report any damages to InPhotonics and/or the shipping company.

Unpack each box carefully noting the contents.

A. Component Checklist

The RS2000-3b system consists of the following components:

1. Echelle spectrograph with CCD camera (NIR or visible model, depending upon the laser excitation wavelength)
    a. Shutter cable
    b. Camera driver cable

2. Excitation laser with fiber optic interface
    a. Power cord

3. PC data station (may be provided by the end-user) with appropriate power cords and cables
    a. CCD camera controller card (mounted in PCI slot)

The RS2000-3b system is designed to be used with a fiber optic probe. The probe should have two single fibers for excitation and collection, both with FC connectors. The probe may also have additional electrical requirements. Consult the probe manufacturer's manual for details.

B. Laser Safety

The RS2000 Raman spectrometer systems are designed to be installed by InPhotonics certified technicians. Installation by anyone other than InPhotonics certified technicians may result in hazardous radiation exposure. Please contact InPhotonics to install your RS2000 system.

CAUTION

The use of controls and adjustments, or performance of procedures other than those specified herein may result in hazardous laser radiation exposure.

During installation procedures, laser radiation of up to 500 mW at 785 nm, 300 mW at 670 nm, and 150 mW at 532 nm are accessible.

AVOID DIRECT EXPOSURE TO THE BEAM.

NOTE: INSTALLATION PROCEDURES SHOULD ONLY BE CONDUCTED BY FACTORY AUTHORIZED PERSONNEL OR INDIVIDUALS WHO HAVE COMPLETED A LASER SAFETY COURSE AND WHO HAVE BEEN TRAINED BY FACTORY AUTHORIZED PERSONNEL.

Reference Material:

"RS2000 Raman Spectrophotometer User Manual";
"American National Standard for Safe Use of Lasers" (Z136.1), American National Standards Institute (ANSI), New York, NY (1993).
"Laser Safety Guide", Laser Institute of America, Orlando, FL (1989).
"Guide for the Selection of Laser Eye Protection", Laser Institute of America, Orlando, FL (1989).

C. Site Preparation Guide

The RS2000 system requires two 110V AC connections, one for the PC data station, and one for the laser source. The use of surge suppressors and line conditioners are recommended in locations prone to power outages and instabilities.

The footprint of the RS2000 system includes three main components: the echelle spectrograph, the laser unit, and the PC data station. Approximate dimensions are shown in Figure I.1. The laser unit must be placed next to the echelle spectrograph in a location convenient for accessing the power control knob and key.

Class I systems (Models RS2000-1-XXX) also include a sample holder with the following dimensions: 8.25" (L) x 13.25" (D) x 16.25" (H). The sample holder can be placed near the spectrograph and laser with relative flexibility since the RamanProbe connects the three units. In practice, it is convenient to have the three units as close as possible.

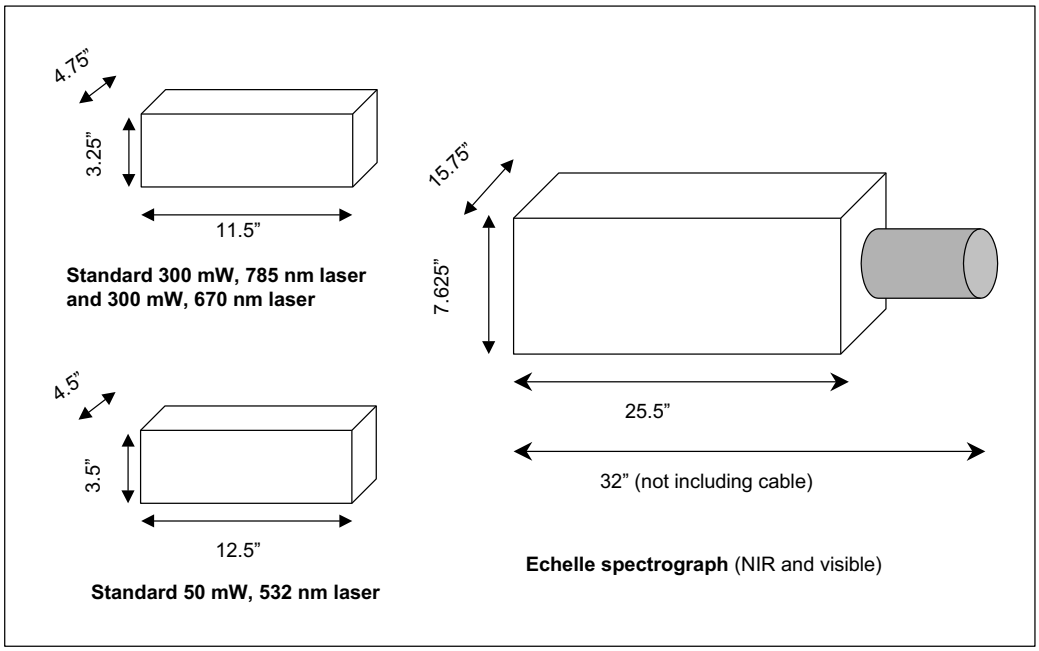

Figure I.1. Approximate dimensions of RS2000 spectrometer system. Refer to laser manufacturer's manual for dimensions of other laser systems.

The RS2000 system components have the following weights:

Component	Approx. Weight (lbs.)
Echelle spectrograph and CCD camera	52
300 mW, 785 nm laser	6.5
PC data station	Variable according to configuration
Universal sample holder (Class I systems)	16.5

II. Setting up the System

The RS2000 system should be installed on a level, sturdy surface. **The echelle spectrograph should be lifted by two people and handled as carefully as possible.** The laser unit, PC, and sample holder (for Class I systems only) should be laid out conveniently for the electrical and fiber optic connections shown in Figure II.1 and described in the following sections.

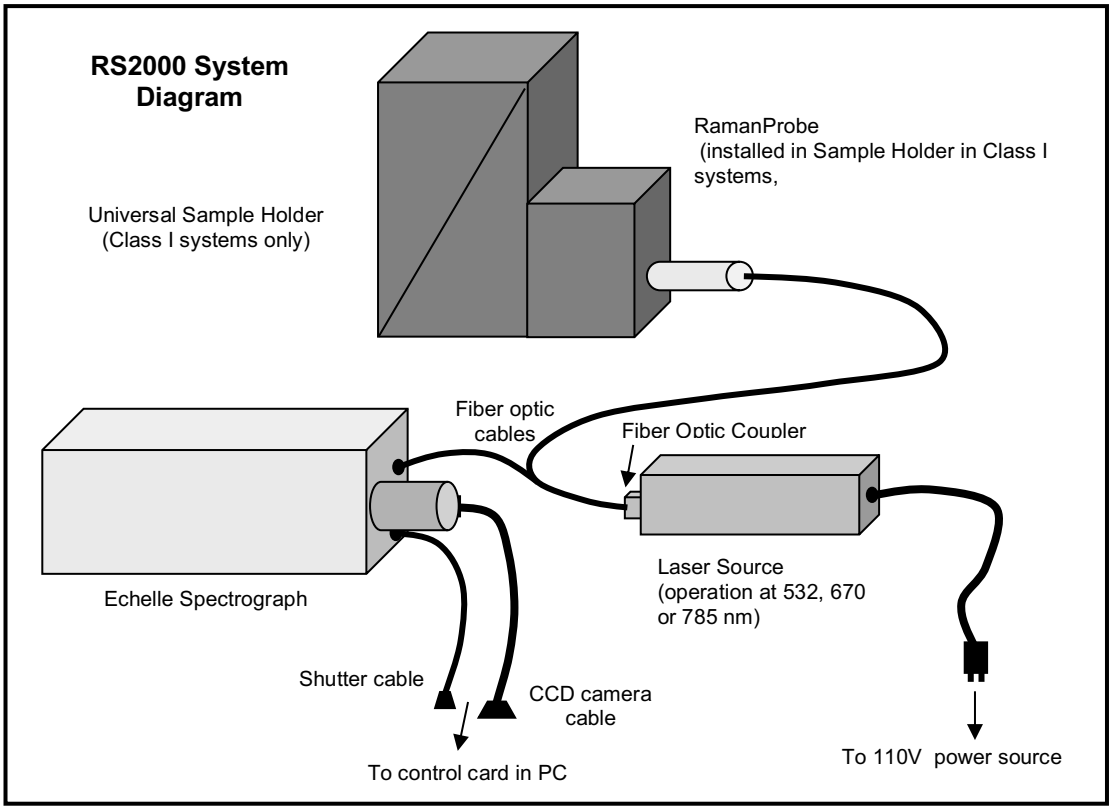

Figure II.1. RS2000 components, electrical, and fiber optic connections.

A. Electrical Connections

Procedure:

1. Locate the two cables required to connect the spectrograph unit and the PC data station.

2. The cable with the larger connectors, the CCD camera cable, attaches to the back of the CCD camera and to the controller card installed in the PCI slot of the PC data station.

3. The cable with the smaller connectors, the shutter cable, attaches to the shutter control located on the side of the spectrograph to the right of the CCD camera. The other end attaches to the smaller connector also on the controller card in the PCI slot.

4. The remaining cables for the PC data station should be connected according to the manufacturer's instructions, including the power cable.

5. The power cable on the laser unit should be connected to a 110V AC outlet.

B. Fiber Optic Connections

CAUTION

All installation is to be conducted by factory trained personnel wearing eyewear appropriate for the laser system wavelength.

All service is to be conducted by factory trained personnel since laser powers up to 0.5W at 785 nm and 670 nm and up to 150mW at 532 nm could be accessible if the protective housing probe covers are removed or the safety interlocks are intentionally defeated and the laser systems are operational. These conditions should exist only during service by factory trained technicians and are outlined below.

1. The green (532 nm) fiber output is emitted from the probe at the end of the fiber optic cable.

2. Focused green (532 nm) is present in the fiber interface. It could be accessible during service if the beam cap was unscrewed from the coupler during the installation of a fiber optic probe.

3. The red (785, 670 nm) fiber output is emitted from the probe at the end of the fiber optic cable.

4. Focused red (785 or 670 nm) is present in the fiber interface housing. It could be accessible during service if the beam cap was unscrewed from the coupler during the installation of a fiber optic probe.

NOTE: THESE PROCEDURES SHOULD ONLY BE CONDUCTED BY FACTORY AUTHORIZED PERSONNEL OR INDIVIDUALS WHO HAVE COMPLETED A LASER SAFETY COURSE AND WHO HAVE BEEN TRAINED BY FACTORY AUTHORIZED PERSONNEL.

Reference Material:

“RS2000 Raman Spectrophotometer User Manual.
"American National Standard for Safe Use of Lasers" (Z136.1), American National Standards Institute (ANSI), New York, NY (1993).
"Laser Safety Guide", Laser Institute of America, Orlando, FL (1989).
"Guide for the Selection of Laser Eye Protection", Laser Institute of America, Orlando, FL (1989).

Procedure:

1. Establish a nominal hazard zone and take the appropriate laser safety precautions, including the use of protective eyewear appropriate for the excitation laser wavelength and power.

2. Verify that the key on the laser unit is in the "OFF" position.

3. Locate the fiber optic probe. Identify the excitation fiber and the collection fiber. Do not proceed unless these two fibers have been differentiated.

4. Connect the excitation fiber to the fiber optic interface on the laser head. The FC connectors are keyed to fit in only one direction.

5. Connect the collection fiber to the FC connector on the spectrograph.

6. For Class I systems, refer to the service procedure USH-002 in the Users' Manual to install the RamanProbe in the sample holder.

C. Powering Up

7. Turn on the PC data station. Let the operating system boot.

8. Click on the "Molecue" icon on the desktop to begin the software.

9. Once the Molecue program has been started, the CCD camera will begin cooling to its preset temperature. Under ambient conditions, the fan in the camera will begin to run after a few minutes.

10. Allow the CCD camera to reach its preset operating temperature (normally –55°C) simply by waiting for 10-15 minutes after the Molecue software has been initiated. If the laboratory temperature is significantly higher than 72°F (22°C), the cooling time will be longer.

III. System Checks

A. Checking Throughput

If necessary, the laser power through the fiber optic probe can be measured with an appropriate laser power meter. When using a standard RamanProbe from InPhotonics, the throughput from the laser source should be between 50 – 60%. Consult the probe manufacturer's manual for throughput specifications on other probe designs.

B. Checking Calibration

Although the echelle spectrograph in the RS2000 systems have no moving optics, shipping may result in slight shifts in the frequency calibration of the system. The calibration can be checked by measuring either the output of an atomic emission lamp (e.g. neon) or by measuring the Raman spectrum of a standard sample. There are several ASTM standards for frequency calibration of Raman spectrometer systems.

If the calibration requires adjustment, a separate utility program can be used to recalibrate the system through software. Refer to the appropriate manual or contact InPhotonics for instructions on using this program.

IV. Measurement Basics

A. Software Basics

Note: Detailed software instructions are provided in the RS2000 User's Manual.

As described in Section II.C, it is necessary to start the acquisition software at least 15 minutes prior to beginning data acquisition.

1. To begin the acquisition program, click on the "Molecue" icon on the operating system desktop.

The software requires two reference spectra to correct for the wavelength response and pixel variation of the CCD chip. The reference spectra from the previous software session are stored on the hard disk as two separate data files.

The bias spectrum must be measured at the beginning of every software session.

2. Measure the bias spectrum by clicking on the "Bias" icon or through the measurement menu.

The white light spectrum only requires measurement after a significant change in the spectrometer system. These conditions would include an adjustment made to the frequency calibration, and the installation of a new fiber optic probe. Under routine measurement conditions, it is not necessary to measure a new white light spectrum.

3. If it has been determined that a new white light spectrum is required, shine a diffuse white light source at the end of the fiber optic probe and measure the white light spectrum, selecting an appropriate exposure time for the lamp intensity.

Hint: If the white light spectrum is inadvertently overwritten, it is possible to reload a stored white light spectrum. If measurement conditions are such that it would be difficult to measure a new white light spectrum (i.e., the fiber optic probe is permanently installed in a

reaction vessel), it is highly suggested that backup copies of the white light spectrum be maintained.

At this stage, the software is ready to acquire Raman spectra.

4. Click on the corresponding "Raman" icon to measure a Raman spectrum. Adjust the exposure time as necessary to obtain the desirable signal-to-noise ratio.

For data manipulation, the spectrum can be exported to the GRAMS/32 program (from Galactic Industries, Inc.) provided with the spectrometer system.

5. To export the data to GRAMS, click on the corresponding "G" icon.

Note: Acquired Raman spectra are stored temporarily. Once the data are determined to be acceptable, the immediate spectrum must be stored either in Molecue or in GRAMS/32.

B. Hardware Basics

Note: Further details of instrument operation are provided in the RS2000 User's Manual, including details of laser safety appropriate for the laser class of the instrument.

Raman sampling with a fiber optic probe is flexible depending upon the probe design. The standard RamanProbe can be held up to samples during the measurement time. Class I systems require that samples be placed inside the sample holder. Custom fiber optic probes can be provided for specific sampling geometries.

1. With the sample and probe positioned accordingly, turn the laser on by turning the key on the power supply/laser unit.

2. The power at the sample can be adjusted with the control knob on the power supply/laser unit. Generally, the control knob is left at the maximum power position. If the probe design allows exposure to the laser beam, AVOID DIRECT EXPOSURE. The use of protective eyewear is also recommended.

3. Measure the Raman spectra of the desired samples.

Hint: It is not necessary to turn off the laser between samples, however the laser should be powered off if there is considerable delay between measurements. The laser requires only a short time to stabilize (refer to the manufacturer's instruction manual).

Hint: Remember that the CCD camera requires controlled cooling and stabilization that can take 15 minutes or longer. It is suggested that the CCD temperature be maintained (i.e. by not exiting the acquisition program) unless the system will not be used for over an hour or more.

C. System Shutdown

If the RS2000 spectrometer system will not be used for more than a few hours, it is recommended to shut down the entire system.

1. If the laser is still powered on, turn off the laser by turning the key to the "OFF" position.

2. Exit the acquisition software program.

Note: Depending upon the version of software, the software will report that the camera is still cold. It is recommended to allow the camera to warm up slowly, controlled through software. Selecting this option will leave the acquisition program running while the camera is warmed to room temperature. After 10 – 15 minutes, the software can be exited without additional warnings. Occasional shut down without controlled warm up will not significantly harm the CCD camera system.

Hint: If, after beginning or completing camera warm up, further data acquisitions are required, it is necessary to exit and re-enter the software to reinitiate camera cooling.

3. Shut down the operating system.

4. Turn off the PC data station.

V. Customer Support

The technical staff at InPhotonics is available for consultation regarding their products. Should there be any problems with the RS2000 spectrometer system, please call InPhotonics between 8:00 – 5:00 pm EST at 781-440-0202, or send us e-mail at info@inphotonics.com.