SQM-5002
Satellite Quality Monitor
Installation and User Guide
Version 2.3

SQM-5002 Satellite Quality Monitor

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www.yesinc.com

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Contents

In This Manual

This manual explains how to setup and use the Satellite Quality Monitor (SQM) optical field source and its associated SQM-Manager monitoring software.

What this manual covers

This manual covers the following topics:

SECTION		CONTENTS
1	Overview	Background information on the system and principle of operation
2	System Setup	Information on setting up the hardware and installing the monitoring software
3	Using the System	Information on using the system to characterize your radiometer
4	Troubleshooting and Service	Service procedures

References

A comprehensive discussion on the original SQM system can be found in: *Johnson, B. Carol, Ping-Shine Shaw, Stanford B. Hooker, Don Lynch, 1998: Radiometric and Engineering Performance of the SeaWIFS Quality Monitor (SQM): A Portable Light Source for Field Radiometers. Journal of Atmospheric and Oceanic Technology: Vol. 15, No. 4, pp. 1008–1022*.

Technical support

Technical support is provided via the web. If you have a question about operating the system and cannot find the answer you need in this manual, contact YES using any of the following methods:

- **Web:** www.yesinc.com (see the *support* section)
- **FAX:** +1-413-863-0255
- **Sales Phone:** +1-413-863-0200 (9AM-5PM EST Monday through Friday)

> **Warning**: *Please read this manual before using your system*. Because the sensor is not waterproof and is AC line-powered, use care when operating outside and in particular, avoid direct contact with precipitation or wave/ocean spray. Keep it out of 100% condensing humidity environments. See the section Important Product Safety and Disclaimer Information on page 4-11.

CHAPTER 1
Overview

The SQM-5002 is a state-of-the-art stabilized optical light source designed to verify the stability of field filter radiometers. It is a commercial version of the system developed by NIST and NASA's Goddard Space Flight Center. The system was initially intended to support field stability checks on various types of ground and buoy-mounted marine radiometers and hyperspectral imagers. These radiometers perform critical ground-truth measurements in support of calibration validation of remote sensing satellite programs such as SeaWIFs and other ESA or NASA missions. By verifying the stability of radiometers *in-situ* via ground truth techniques, the long-term stability of satellite observations can be established.

The system consists of the following components:

- SQM source with internal CPU-controlled power supply
- Optical table for mounting radiometers with handle and two "V" blocks
- RS-232 null modem cable
- SQM-Manager control and monitoring software for MS-Windows

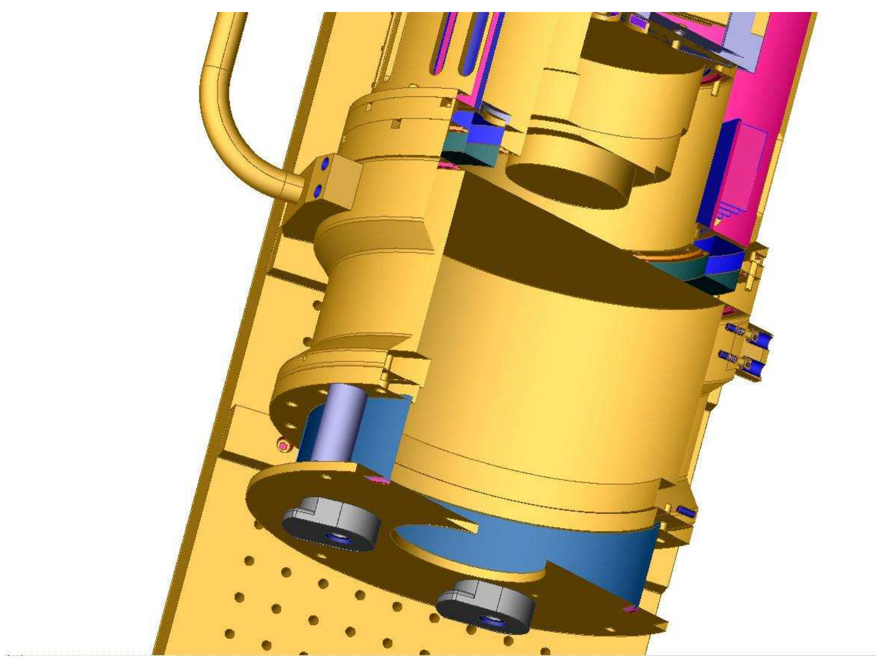

Figure 1. Cutaway view of optical integrating cavity with exit aperture at bottom.

The system is a computer-controlled stabilized light source and is also a *virtual instrument* that can be optionally monitored by a software application. While the lamp housing and optical components are nearly identical to the original NASA/NIST design, the power supply and control system were carefully re-designed to enhance long term stability, reliability and ease-of-use in the field.

Principle of Operation

An internal *thermally stabilized* current regulation circuit ensures precise current regulation to two independent lamp rings. Each lamp ring contains eight low or high-power lamps. Each of the two rings is independently operated to produce three possible optical power levels, LOW (low lamps on) HIGH (high lamps on) and BOTH (both rings on). This design provides three stable flux levels.

All lamps have individual sockets to enable field replacement. During operation internal flux levels are monitored via three detectors positioned within the lamp housing to permit direct optical monitoring of the integrating cavity output. Separate blue and red filter-detectors, as well as a third unfiltered broadband silicon detector are *thermally stabilized* via a thermoelectric cooler at ≈35 °C. Detector outputs are displayed during system operation and can be logged to a file. The source is shipped mounted to a universal optical table for use with a wide variety of radiometer and imager hardware.

Figure 2. System Control Panel.

The system is monitored via a rear-mounted two line digital display. During operation the display scrolls through readouts shown in Figure 2 though Figure 5 including low and high power lamp ring currents, three internal optical detector levels, as well as internal case, monitor detector and current shunt temperatures.

System Controls and Interpreting the Digital Display

A single rotary knob on the rear of the system controls the operation of the two lamp rings. Lamp ramp up/ramp down is automatically controlled by the internal CPU to prolong lamp life. Users can monitor system performance during warm-up and operation either via the digital display or optionally via the supplied *MS-Windows* SQM Manager monitoring application if connected to your PC.

Figure 3. Ilb Low beam (top) and Ihb High beam (bottom) lamp currents. Note here only the low beams are active.

Figure 4. Red (top) and unfiltered/white (bottom) optical monitor outputs.

Figure 5. Blue monitor detector output (top) and Tpd detector thermoelectric cooler temperature, in °C (bottom).

Figure 6. Tsh temperature of shunts (in °C, top) and the Tcs lamp case (bottom). The lamp temperature measurement is made at the lamp rings, which is close to the air temperature inside the optical integrating cavity that houses the lamps.

Why the SQM is a Better Light Source

The SQM provides a field-proven highly integrated, self-contained and computer-monitored light source solution that is equally at home in the lab or in the field. Over the years a wide variety of working irradiance standards have been developed and used, including 1kW FEL lamps and the YES Model PFC-5001 *Portable Field Calibrator,* which is an irradiance source. While the SQM may initially seem to share characteristics with traditional laboratory optical sources it has a number of important differences that make it uniquely suited for a variety of scientific optical measurement applications.

First, the primary design goal of the SQM is long term stability, not irradiance. It was designed to provide a stable, usably wide working aperture. It can thus accommodate a wide variety of devices ranging from radiometers to hyperspectral imagers. It's thermal stabilization makes it largely independent of ambient temperature. Internal current monitoring shunts are temperature-controlled. An isolated and thermally-stabilized three multi-spectral radiometer provides an independent quality monitor of the output in real time. The integrating cavity area is regulated by a computer controlled heater/fan that attempts to regulate against changes in ambient temperature. Next, its large internal optical integrating cavity uniformly mixes the output of either eight or sixteen lamps, minimizing fluctuations of any one filament.

Note that due to its rather large exit aperture size, the SQM it isn't possible to calibrate its output in terms of absolute integrated irradiance in the same way a point source can be characterized. On the other hand, severe geometry problems arise from using practical so-called "point source" filament lamps that are not really point sources. Particularly in the case of characterizing hyperspectral or CCD imagers, its highly uniform flux over a wide aperture is ideal for checking stability. In this sense the SQM is used as a transfer source that you can use to characterize field radiometers or imagers that cannot be returned to the factory.

CHAPTER 2

System Setup

Please read this section completely before attempting to set up and operate the system.

System Hardware and Software Requirements

The hardware requires a 6 Amp 120 Vac, 60 Hz power source. The MS-Windows SQM-Manager display and control software requires a PC with the following minimum requirements:

- Pentium or faster processor with MS-Windows 9x/NT/2000/XP
- 32 MB of memory (64 MB recommended)
- ≈3 MB of hard disk space
- An available RS-232 serial port
- SVGA (800 x 600) or higher resolution display

Unpacking the system

Unpacking the System:

Your system hardware was supplied in a shipping container. Note how the system was packed so that it can be repacked the same way for shipment. In order to ensure long term stability, move it only in a well padded container.

The optics bench supplied for mounting the system to your device under test is quite heavy. This bench provides flexibility when working with a wide variety of radiometers. Check that the SQM system unit is fastened securely to the optical bench before proceeding.

Installing the SQM-Manager software on your PC:

Software installation

- If you are running MS-Windows 95, you must first install the Microsoft® distributed component object model. Locate and run the **dcom95.exe** program on the CD. The program installs a .DLL library into the appropriate location. Note later versions of MS-Windows already have this library.
- Insert the CD and wait for the autostart, and follow the instructions.

  The installation program installs the main executable file as well as other runtime support files into the specified installation directory. The default install directory is **c:\program files\yesinc\sqm**. If, after the installation, you decide to move these files to another directory, you must move all files together in the same new destination directory.

Understanding the Cable Connections

Connecting the Cables

There are two system cables, the AC power cord and the RS-232 serial control cable. The control cable is only required only if you choose to use SQM Manager to log internal values for quality control purposes. Connect the cables as follows:

CABLE	PURPOSE	CONNECT TO
9pin, RS-232 (DTE) null modem type	Communicates status info	PC's serial port. Make a note of the "COMn" serial port you connected to.
AC line cord	Power to system	100-125 VAC wall outlet. The main AC cord is permanently attached. If you need more length, use a heavy-duty 15 Amp extension cord.

Note: The SQM is wired at the factory for 100-125 VAC 50/60Hz. If you need to run it from 220-250 Vac, provide a 1kVA or larger step down transformer.

AC power draw of the system will vary depending on the dynamic state of the system. Several factors contribute to power demand including the length of time the system has been on, the local ambient temperature and which lamp rings are active. Individually, the power sinks include:

- Control electronics alone: ≈37 watts
- Case preheater: additional ≈120 watts
- Fan: additional ≈30 watts
- Lamp low beams: additional ≈75 watts
- Lamp high beams: additional ≈150 watts

CHAPTER 3

Using the System

In this chapter we describe a typical procedure for using the system to expose and characterize a field radiometer or device under test. It is assumed here that you are working in a suitably warm and dry laboratory space with reasonable temperature regulation.

Attaching your Device Under test to the SQM source

Attaching the DUT

Before applying AC power, you will need to physically attach your radiometer device under test (DUT). The DUT must be positioned carefully such that you maintain a consistent mechanical alignment between tests. The optical breadboard base provides a flexible support platform upon which you can mount fixtures. While a pair of Vee-blocks are provided, generally, depending on the design of the DUT you will need to fabricate mechanical adapters and/or brackets (fixtures) that hold the DUT in place.

Ideally, you want the mechanical mating to be repeatable to a tolerance on the order of 1 mm. The goal of the fixture is the DUT must be held both centered and perpendicular to the exit aperture at a fixed distance. Note the same azumithal orientation with respect to the SQM exit aperture should also be maintained as most radiometers or imagers have axial dependencies. Each distance and orientation parameter must be mechanically repeatable each time you mate the DUT to the SQM system.

Figure 7. SQM on its optical bench. The DUT mounts on the left side.

Note: As there is no standard for radiometer mounts, you will need to provide suitable mechanical adapters for your DUT.

Powering up for the first time:

The SQM system is controlled via a single rotary control knob on the rear of the system. You can also use the SQM Manager application to log internal optical stability detector levels as well as temperatures to disk, however, its use is optional.

Powering on the System

To activate the system, with it plugged into the AC line power, rotate the main control knob from STANDBY one stop to PREHEAT. This activates the thermoelectric detector coolers, the internal case heater and the chassis fan. The alphanumeric digital display light should come on indicating that AC power is available. You will hear the power supply fan start but depending on ambient temperature and the case temperature, the rear-mounted chassis cooling fan may not start at power up. This chassis cooling fan and case heater work together to try to maintain the lamp bases at a relatively stable temperature.

During normal operation, you can rotate the knob one two or three more stops to LOW, HIGH or BOTH beams. Each time you change the knob position an automatic slow ramp up/ramp down cycle will occur. This ensures the lamps will not turn on/off instantly and thermally shock their filaments. By observing the temperature and current values on the display, in a few minutes you can tell when the system has stabilized and is ready for use with the DUT. The cooling fan operates automatically as needed to maintain system case temperature.

Important: To prolong lamp life and ensure stability, after you are finished using the system, do not simply unplug the system. Instead, rotate the main knob to PREHEAT or STANDBY. Wait for the system to fully ramp down current to the lamps, and for the fan to stop completely before unplugging the AC power. Note that even in STANDBY mode, the case heater is off but the system electronics still draw a slight amount of AC power - once you are finished using the system you should unplug it.

Using SQM Manager

Starting SQM Manager

With AC power applied to the system, you can use the optional SQM Manager application to monitor both lamp ring currents, monitor detector outputs, lamp current monitor shunt temperatures as well as case and detector temperatures. Start the monitoring program by double-clicking on the OCS icon in the OCS group on your MS-Windows desktop or selecting the Start ⇨Programs ⇨ Yesinc ⇨ OCS item. A SQM Manager window will appear similar to that shown below.

The SQM Manager application provides a graphical strip chart interface. Once SQM Manager is running, begin by selecting the correct serial data Com Port that you connected the serial cable to. This control is located at the lower right of the main window. If this is the first time running the program, depending on your screen resolution, you might need to scroll the window down so that this field is visible.

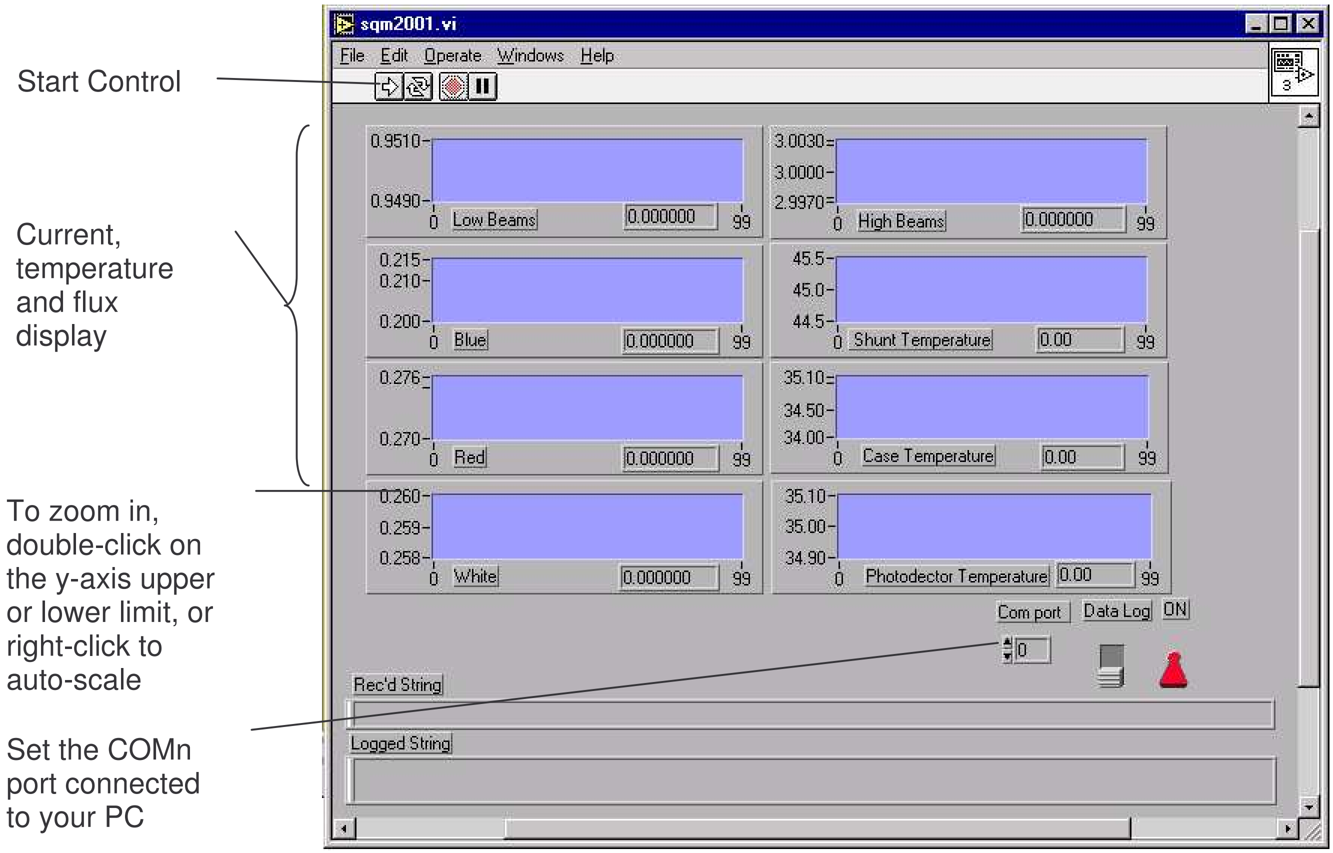

Figure 8. SQM Manager screen shows internal temperatures and optical stability detector levels. Right-clicking on charts allows auto-scaling the Y axis

Note: To change the y-axis scale on a chart to zoom in, double-click on one of the y-axis limit values. If you wish to save the new y-axis settings, select Operate ⇨ Use Settings as Defaults. Right-clicking on any graph allows you to activate the auto-scale feature.

The default port is COM 1, however, the RS-232 serial communications port used to communicate with the PC must match this setting. To change the serial port you are using click on the up/down arrows under the “Com port” control. Note that the ON toggle switch is to activate the SQM Manager program itself, and does not control the lamps.

Important: SQM Manager cannot communicate to the SQM if the RS-232 serial COM port setting is incorrect. Also, when the main system control knob is rotated to STANDBY, SQM Manager will still function, but the SQM’s internal green digital two line display will not scroll. Instead, it holds the value at the point the system was switched to STANDBY. Rotating the main system control knob to the PREHEAT position will display live data again on the internal display.

CONTROL	DESCRIPTION	NOTES
Data Log	Turns data logging on.	Leave this switch off until you have started the program.
ON	Power switch	Halts program activity. This switch does *not* turn off lamp rings. Normally leave set to ON.

With SQM Manager running, strip charts display the following levels continuously:

CHART	DESCRIPTION
High Beams	Current through the high beam lamp ring (Amps)
Low Beams	Current through the low beam lamp ring (Amps)
Blue Monitor	Blue filtered lamp monitor detector: (ADC counts)
Red Monitor	Red filtered lamp monitor detector: (ADC counts)
White Monitor	White/Unfiltered monitor detector: (ADC counts)
Shunt Temperature	Temperature of power supply shunt resistor (°C)
Case Temperature	Temperature of case near lamps (°C)
Monitor Detector Temperature	Temperature of thermally stabilized monitor detectors. (°C)

Note: *Temperature readings for the current shunt and optical monitor detectors should settle to constant values once the when the system is stable and up to operating temperature. Case temperature is a function of ambient room temperature and can vary several degrees as the fan operates.*

Basic Operational Sequence

Basic Operational Procedure

1 Verify that data logging is OFF.

2 Move the toggle switch in the lower right-hand corner to the ON position.

3 Click on the Arrow icon (also called the Go button) on the menu toolbar.

4 If you wish, enable data logging and specify the log file in the dialog box.

Use the Go button to start the software the first time

Important: The On/Go button establishes communications and activate the application. If the strip charts scroll, this indicates SQM Manager is operating. If you don't observe activity after a few minutes, proper serial communication has not been established. Check the SQM Manager's COM Port setting vs. the serial port on your PC that the RS-232 null modem cable is connected to.

1 Once SQM Manager has been started using the Go button, you can choose to log data to an ASCII text file. Move the Data Log slide switch to the "On" position to begin logging. The system displays a window, prompting you for the file name. Specify a file name and select OK to continue.

> **Note**: Log files are ASCII text file that can be read by any text editor, spreadsheet, or math analysis program such as Matlab or MathCAD. Each line consists of 10 fields containing the data displayed as charts in the main window. Each field is comma-delimited and lines are terminated by an ASCII CR/LF.

2 Wait until the shunt and optical monitor detector temperatures stabilize at their set points, which may take 15-30 minutes. Once up to temperature, observe the three monitor detectors to verify optical stability.

> **Note**: During operation, it is normal for the case temperature to wander by several degrees. In contrast, the thermoelectrically-regulated optical monitor detectors are set at ≈35°C and the heated current monitor shunts are set at ≈45°C. Unlike the optical monitor detectors, the current shunts are heated and they cannot cool below their setpoints. In rare instances in very warm ambient environments you may notice the shunt temperatures exceed their setpoint value. In this situation, shut down the SQM and let it cool down before proceeding.

3 Depending on the light level that is required to characterize your DUT, rotate the control knob to LOW, HIGH or all the way to BOTH. This energizes the LOW, HIGH or BOTH lamp rings at the same time. You will need to experiment which setting produces the optimum output flux level. Each time you change the lamp settings, you will want to wait for the case temperature to stabilize.

4 During the entire test, setup your DUT's monitoring software is logging the data from it to record readings during exposure.

> **Note:** If you must operate the system in a colder ambient environment below ≈12°C, you will need to wait longer for the system to thermally stabilize. At room temperature warm-up times are generally 10-25 minutes, however, colder regimes may require an hour or more for warm-up. At startup and shutdown the controls energize/de-energize lamp rings gradually to ease the stress on bulb filaments. As standard operating practice for calibration lamps, you should keep a written log of hours you run the lamps in order to track bulb life.
>
> Shutting down the PC or stopping/exiting from the SQM Manager monitoring program will not affect the present state of the lamps. However, to help promote bulb life, avoid unplugging the AC power cord until all lamp currents have returned to below 100mA by turning the knob to PREHEAT or STANDBY.

Shutting Down the System

Stopping the System

1 To turn off the lamps, rotate the main control knob to PHEHEAT or STANDBY. The internal electronics decrease current over a period of time to ramp the lamps down gradually thereby prolonging their life.

2 After both the high and low beam currents have ramped down below 100mA, you can safely unplug the system from AC power.

Understanding long term thermal behavior

During operation, the current measuring shunts are maintained at ≈45°C by heating while the case is held loosely to ≈35°C by heating. The cooling fan will normally cycle on/off to maintain the case temperature, which is only regulated to ≈±2°C. The system is intended to be used at indoor ambient temperatures below ≈33°C. If you are operating outside and it is warmer that this temperature, internal thermal regulation will not be able to maintain control. With diurnal temperature changes, this may occur hours after power on. In such situations, you can safely use the SQM until it starts to lose thermal control, however, this underscores the need to carefully observe temperatures to verify that the source is stable.

When Not in Use: Proper Storage

It is important to unplug the system from the AC line when it is not in use and store it in a cool, dry location. While plugged into AC power, the system electronics are powered on and susceptible to power line transients. Similarly, burn the lamps only as necessary. As with any filament lamp, they have a finite lifetime.

Interpreting Log files

Interpreting Log Files

The SQM Manager monitoring application provides data logging of the three internal monitoring detectors via the supplied a RS-232 serial cable, as well as various internal temperatures and lamp currents. Data are stored as single-line-per-reading ASCII records followed by CR/LF. The data columns are as follows:

COLUMN	DIAGNOSTIC PARAMETER
1	Low beam current set point
2	Low beam current
3	Low beam command register (factory diagnostic)
4	High beam current set point
5	High beam current
6	High beam command register (factory diagnostic)
7	Red photodetector internal monitor
8	White photodetector internal monitor
9	Blue photodetector internal monitor
10	Current shunt temperature (both lamp rings)
11	Case temperature (measured near lamp ring)
12	Photodetector temperature (block holding all three detectors)

CHAPTER 4

Troubleshooting and Service

Your SQM-5002 system is designed to perform in harsh field conditions, but you should always exercise extreme care in handling the lamp housing and recognize that under normal use, lamps will eventually fail and will need replacement.

Proper care of the system is essential – always store it in a cool, dry location and when shipping use the shipping case and an air-ride transport carrier. Take care not to let water come in contact with it.

Care and Common Problems

On rare occasions, the three external fuses can blow, and there is a fourth fuse inside in the core power supply. Be sure to replace them with “slow blow” type fuses. Check these fuses before opening the unit to replace a bulb.

Replacing a Blown Lamp

There are two rings of eight lamps in series inside the system. If any one lamp burns out, that ring will fail. A minor variation from the original NASA/NIST SQM design, your system has serviceable porcelain and Teflon™ lamp sockets for each individual lamp, permitting individual bulb replacement in the field.

Before you open the system to replace a bulb, start by verifying that all three external fuses on the rear panel are present and functional. There is a fourth fuse in side the AC supply internal to the unit. However, it is extremely unlikely that this fuse has blown as the series-wired AC fuse on the back of the SQM is a smaller value and should blow first.

A reliable indication that a bulb has blown out is if its that lamp ring current reports zero, as opposed to a few mA when idling in PREHEAT or STANDBY modes.

Caution: Hazardous AC voltages are present inside while the system is plugged into AC power, *even with the switch tuned to STANDBY*. When replacing lamps always unplug the AC power cord before opening. Refer servicing to qualified personnel. Only experienced technicians should perform the procedures in this section. Always unplug the system from AC power when servicing the instrument. Also, observe proper Electro-Static Discharge (ESD) procedures when working with sensitive electronic components.

Lamp Replacement

Replacing a burned out lamp is normally the only major maintenance required by the system. Replacing a burned out lamp involves these steps:

- removing the exterior cylindrical housing
- removing the internal power electronics chassis subassembly
- removing the rear lamp ring cover plate
- locating the defective bulb using a DVM ohmmeter
- removing the burned out lamp and replacing it
- reassembling the unit in reverse order
- conducting a test run to verify proper operation

Because this procedure involves opening up the system internals, work inside. Before starting, you will need the following tools:

- 3 1/2 digit (or better) DVM
- set of 90 degree hex key (Allen) wrenches and T-type Allen wrenches
- spare bulb kit (available from YES)
- small amount of isopropyl alcohol and lint free cloth
- small snap ring pliers
- cable ties and cutters

1. Begin by verifing the system is unplugged from the AC power outlet.

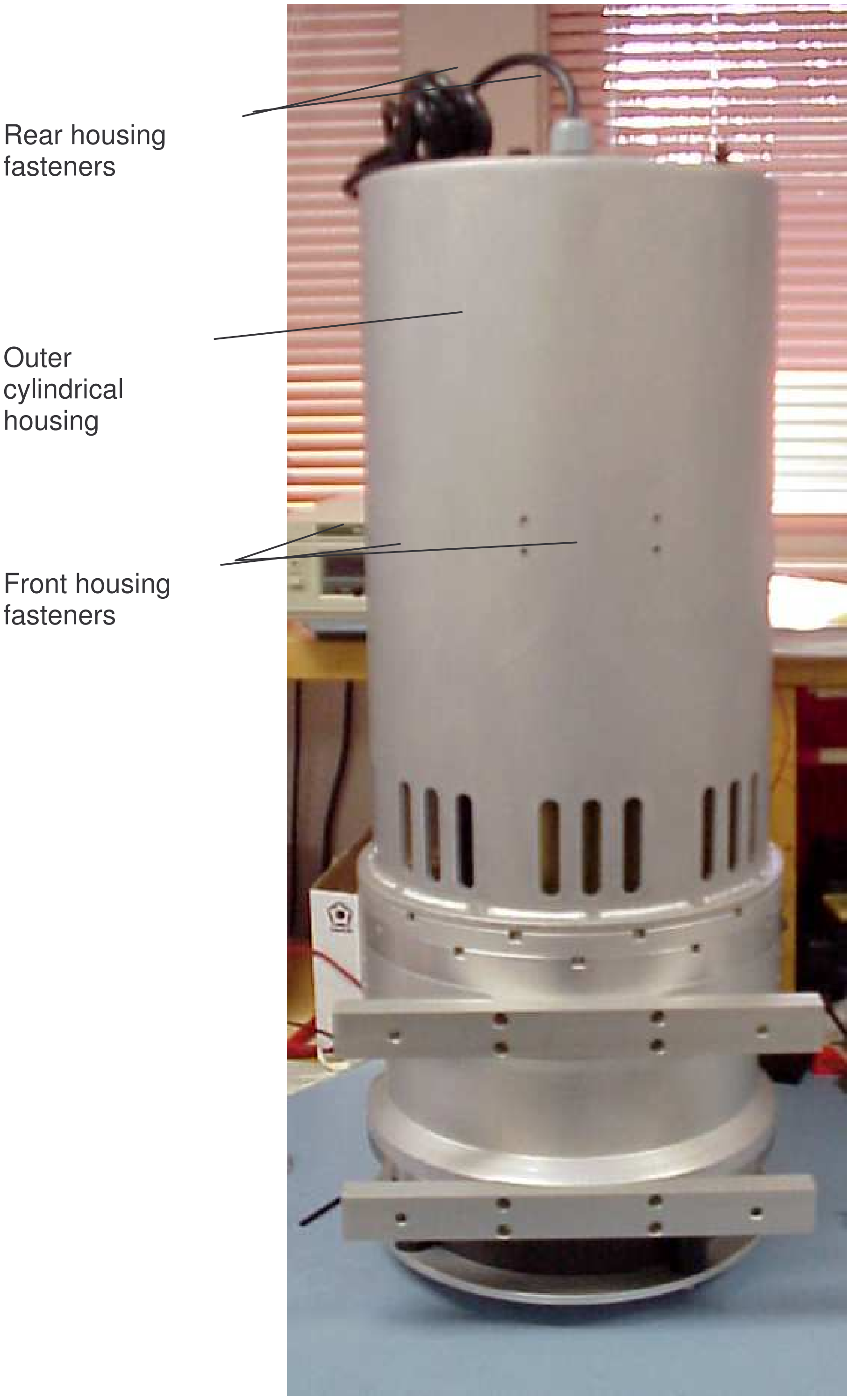

Figure 9. Shown after removal from optics bench but prior to cover removal.

2. Working a clean dry area, unbolt the system from the optics bench. With an assistant helping you, set it on a soft but sturdy surface such as the floor or a workbench. Use a towel to prevent scratching the exterior of the system.

3. Being careful to balance the system, remove the screws that are at the perimeter of the *outer cylindrical housing*, and then remove the other set of screws that hold it to the main core.

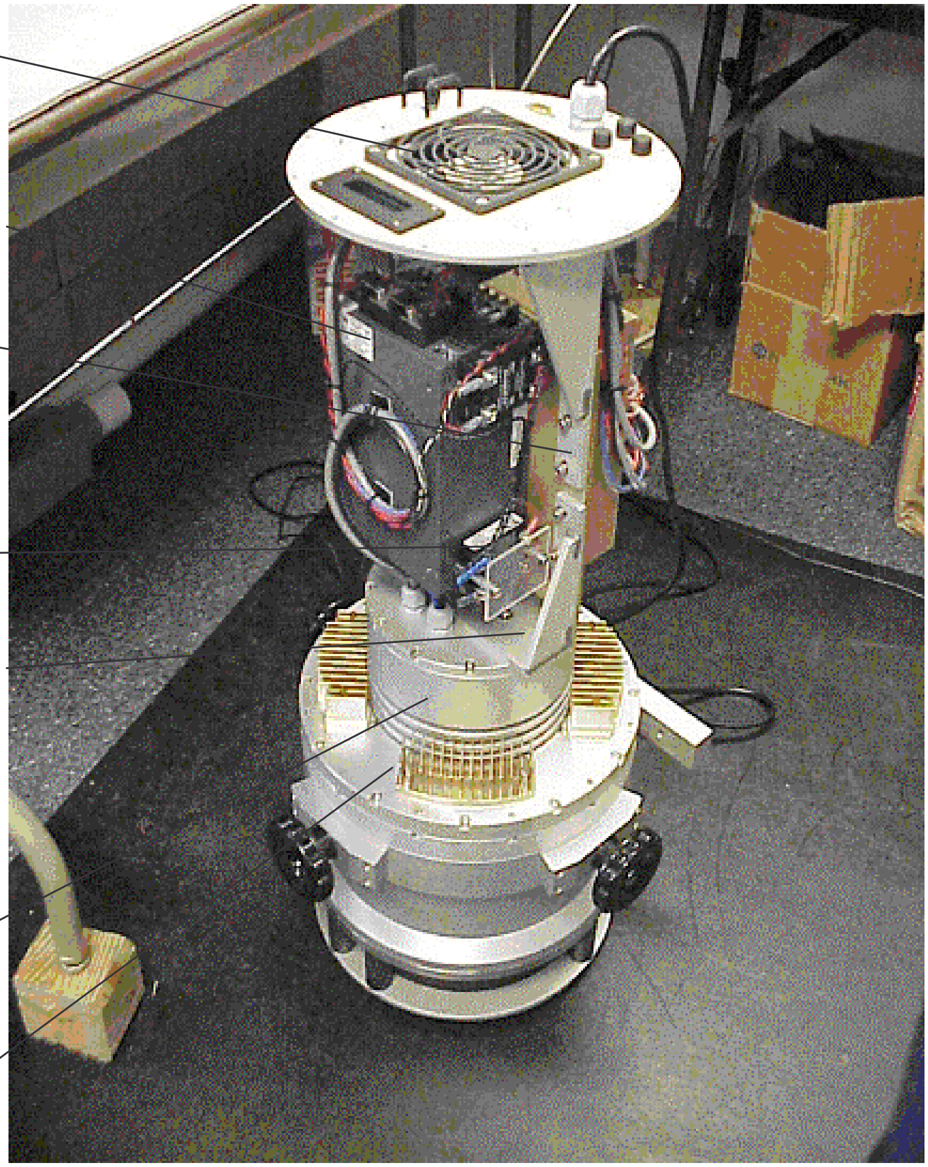

Figure 10. The outer cylindrical housing has been removed, exposing sub-assemblies.

4. Carefully slide off the *outer cylindrical housing*, noting its orientation relative to the system, such that you can put it back together the same way later.

5. Using a T-type handle long Allen wrench, remove the 28 screws that secure the *lamp ring cover plate*. Before removal, note orientation and keep threads of all screws free of dirt. As you lift the cover plate upward to expose the 16 bulb sockets, note the two O-rings. Provide a support to hold the ring up and out of the way.

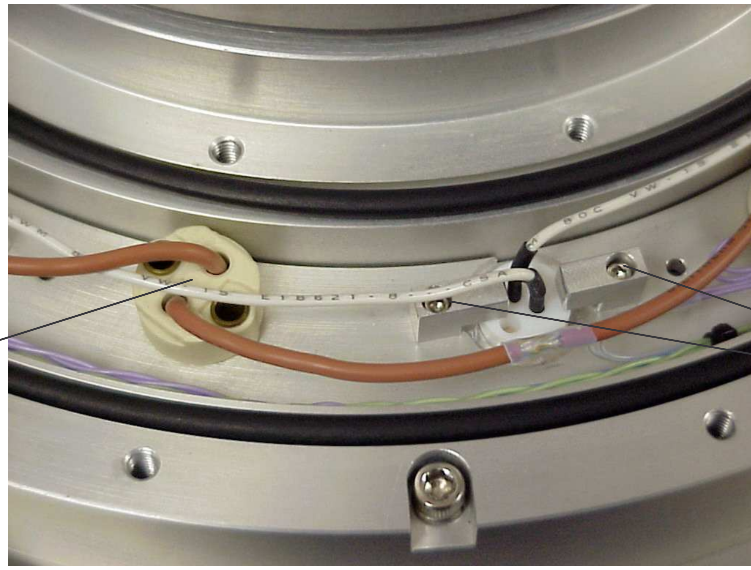

Figure 11. Rear lamp ring cover plate pulled away, exposing two bulb types; larger type (left), retained with snap rings and smaller type (right), retained with two side clamps.

6. Note there are two types of lamps and they are *not* interchangeable. To locate the faulty bulb set the DVM to 0-300 ohms and using a set of sharp, pointed probes, carefully probe the points at the porcelain sockets. You will need to penetrate the insulation where the feed wires enter the rear of each bulb to make contact with the conductors. Locate the bulb that has greater than a few ohms and identify it by placing a piece of tape on the rear of the socket.

Note: Even though a bulb may be blown open, this is an *in-circuit* test and the power supply source is across both sides of the bulb and represents a partial load. Therefore, the DVM will not indicate an open circuit, but rather a higher resistance than the other bulbs.

7. To prevent confusion the two bulb types are retained via two different mechanical ways. The larger type is retained by a metal snap retainer ring and the smaller bulb type is held in with two aluminum side clamps.

   For the larger lamp type with the porcelain socket, pull the socket straight up and off the pins of the bulb. Then use the small snap ring pliers carefully remove the *retainer ring*. Note that these spring-loaded retainer rings tend to fly off and can easily get lost. It is a good idea to cover the immediate working area with a cloth so as to capture the snap ring as it flies off in a random direction. See the two figures below.

Important: Avoid touching glass lamp envelopes with your bare fingers – the oil from your fingers will likely cause the bulb to fail prematurely. Wear gloves when servicing the lamp housing and use alcohol to clean the bulb prior to powering on a replaced lamp. If you touch the lamp envelope glass by accident, clean it with alcohol and wipe with a lint-free cloth.

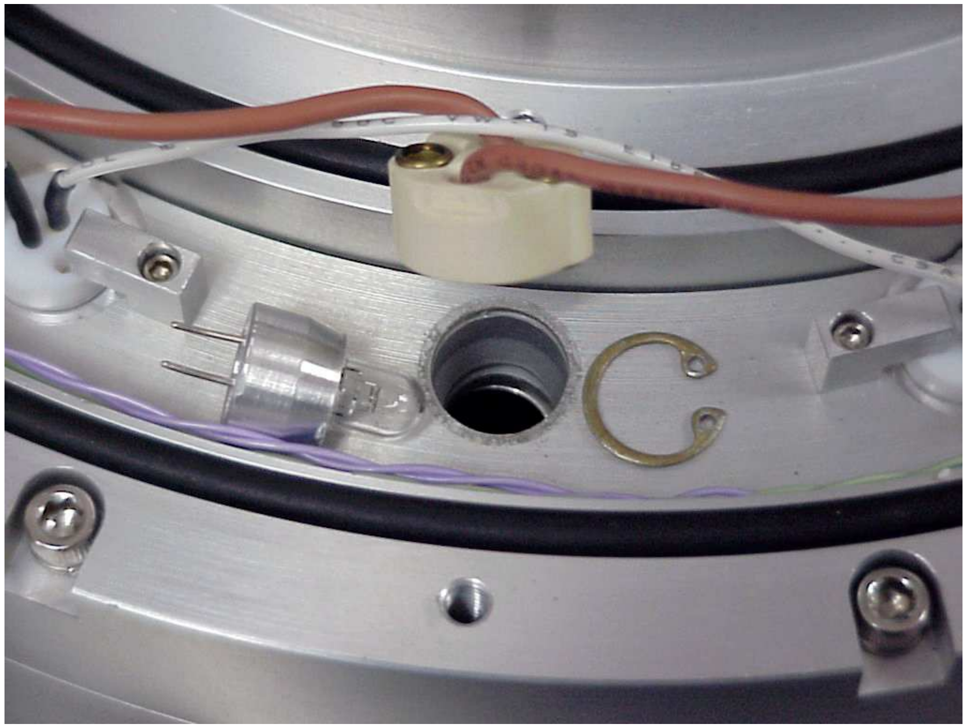

Figure 12. Larger socket removed, bulb out, with snap ring removed at right.

For the other smaller socket remove the screws holding the two side clamps.

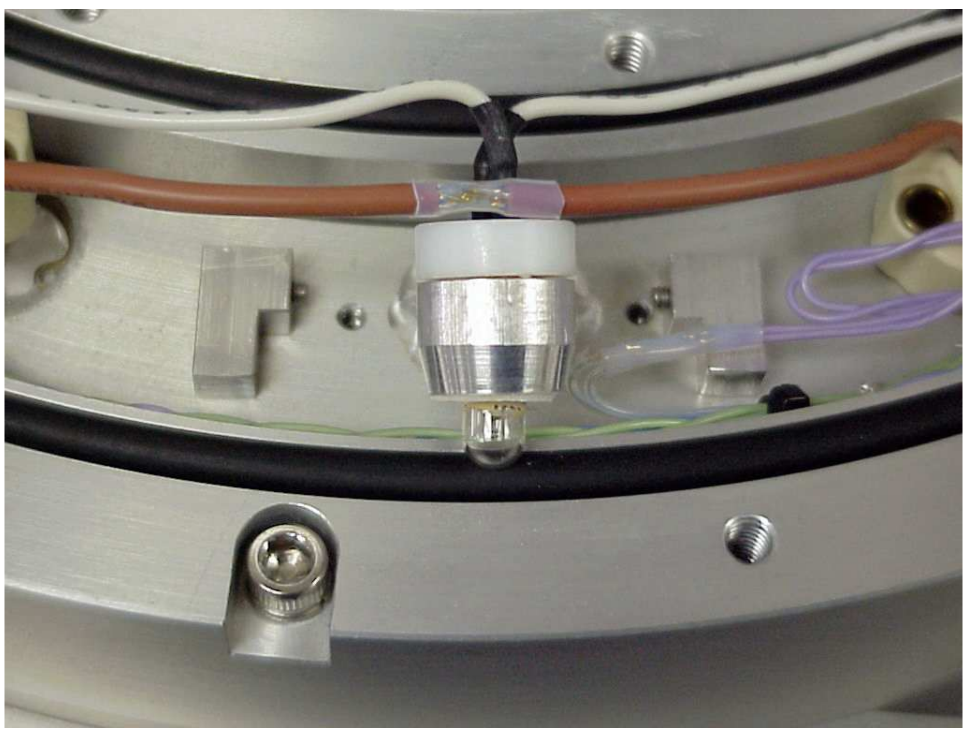

Figure 13. Smaller socket removed, bulb in socket, side clamps at left and right.

8. Both bulb types plug into their sockets. Gently remove the lamp and visually inspect the filament. Note the bulb's size and shape, which indicates the type.

Use the DVM again to verify the bulb has truly failed. Similarly, check the resistance of the new bulb you are about to install.

9. Once you have double checked the bulb type, replace the old bulb with a new bulb. Use extreme care to avoid touching the glass envelope with your fingers. Replacement bulbs are custom potted assemblies and are available directly from YES.

10. Repeat the above 4 steps to verify that there are not additional burned out bulbs in the system. Often, more than one bulb may burn out at a time, especially if there was an AC power surge.

11. Tuck the wires back in the groves and position the *rear lamp ring cover plate*, carefully looking at the wires to ensure none get pinched in the process.

12. Hand tighten the *rear lamp ring cover plate* using a “tire lug nut” pattern. Work slowly and avoid over tightening these screws or pinching any wires.

13. Slip the *outer cylindrical housing* over the system, and secure it with the two rings of screws. Tighten each screw gently, and use a rotating pattern. If you have some available, put a small drop of anti-seize thread lubrication on each screw before re-inserting. Be especially careful not to let this compound migrate onto the surface of the lamps inside the housing.

14. Set the system back on the optics bench and secure it.

15. Power on the system and using procedures outlined in the previous chapter, verify both lamp rings are operational.

Important: If you have verified that all fuses and all lamps are intact but the system still is malfunctioning, do not attempt repairs without consulting technical support first. Aside from the internal power supply fuse, the electronics sub-assemblies are not field-replaceable units.

Disassembly of Internal Electronics

If you need to access the internal components it is necessary to decouple the electronics assembly from the main core that holds the internal optical detectors and lamp rings. This procedure presumes that you have proceeded with the steps 1-4 of the previous procedure and the external cover is already off the system, and we are jumping in at step five.

1. Note the orientation of the *internal power electronics subassembly* chassis relative to the system, such that you can reassemble it properly later.

Note: The mechanical alignment of the internal electronics chassis is critical to proper alignment of the external cover during re-assembly. Once you proceed, you will lose this alignment. It is a good idea to mark the position of the bracket (shown below) on the core backplate using masking tape.

2. Using a 90°Allen wrench, carefully loosen the four hold down screws that secure the *internal power electronics subassembly* to the *main core*.

3. Note there is a service loop that tethers the components together. Cut the cable ties that secure the service loop to the power supply.

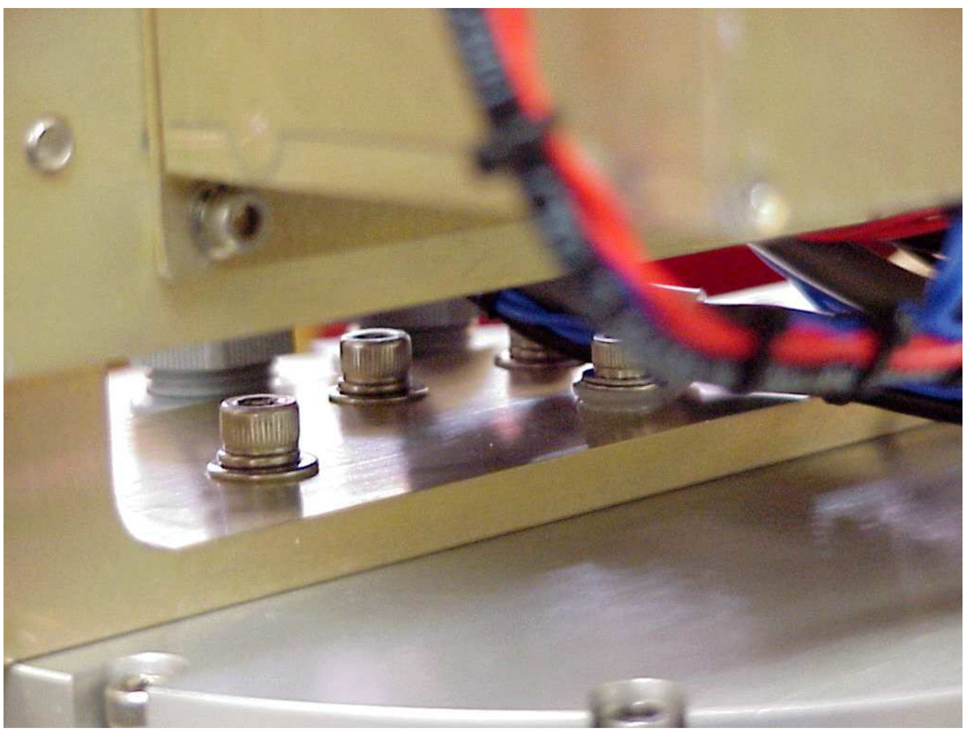

Figure 14. Close up of four bolts that secure the internal electronics subassembly to main core. Use an 90° Allen wrench to access these bolts.

4. Cut the cable ties on the tether and while supporting the *internal power electronics subassembly* with an assistant, remove the four screws and gently set it to one side. Use care with the cable tether and avoid putting any tension on the wiring between the main core and the electronics assembly.

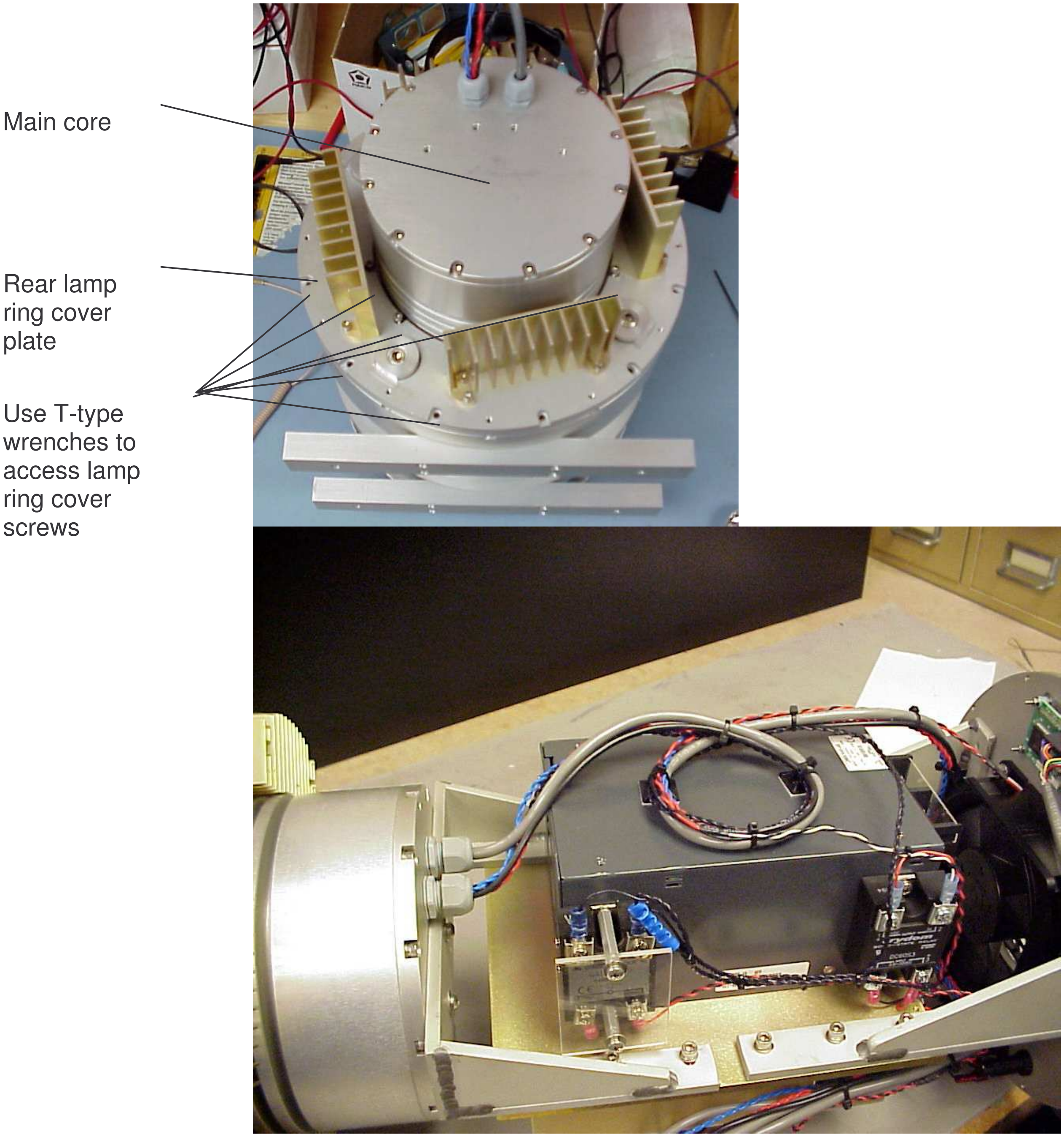

Figure 15. Above, system core with internal power electronics subassembly detached and set aside. Below, note how cable tether is stowed and tied with cable ties. There is an AC line fuse inside the power supply.

5. Re-assembly generally follows the reversal of the above steps be careful to position the electronics assembly on the core plate in exactly the same position. Secure it with its larger hold down hardware, orienting it in the correct position. Be careful not to over-tighten these as they can strip the threads in the aluminum plate on the *main core* assembly.

6. Verify that all cables are correctly positioned, and tie them using cable ties as necessary.

7. Follow the latter steps in the previous procedure to replace the outer cover. You will need to carefully align the internal electronics assembly to allow the cover to fit. If the assembly is not positioned exactly as it was when you first disassembled it, you will need to loosen the bolts on the core assembly and try again. This can be done as an iterative process, where finally everything is in its proper location and the cover fits tightly onto the assembly.

Important Product Safety and Disclaimer Information

Important: READ THIS PAGE BEFORE USING THE SYSTEM!

Be careful, it's hot!

Because the system operates from AC line voltages, there is always the potential for injury if you physically touch and it is not properly grounded. Take the same precautions that you would while working with any AC device. The system must be mounted such that it is out of reach of small children. Ensure that unauthorized personnel are denied physical access to it *at all times*.

Caution: Installation factors are not within the control of the manufacturer and it is therefore your responsibility to install and use the system with appropriate caution.

Lethal voltages present inside enclosure

There are lethal AC voltages inside the system, therefore no work should be performed on it while it is connected to line power - always disconnect AC line power before servicing the system. Only operators familiar with the detailed operation of the system should be allowed to maintain it, and all servicing is to be performed by qualified, technically-trained personnel only.

Danger: Use extreme care when working on the system outdoors, especially when the ground is wet, as you can be killed! It is not intended for operation in wet or 100% condensing environments. Always disconnect AC power first before opening the enclosure. Wear rubber gloves and rubber soled shoes.

Advisory use only

This equipment is not designed or intended for hazardous or otherwise life-critical applications. The complex physics of optical measurements depend on factors that are difficult to control. Yankee Environmental Systems, Inc. (YES) provides this equipment *as-is* and makes *no warranty as to the suitability of purpose of the product or the data it produces*. Data provided by the system are for "advisory" use only. While best practices have been employed in the design and manufacture of the system, malfunctions can and will occur, requiring periodic user-maintenance and intervention.

Disclaimer

You agree to use the product and the data it provides *at your own risk*. YES, its agents, distributors, assigns, shareholders or employees are not responsible for any damages whatsoever, resulting from either proper or improper use of this product, or application of data it provides. Further, YES, its agents, distributors, assigns, shareholders or employees are not responsible for any injury or injuries that may result from improper installation, malfunction, system design elements, improper or normal operation, or as a result of real or perceived negligence on the part of anyone. By using the instrument, you agree to these terms herein included in this User Manual as provided with the system at time of purchase. If you have any questions about this policy or on using the equipment in your particular application, contact technical support before proceeding with installation or use any of the methods listed in *In This Manual* located just after the table of contents.

Product Warranty

Warranty Terms

The YES standard product warranty applies only to defects in manufactured parts as described by its general product warranty located at www.yesinc.com. Fuses and internal lamps are considered expendables and are not covered under the warranty. Spare lamp sets can be ordered from the factory.

Documentation Feedback

While we strive to provide the highest level of technical accuracy in this document, we welcome any comments you have on this user guide, both positive and negative. Please do not hesitate to contact us via any of the methods listed in the section *In this Manual* located just after the table of contents.

Also, be sure to check our corporate web site for the latest technical information—look in the *support* section, under the data sheets and in the *frequently asked questions* link. In addition to providing the latest development news, the YES web site www.yesinc.com offers downloadable software updates to licensed customers, and in some cases tutorials on topics too changeable or complex to be covered in a printed manual (such as videos demonstrating complicated service procedures). You can also submit feedback and questions directly to the YES engineering team via the on line support site.

STOP!

READ THIS MANUAL FIRST!