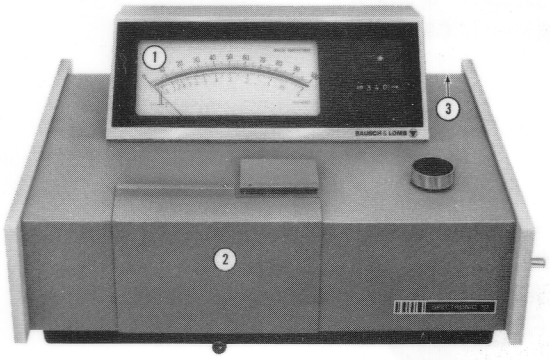
THE BAUSCH & LOMB
SPECTRONIC® 70 SPECTROPHOTOMETER
OPERATING PROCEDURES

Before operating the instrument, read and become familiar with the entire Operator's Manual. Be sure that "Initial Checkout Procedures" are complete before first operation of instrument.

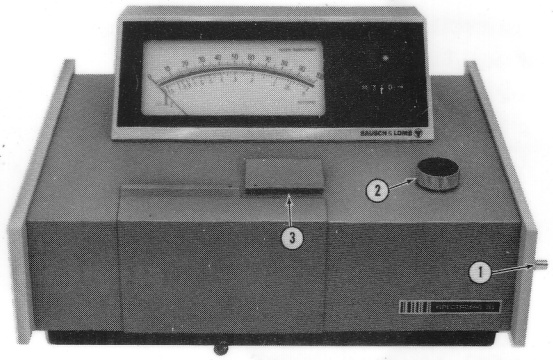
Preliminary

1. Check that meter reads EXACTLY 0%T with power OFF. (Refer to "Meter Zero Adjust" for adjustment procedure).
2. Install the sample compartment and select the glassware that are most suitable to the analysis. (Refer to "Sample Compartments").
3. Turn power ON with rear panel Power Switch, allow five-minute warmup, minimum.



Sample Measurement

Step	Use
1. Set Analytical Wavelength	Wavelength Drive Knob
2. Insert reference blank, set 100%T (OA)*	100%T/Zero A Knob
3. Insert unknown sample, read sample value.*	Meter Display



**IMPORTANT - IF INSTRUMENT HAS REDUCED SENSITIVITY OR EXCESSIVE NOISE, FIRST REFER TO THE "MIRROR ALIGNMENT" PROCEDURE IN THE MAINTENANCE SECTION.*

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SECTION 1
DESCRIPTION

The SPECTRONIC® 70 spectrophotometer is a direct-reading, single-beam, grating instrument which provides a continuous 325-925nm wavelength range, using automatic interchange of phototubes and automatic insertion of stray radiant energy and second-order filters.

The locations of principal operating features are shown in Figure 1.

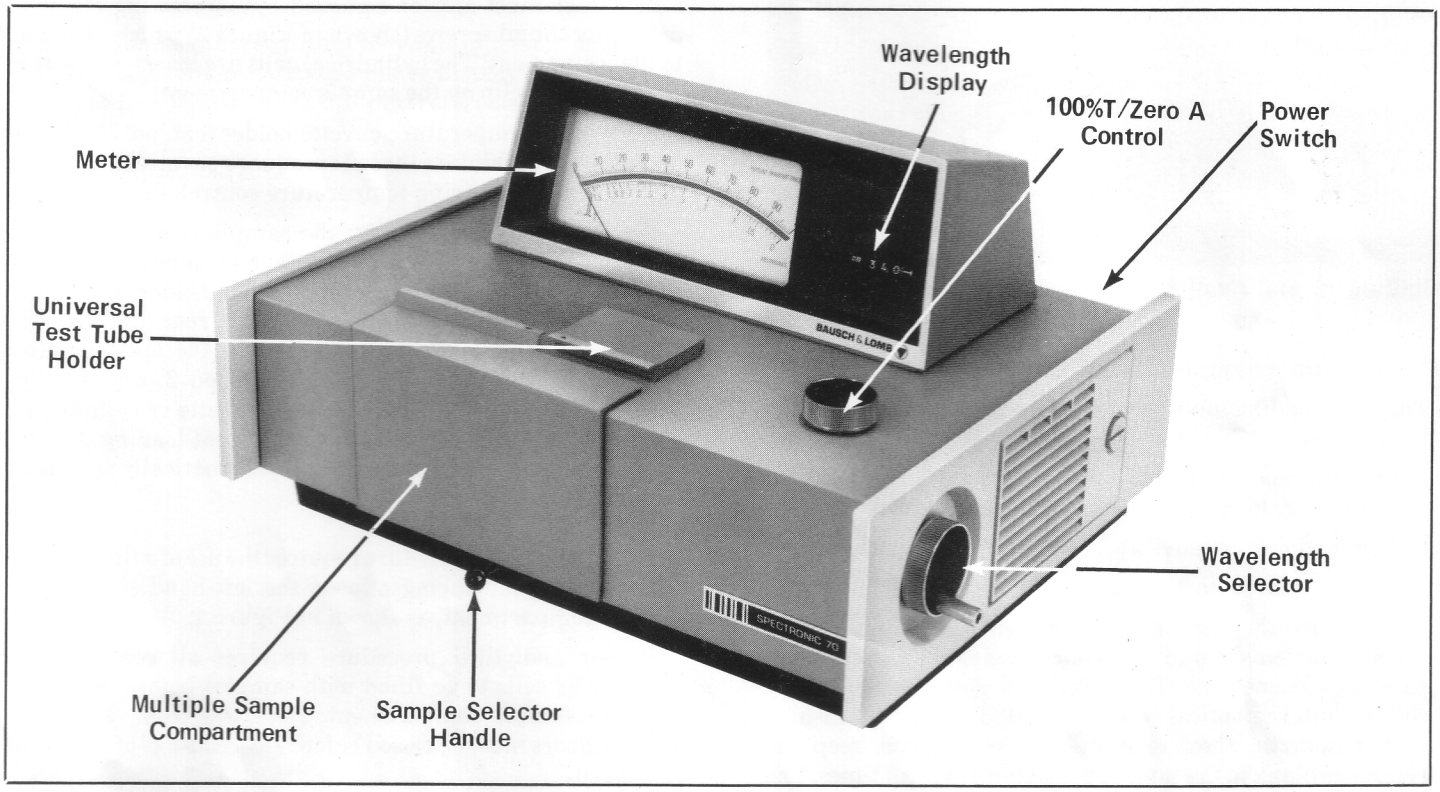

Figure 1. Location of Operating Features

1.1 Specifications

Wavelength Range	325-925nm
Spectral Slitwidth	8.0nm
Wavelength Readability	0.1nm
Stray Radiant Energy	0.5% at 340nm
Photometric Range	0-100%T 0-2.0A
Photometric Accuracy	1.0%T at meter 0.5%T at analog output
Photometric Readability	0.2%T (1/5 division)
Photometric Noise	0.1%T
Photometric Stability	
0%T Drift	0.2%T/day
100%T Drift	0.1%T/15 minutes 0.2% T/hour
External Output	0-1.0 VDC
Power Requirements	100, 115, 220, 240VAC; 50, 60 Hz, 90 Watts
Size	43.2cm W x 25.4cm H x 34.3cm D (17 in. x 10 in. x 13 1/2 in.)
Weight	15.9 kg (35.0 lbs.)

1.2 Meter

The instrument displays photometric values on an 8-in. meter with an anti-parallax mirror. The meter displays % transmittance using a linear 0-100% scale, and has an additional logarithmic scale for absorbance readout from 0.0 to 2.0 absorbance units.

1.3 Wavelength Selector

The wavelength selector is used to select the desired wavelength within the range of 325-925nm. The selected wavelength is shown on the wavelength display.

1.4 100%T/Zero A Control

The 100%T/zero A control is used to set the instrument for a 100%T or 0.0A meter readout on a blank reference sample.

The control has a unique coarse/fine adjustment feature. Shifting from coarse to fine is entirely automatic, requiring only a reverse rotation of the knob. For this reason, the control is best utilized in the following manner: Turn the knob in the required direction to achieve the desired 100%T/zero A setting and slightly overshoot the setting. Reverse the rotation and the fine adjust will come into operation, allowing a very accurate setting to be made. The control remains in fine adjust for approximately 1 1/2 revolutions of the knob, and then automatically reverts to coarse adjust.

1.5 Universal Test Tube Holder

The universal test tube holder accepts test-tube cuvettes up to 20mm in diameter and positions them with a precision of better than 0.5%.

To use the holder, close the front-loading door and fill the cuvette with sample to the horizontal mark on the cuvette. Insert the cuvette through the top-loading door, with the vertical mark on the cuvette aligned to the indicator mark on the instrument. Close the top door. If overlength cuvettes are used, install a light shield, cat. no. 33-30-22, over the cuvette.

It is not necessary to remove the holder except when 100mm-pathlength cylindrical cells are used in the multiple sample compartment.

To remove the holder, unfasten the two mounting thumbscrews (shown in Figure 2) which position the holder on the compartment wall, and remove it through the front opening.

1.6 Multiple Sample Compartment

The front-loading multiple sample compartment accepts the following sampleholders:

a. Conventional rectangular cuvettes, including flow-thru, short-path, long-path, or constant-temperature.

b. Conventional cylindrical cells up to 100mm pathlength.

c. Filter plates up to 3″ square.

The multiple sample compartment can accept three rectangular cuvettes or two conventional cylindrical long-path cells at one time. The cuvettes or cells can be quickly shifted into the optical beam in a 1-2-3 sequential fashion with automatic reset to position 1 so you can keep the reference blank in the sample compartment at all times. The compartment is provided with a front-loading door and a removable cuvette holder.

The removable cuvette holder (shown in Figure 3) is attached to the sample compartment with a spring latch and will accept up to three 10mm cuvettes. If 20mm- or 50mm-pathlength cylindrical cells are to be used, unclip the cuvette holder and remove it from the sample compartment. If 100mm pathlength cells are to be used, the universal test tube holder must also be removed by unscrewing the two mounting thumbscrews (shown in Figure 2) which fasten it to the instrument. The cylindrical cells are inserted into the double spring clip on the sample compartment.

A constant-temperature cuvette holder (cat. no. 33-30-14) is available to maintain three 1cm square cuvettes at 5° - 55° C for samples requiring temperature control.

Sequencing is provided by the sample selector handle, shown in Figure 1. The handle has three positions corresponding to the three cuvettes in the holder. When the handle is pulled all the way out, the rear cuvette (or cylindrical cell) is precisely aligned in the optical path. Pushing in on the handle selects position 2, and finally position 3. Position 3 aligns the front cuvette or cylindrical cell in the optical path. Whenever the front-loading door is opened, the sample selector handle is automatically returned to position 1.

If the analytical procedure requires the use of a filter plate, insert it into the spring clip on the left-hand side of the sample compartment, as shown in Figure 4.

Proper analytical procedure requires all conventional cuvettes or cells to be filled with samples before insertion into the sample compartment. Both the front- and top-loading doors must be closed before any readings of any kind are taken.

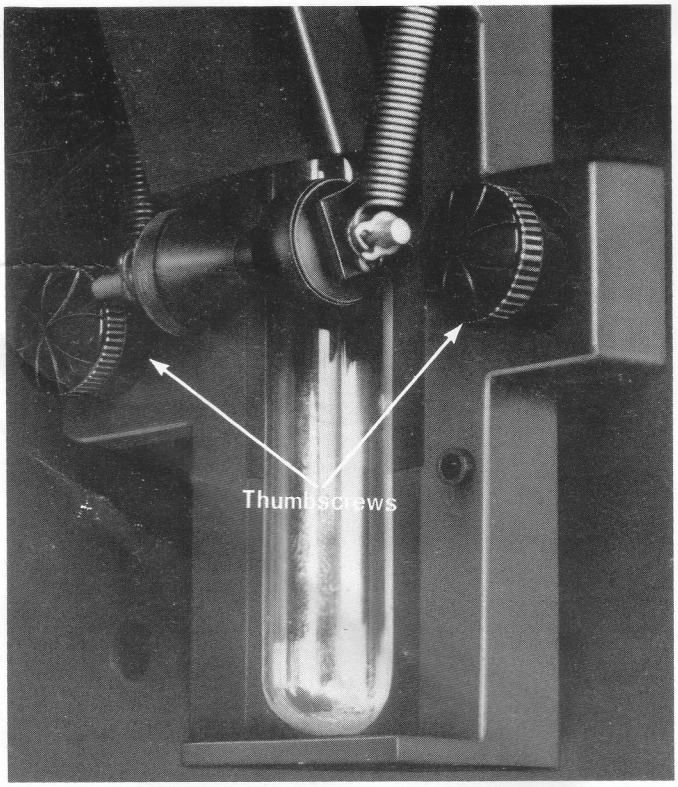

Figure 2. Location of Mounting Thumbscrews on Universal Test Tube Holder

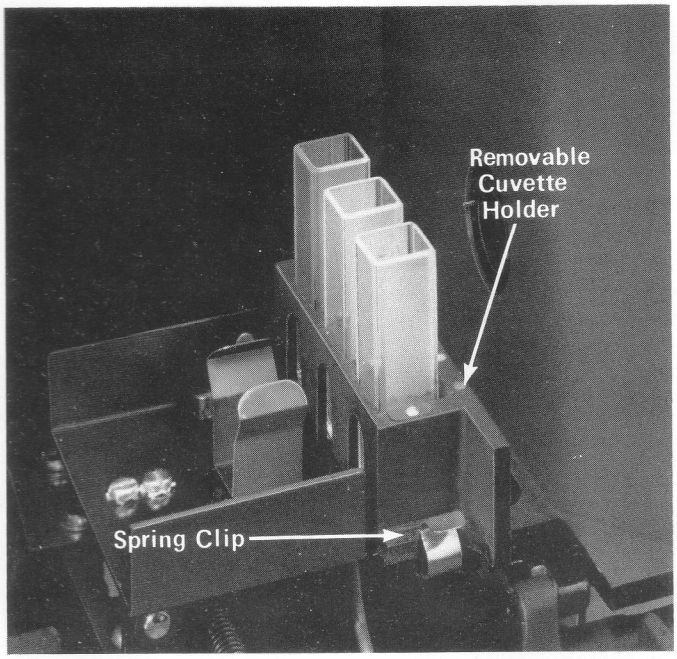

Figure 3. Removable Cuvette Holder in Multiple Sample Compartment

1.7 External Output Jack

The external output jack on the rear of the instrument permits attachment of a variety of external readout devices, including the Bausch & Lomb 10″ Strip Chart Recorder and the DR-37 digital readout listed in Section 5.1, Accessories.

The six pins of the jack are numbered as follows, viewed from the rear of the instrument.

6 - 4 - 2
5 - 3 - 1

The photometric transmittance value is present on pin 1 as a DC analog voltage. A 100%T meter display correlates to a nominal 1.2VDC signal on this pin (referenced to ground on pin 2).

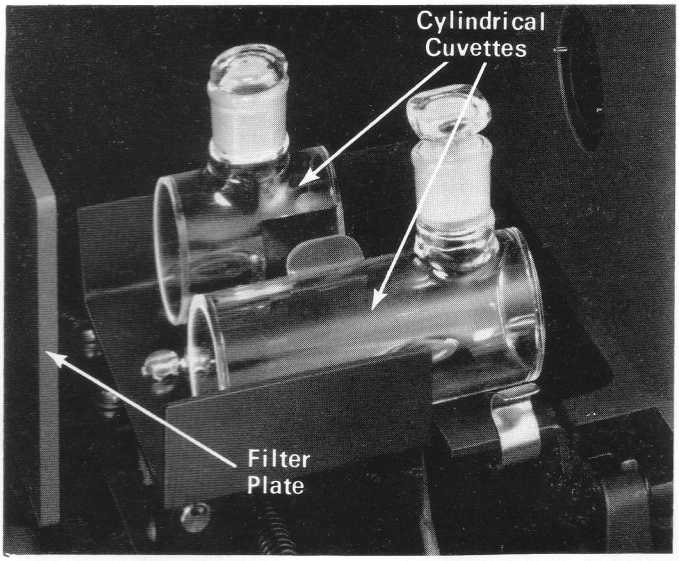

Figure 4. Cylindrical Cells and Filter Plate in Multiple Sample Compartment

SECTION 2
INSTALLATION

The SPECTRONIC 70 spectrophotometer operates best in a relatively clean, stable environment. Dust, smoke, vibration, corrosive vapors, and wide temperature/humidity fluctuations must be avoided to prevent reduced efficiency and ultimate instrument deterioration.

NOTE

All instruments are shipped ready for 115VAC ± 10% operation.

Before the instrument is first used, perform the Line Voltage Adaptation, Meter Zero Adjustment, and Mirror Alignment procedures given in Section 4, Maintenance.

SECTION 3
OPERATING PROCEDURES

NOTE

If at any time the instrument exhibits reduced sensitivity or excessive noise, perform the Mirror Alignment procedure in Section 4.3.

Operating controls are shown in Figure 1.

3.1 Setup

a. Set the power switch on the instrument rear panel to OFF. Plug the instrument into a grounded outlet.

b. With the power switch still OFF, check that the meter reads exactly zero. If not, perform the Meter Zero Adjustment procedure in Section 4.2.

c. Set the power switch to ON and allow at least five minutes for warmup before using the instrument.

3.2 Transmittance or Absorbance Measurement

a. Set the desired wavelength with the wavelength selector.

b. Insert a reference blank and, using the 100%T/zero A control, set the meter to read 100%T.

c. Insert the unknown sample and read %T or A on the meter.

SECTION 4
MAINTENANCE

This section describes all maintenance procedures that should be performed by the operator. All other maintenance, troubleshooting or repair tasks should be performed only by an authorized Bausch & Lomb service representative.

4.1 Line Voltage Adaptation

The instrument can be used with line voltages of 100, 115, 220, or 240 VAC, 50/60 Hz. Adaptation is made with a plug/socket connector located in the interior of the instrument just in front of the transformer assembly.

WARNING

Unplug the instrument before proceding.

a. Remove the lamp access door on the right side of the instrument by loosening the captive screw.

b. Loosen the protective bracket screw and swing the bracket down to expose the connector.

c. Referring to Figure 5, locate the line voltage connector. Note that the lowest socket position is a blank and is not used. Remove the plug with a firm pull and push fully onto the socket pin corresponding to your line voltage.

d. Replace the protector bracket.

e. Replace the lamp access door.

f. For 220-240V operation, replace the 1.5 amp fuse with a 0.7 amp 250V Slo-Blo fuse. (See Section 4.6, Fuse Replacement.

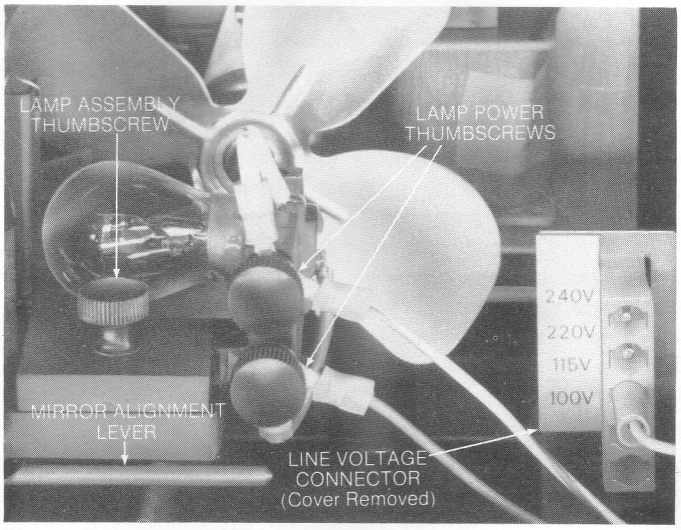

Figure 5. Interior of Lamp Compartment

4.2 Meter Zero Adjustment

When the instrument is first installed, and periodically before routine operation, check that the meter pointer rests exactly over the 0%T line with power off. Adjustment, if required, is made through an access hole (shown in Figure 6) in the rear wall of the sample compartment area as follows:

a. Set the power switch (shown in Figure 7) to OFF.

b. Remove any cells from the sample compartment. The rear wall may have either one or two access holes; if two holes are found, the adjustment screw is behind the right-hand hole.

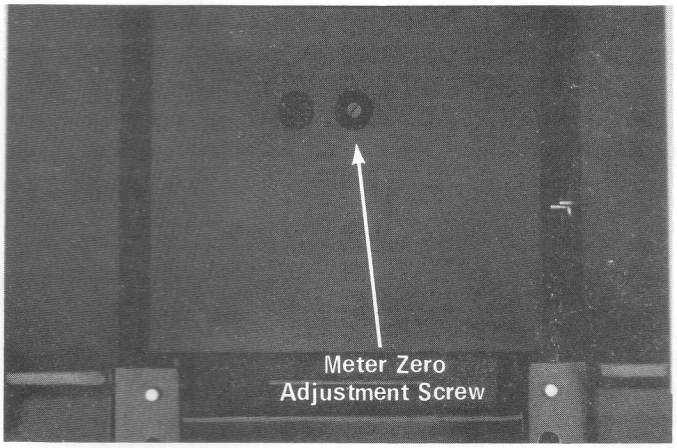

Figure 6. Rear Wall of Sample Compartment, Showing Location of Meter Zero Adjustment Screw

NOTE

The access hole may be partially blocked by a foam cushion which must be gently pushed aside with the screwdriver blade to reach the adjustment screw.

c. Using a thin-blade screwdriver, carefully turn the adjustment screw behind the access hole until the pointer is exactly over the 0%T line. Use the anti-parallax mirror and shift your viewing angle to achieve a single, coincident pointer image.

4.3 Mirror Alignment

Correct mirror alignment ensures that the instrument operates at its maximum sensitivity by accurately imaging the lamp radiation onto the entrance slit of the monochromator. The mirror alignment must be checked when the instrument is first installed, whenever the lamp assembly is replaced, and if the instrument has reduced sensitivity or excessive noise.

a. Turn the instrument on and remove the lamp access door on the right side.

b. Use the wavelength selector to set 415nm or higher.

c. Observe the monochromator entrance slit by sighting through the rotating chopper blades and visually center

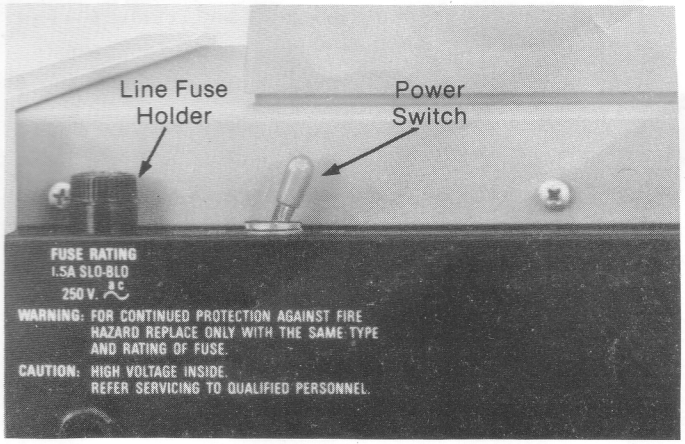

Figure 7. Instrument Rear Panel, Showing Location of Line Fuse Holder and Power Switch

the lamp filament image on the entrance slit using the mirror alignment lever (shown in Figure 5).

d. Set the 100%T/zero A control for a 50-90%T readout. Carefully adjust the mirror alignment lever for the maximum meter readout. If the meter goes off-scale, readjust the 100%T/zero A control for 50-90%T and again position the mirror alignment lever for maximum readout.

e. Replace the lamp access door.

4.4 Mirror Cleaning

CAUTION

The lamp mirror (mounted inside the lamp access door) has a first-surface reflective coating; this mirror surface must not be touched under any circumstances with any kind of object including cleaning swabs, lens tissue, etc. Accidental fingerprints are particularly damaging to the mirror. If excessive mirror dust is suspected of causing low sensitivity, it may be cleaned using the following procedure:

a. Turn the instrument off and open the lamp access door.

b. Use the mirror alignment lever (shown in Figure 5) to swing the mirror surface toward the door.

c. Using a hand-operated air bulb, blow any loose dust from the mirror surface.

d. Rotate the alignment lever back toward its original position and perform the Mirror Alignment procedure.

4.5 Lamp Replacement

WARNING

Lamp replacement involves contact with electrical wiring. Make sure the instrument is unplugged before replacing the lamp assembly.

The tungsten lamp assembly, cat. no. 33-33-23, has a nominal life rating of 400 hours minimum. Because of the instrument's sensitivity and the lamp position employed, the usable lamp output will remain almost constant over its life span. It is recommended that a spare lamp assembly be kept available. The prealigned assembly can be quickly replaced by referring to Figure 5 and using the following procedure:

a. Remove the lamp access door on the right side of the instrument by loosening the captive screw.

b. Loosen the two lamp power thumbscrews holding the four wires in place on the lamp assembly and remove the two wires coming from the instrument.

c. Remove the lamp assembly thumbscrew. Discard the old lamp assembly.

d. Being careful not to touch the bulb, insert the new lamp assembly. Replace the lamp assembly thumbscrew and tighten it down.

e. Insert the wires from the instrument under the lamp power thumbscrews (either orientation) and tighten the screws.

f. Perform Mirror Alignment procedure to align mirror.

4.6 Fuse Replacement

The line power fuse (shown in Figure 7) is located on the instrument rear panel.

Because an open fuse normally results from defective instrument electronics, we do not recommend operator fuse replacement and suggest that the problem be checked by an authorized service representative. If, however, circumstances require immediate replacement, use the following procedure:

WARNING

Hazardous line voltage is present at the fuse holder terminals. Turn off and unplug the instrument before proceeding.

a. Remove the fuse-holder cap by pressing down and rotating 1/2 turn counterclockwise.

b. Remove the fuse from the cap and insert fuse of proper value into the cap retainer. This spectrophotometer requires a 1.5 amp 250V Slo-Blo fuse for 100-115V operation and a 0.7 amp 250V Slo-Blo fuse for 220-240V operation.

c. Insert the cap and fuse into the holder and lock by rotating 1/2 turn clockwise.

d. Connect the line cord and turn the power on. If the replacement fuse opens, refer the problem to an authorized service representative.

4.7 Glassware Maintenance

Cleaning of cuvettes both inside and out is important not only because any contamination material may absorb light, but also because material within the cell may chemically react with subsequent reagents or standards introduced into the cuvette. Cleaning methods depend to some extent on the nature of the contaminating material. Sodium (or ammonium) hydroxide or dilute hydrochloric acid may be used to remove some acidic and basic contaminants, respectively. Household bleach (undiluted or 1:1) effectively removes proteinaceous and bacterial contaminants. Soaking in chromic acid will remove most types of contaminants, but the acid should be handled and disposed of with care. Because of the exothermic reaction of the acid and water, any heat generated should be quickly dissipated to avoid alteration in the pathlength of the cuvette. Cuvettes should not be placed in hot chromic acid.

To prepare chromic acid cleaning solution, slowly add (with stirring) 800ml of concentrated sulfuric acid to 458ml of distilled water containing 92g of sodium dichromate ($Na_2 Cr_2 0_7 \bullet 2H_2 0$). This cleaning solution should be red-brown. Discard when green tinge appears.

Cuvettes with scratches in the optical path should be discarded because scratches will cause anomalous absorbance readings. Round test-tube cuvettes should be protected during cleaning and never thrown into a bath with other test tubes where they might scratch each other, or stood in a wire rack that might scratch their faces. The outside of the cuvettes may be wiped with a soft tissue and should be kept free of fingerprints, which also absorb light.

SECTION 5
ACCESSORIES AND REPLACEMENT PARTS

5.1 Accessories

The following accessories are available for use with the SPECTRONIC 70 spectrophotometer:

a. 10-in. Strip-Chart Recorder, cat. no. 39-11-20 for 100-115V operation or cat. no. 39-11-30 for 220-240V operation. Useful for making a permanent record of photometric values or for monitoring a changing value, such as time-rate enzyme reactions. Patch cord, cat. no. 33-26-74, is required to connect the strip-chart recorder to the SPECTRONIC 70 spectrophotometer.

b. DR-37 Digital Readout, cat. no. 33-30-92 for 115VAC, 60 Hz model or cat. no. 33-30-93 for 230VAC, 50 Hz. Features four-place LED display of photometric values with selectable decimal point. BCD output provided to enable interfacing with data printers, computers, etc. Patch cord, cat. no. 33-26-71, is required to connect the DR-37 Digital Readout accessory to the spectrophotometer.

c. Constant-Temperature Cuvette Holder, cat. no. 33-30-14, for multiple sample compartment.

d. Light Shield, cat. no. 33-30-22, for extra-long test tubes.

e. SPECTRONIC Standards, cat. no. 33-31-50, for checking spectrophotometer performance. Test 0%T, spectrophotometric accuracy and optical alignment.

f. Filter Adaptor, cat. no. 33-30-27, for use with SPECTRONIC Standards.

g. Multiple Sample Compartment, cat. no. 33-30-02.

h. Cuvette Holder, cat. no. 33-30-15, for multiple sample compartment.

i. Glassware:

Square cuvettes, 10mm pathlength, 45mm tall, optical glass, matched set of 2 in case; cat. no. 33-17-09.

Test tube cuvettes, selected, 10mm pathlength, optical glass, double stopper, matched set of 2 in case; cat. no. 33-17-75.

Test tube cuvettes, selected, 20mm pathlength, 88mm tall, optical glass, box of 12, cat. no. 33-17-77.

Cylindrical cells, 50mm pathlength, optical glass, double stopper, matched set of 2 in case; cat. no. 33-17-32.

Cylindrical cells, 100mm pathlength, optical glass, double stopper, matched set of 2 in case; cat. no. 33-17-32.

j. SPECTRONIC 70 Service Manual, cat. no. 333041-10020.

k. Water Technology Manual, cat. no. 331015-10030.

5.2 Replacement Parts

a. Universal Test Tube Holder, cat. no. 33-30-30.

b. Blue Phototube, range 325-625 nm, cat. no. 33-30-56.

c. Red Phototube, range 625-925 nm, cat. no. 33-30-57.

d. Tungsten Lamp. 28V, 0.93A, mounted and prefocused, pkg. of 2, cat. no. 33-33-23.

e. Chart paper for recorder, cat. no. 39-11-20 or cat. no. 39-11-30:

5 div/inch, single roll, cat. no. 39-11-42; box of 4 rolls, cat. no. 39-11-44; box of 24 rolls, cat. no. 39-11-46.

6 div/inch, single roll, cat. no. 39-11-43; box of 4 rolls, cat. no. 39-11-45; box of 24 rolls, cat. no. 39-11-47.

f. Pens for recorder, cat. no. 39-11-20 or cat. no. 39-11-30:

P-65, 2 red, 2 black, cat. no. 39-11-65.

P-68, 1 black, 1 red, 1 blue, 1 green, cat. no. 39-11-68.

P-69, 4 black, cat. no. 39-11-69.

P-70, 4 red, cat. no. 39-11-70.

P-71, 4 green, cat. no. 39-11-71.

P-72, 4 blue, cat. no. 39-11-72.

g. SPECTRONIC 70 Operator's Manual, cat. no. 333041-10001.