QUV Accelerated Weathering Tester

Revised: 4/93

with Solar Eye Irradiance Control

Model: QUV/SE

Operating Manual

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1.0 Safety Information

Electrical Shock Hazard

The QUV/SE is equipped with interlock switches that cuts off the power to the UV lamps anytime you open either of the trapezoidal End Cover (Figure 1A).

The QUV/SE uses high voltage to operate its fluorescent UV lamps. When the QUV/SE is in the UV Cycle, the rubber lamp sockets are energized with high voltage energy. If a lamp is plugged into a lamp socket on one side, but the socket is disattached on the other side, the exposed lamp pins may be energized with high voltage. This voltage can be extremely dangerous.

Unless you are a qualified electrician, do not bypass the electrical interlock switch. If you do bypass the interlock switch, please follow the following safety precautions:

- Turn off the main power before working on the lamp electrical system.
- Do not touch the lamp pins when the tester is in the UV cycle
- Do not put anything into the lamp socket the tester is in the UV cycle. These sockets may be energized with high voltage.

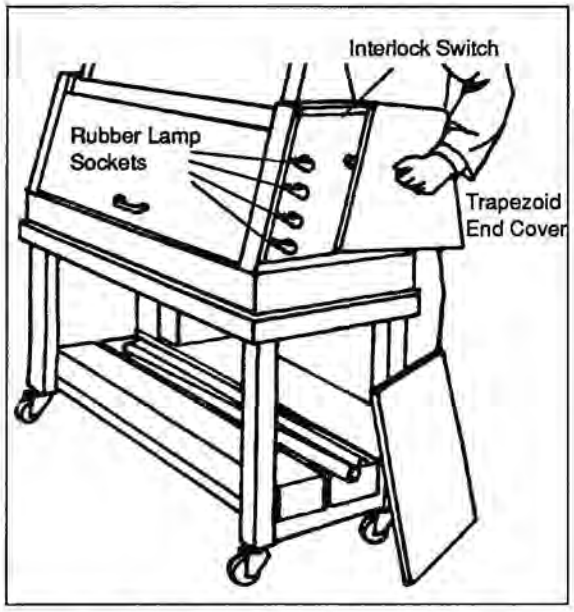


Figure 1A. The QUV/SE is equipped with interlock switches that cut off the power to the UV lamps anytime you open either trapezoidal End Cover.

Ultraviolet Hazards

- The QUV's lamps may cause severe sunburn or eye inflammation.
- Shut off lamps before opening machine and removing test panels.
- Never look at lighted UV-B lamps without UV absorbing goggles.
- Don't be fooled by the lamps' cool blue appear ance or by the lack of heat and visible light. Th QUV's lamps are efficient generators of UV light similar to that in sunlight. These lamps requir safety precautions similar to the precautions for the sunlamps used for sun-tanning and medical therapy. Exposure of a few minutes to unshielded lamps may cause painful sunburn or eye inflammation. This eye inflammation is much like a severe sunburn on the surface of your eyeball, and is familiar to skiers as "snow blindness." As with sunlight, extensive or repeated exposures may lead to premature aging of the skin or per manent skin damage.
- Sunburn and eye inflammation are delayed reactions. Symptoms (pain, redness, hot sensation) don't appear until 4 to 12 hours after UV exposure.
- After severe sunburn and eye inflammation, skin and eyes may be more sensitive to future UV exposures, including sunlight.
- There is no UV hazard from the QUV in normal operation with doors closed. With doors closed, UV leakage from the QUV is less than 1/20 the intensity of the UV from sunlight transmitted through a closed window. With doors open but with test panels in place, UV leakage is still less than sunlight through a window. Note: the QUV does not produce any appreciable infrared radiation.
- Burning effects of UV-B lamps depend on duration of exposure, distance from lamps, and percentage of lamp surface that is visible. Figures 1 through 3 show time of permissible daily exposure to light from the QUV under various conditions. These times are based on Threshold Limit Values (TLV) for UV exposure published by the American Conference of Governmental Industrial Hygienist. The Threshold Limit Values represent conditions under which it is believed that nearly all workers may be repeatedly exposed without ad-

verse effect. These TLV's should not be used for determining exposure of photosensitive individuals to UV. The TLV's should be used as guides in control of UV exposure, and should not be regarded as a fine line between safe and dangerous levels. Not that 12 successive exposures of 5 seconds during a day is the equivalent of a single exposure of 1 minute.

- If exposure to UV-B lamps is necessary, wear UV absorbing goggles. Protect skin with opaque clothing or a quality sunscreen lotion (e.g. 5 percent PABA), not a "suntan" lotion.

- Individuals with light complexion are more susceptible to UV, and some individuals are allergic to UV. Many common medications increase your sensitivity to UV (including sunlight).

- Do not use the UV lamps for any purpose except QUV testing. When discarding the lamps, disable them to prevent unauthorized use. To disable, remove two of the end-pins with a wire cutter or pliers (do not break lamps). UV lamps are not usefulfor plant growth or similar purposes.

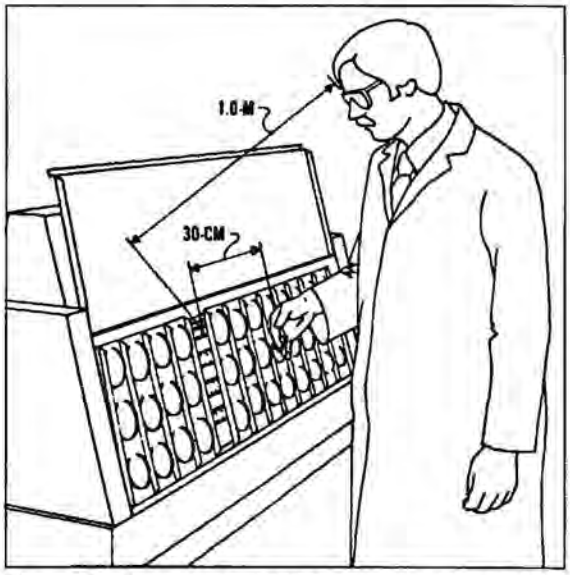


Figure 2. One sample holder removed. Hand 30 cm from lights: allowable daily UV-B lamp exposure 6 minutes. Face 1 m from lights: allowable daily

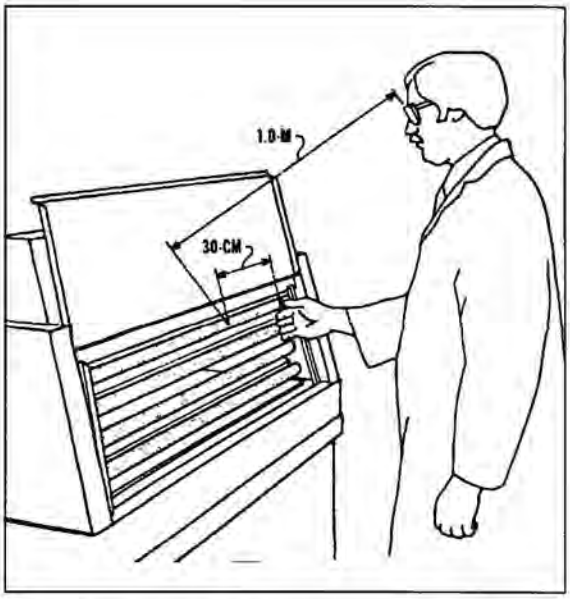


Figure 3. All sample holders removed. Hand 30 cm from lights: allowable daily UV-B lamp exposure 2 minutes.

Figure 1B. One sample holder removed. Hand 50 mm from lights (same as sample): allowable daily exposure is 1 minute for UV-B lamp.

2.0 General Description

The Q-U-V Accelerated Weathering Tester is a laboratory simulation of the damaging effects of weathering.It is used to predict the relative durability of materials exposed to the outdoor environment. Rain and dew are simulated by a revolutionary condensation system. The damaging effects of sunlight are simulated by fluorescent UV lamps. Exposure temperature is automatically controlled, as is the daily sequence of UV periods and condensation periods. In a few days or weeks, the Q-U-V can produce damage that might occur over months or years of outdoor exposure. Deterioration observed includes fading, chalking, cracking, crazing, hazing, blistering, gloss loss, strength loss, and embrittlement.

3.0 Warranty Information

One Year Limited Warranty

This product is guaranteed against defects in workmanship or materials for one year.

Liability is limited to replacing or repairing any part or parts which are defective in materials or workmanship and are returned to our factory, shipping costs prepaid.

Liability in all events is limited to the purchase price paid. Damage due to accident or abuse is not covered. Labor cost is not covered.

The Q-Panel Company makes no other warranties, including implied warranties of merchantability or fitness for a particular purpose, except as may be expressly provided by The Q-Panel Company in writing. The Q-Panel Company shall not be liable for any incidental, consequential, special, or contingent damages arising out of the sale or use of any product.

4.0 Specifications

Functions

UV Exposure

Choice of lamps for various applications. Exposure temperatures of 50° to 80°C (122° to 176°F).

Condensation Exposure

Direct condensation of distilled water on the test sample at temperatures of 40° to 60°C (104° to 140°F).

Utilities

Water Requirements

Uses either tap or deionized water. Consumption is approximately eight liters per day. Automatic water feed is standard, including 1/4 inch tubing and saddle valve for simple hook-up. No drain is necessary.

Electrical

Maximum power consumption 1700 watts. Average power consumption 700 watts. Available in 120V, 60 Hz, or 230V, 50 Hz. Plugs in anywhere.

Physical Dimensions

Size: 54" x 21" x 53" high (137 x 53 x 135 cm); Weight: 300 pounds (136 kg)

Construction

Chassis and cabinet are all stainless steel and aluminum. Nothing to rust.

Test Capacity

48 test samples 3" x 6" (75 x 150 mm). Thickness up to 3/4" (20 mm). Panels are spring mounted on removable holders.

Lamp Usage

Dependent on irradiance level.

Recognition

When operated at the proper irradiance level, the Q-U-V with Solar Eye Irradiance Control conforms to ASTM G-53, D-4329, D-4587, D-4799, SAE J2020, ISO 4892 and numerous International Test Methods and Material Specification Requirements.

5.0 Control Functions

5.1 Main Panel Controls

1. **Total Time**
   Hours that the unit has been in operation
2. **Test Time**
   Re-settable timer shows time (in hours) into test.
3. **Ultraviolet Cycle Indicator Light**
   Shows that the Q-U-V is operating in the UV cycle.
4. **UV Cycle Thermostat.**
   Used to adjust the panel temperature during the UV cycle.
5. **Heater On Indicator Light.**
   Shows that the UV thermostat (No. 4 above) is calling for heat.
6. **Cycle Timer.**
   Used to program timing of UV and Condensation cycles.
7. **Condensation Cycle Indicator Light.**
   Shows that the Q-U-V is operating in the Condensation Cycle.
8. **Condensation Cycle Thermostat.**
   Used to adjust the panel temperature during the Condensation Cycle.
9. **Heater On Indicator Light.**
   Shows that the Condensation thermostat (No. 8 above) is calling for heat.
10. **Main Power Switch**
11. **Black Panel Temperature**
12. **Circuit Breaker (re-settable)**
13. **Blower On Indicator Light.**
14. **Condensation Cooling Timer**
    (Not Shown. Mounted inside control panel.).

5.2 Solar Eye Controller

15. **Actual Irradiance Display.**
    Irradiance measured by sensor number 1, upper front lamps
16. **Actual Irradiance Display**
    Irradiance measured by sensor number 2, lower front lamps
17. **Actual Irradiance Display**
    Irradiance measured by sensor number 3, upper rear lamps
18. **Actual Irradiance Display.**
    Irradiance measured by sensor number 4, lower rear lamps
19. **Set Point Display.**
20. **Set Point Adjustment.**
21. **Calibration Indicator Light.**
    Illuminates when it is time to calibrate the Solar Eye system.
22. **Plug for Calibration Connection Cable.**

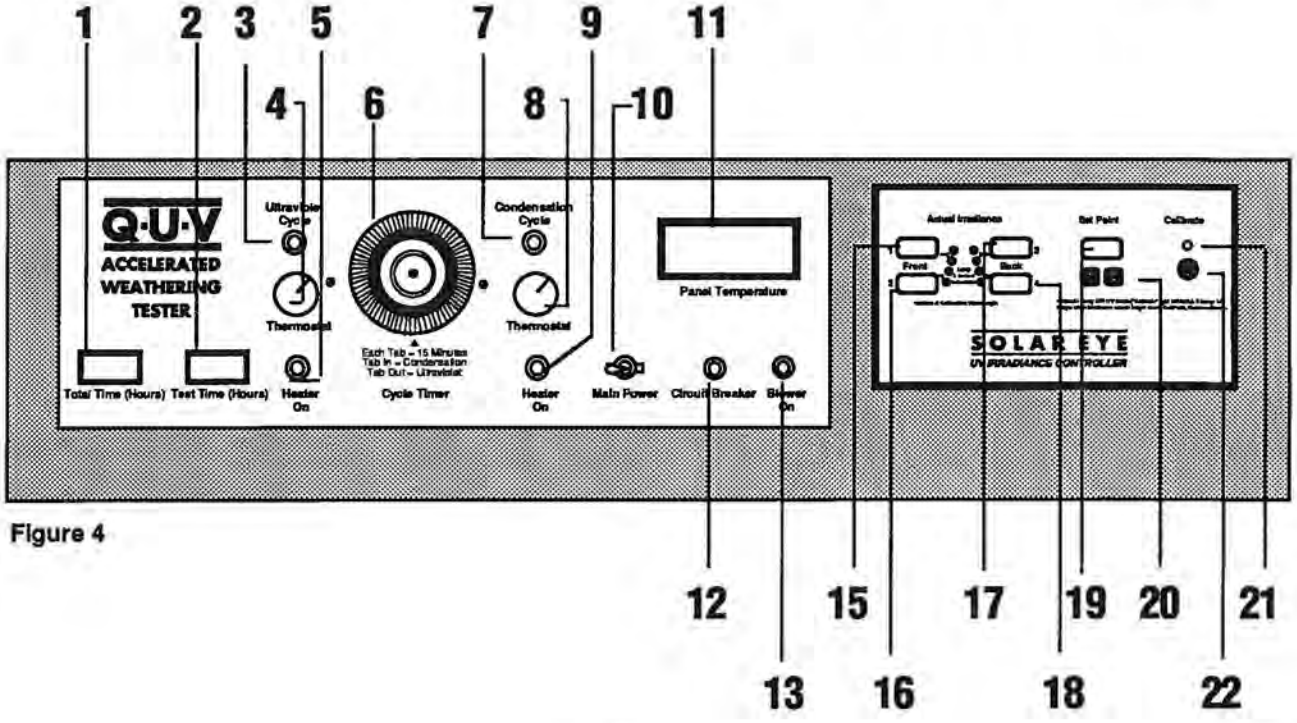


Figure 4

6.0 Setting Up Your Q-U-V

Uncrating

Cut the metal straps which hold fiberboard carton to skid. Lift off the fiberboard carton. Cut metal straps connecting unit to skid. Lift the unit off the skid and move into place. Remove adhesive tape from various parts on inside and outside of unit.

Locate the Q-U-V away from strong drafts which might adversely affect temperature uniformity. For best temperature stability it is helpful (but not essential) to locate the Q-U-V in an air-conditioned room.

Caster Installation

To install casters, prop up one end of the Q-U-V on a box and push the casters into the sockets in the legs.

6.1

Figure 5

Floor Plan — Multiple Q-U-V Installations

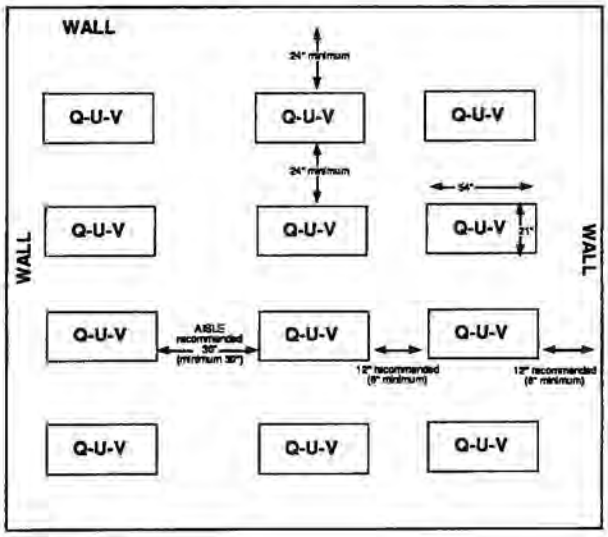


Figure 6

Multiple Q-U-V Installations

Floor Space Recommendations

When you get several Q-U-V Weathering Testers in the same room, it's very helpful to maintain proper spacing between testers, and between testers and the wall. If the Q-U-V's are jammed together too tightly, it becomes difficult to open the doors, remove samples, and perform maintenance. Figure 6 shows the spacing that we recommend from our experience.

Electrical Connections

The maximum instantaneous electrical load from a Q-U-V is 1700W at 120V. If your electrical circuits are 20A, each Q-U-V should have its own circuit. Each Q-U-V has a built-in 20A circuit breaker, so if you connect several Q-U-V's to a high capacity circuit, each Q-U-V will still have adequate over current protection.

Water Connections

Each Q-U-V uses only about 8 liters of tap water per day. The automatic water feed is connected to the tap line by a standard 1/4 inch (6 mm) flexible tube. We recommend connecting the 1/4 inch (6 mm) tubes to a water line above the hung ceiling and running the tube to the Q-U-V through a small hole in the ceiling tiles.

Ventilation

The 1984 revision of ASTM G-53 calls for a room temperature kept below 86°F. We recommend keeping the room temperature between 70° and 80°F. Each Q-U-V generates an average of 700 watts of heat on a continuous basis. That's equivalent to 2400 BTU/hr. Each Q-U-V also evaporates about 8 liters of water per day. These loads should be taken into account when designing air conditioning and ventilation.

Organizational Considerations

Over the past 15 years, we've observed that the best-run multiple Q-U-V installations are invariably the ones where a single individual has responsibility for operation and maintenance of all the Q-U-V's. This ensures that the sensors will be calibrated on the proper schedule and that the testers will be checked regularly for proper operation.

6.2 Room Temperature

The Q-U-V operates best in a room where temperature remains between 70°F and 80°F. Room temperatures outside of this range can cause poor control of test temperature. High room temperature can also prevent proper condensation by reducing sample cooling. The optimal place for a Q-U-V is in an air-conditioned lab or office. The Q-U-V will not strain ordinary air-conditioning because it produces only about as much heat as 2 people in a room. The Q-U-V should be located away from strong drafts which can cause one end of the machine to be cooler than the other.

6.3 Electrical

Be sure to supply your Q-U-V with voltage within ± 10 percent of its voltage rating.

Electrical voltage and frequency for the Q-U-V is marked on a plate on the machine. Since the maximum current requirement is 15 amps at 120V (7.5 amps for 230V machines), a 20 amp connection is adequate. Do not use an extension cord. A 3-prong grounding plug is provided and must be connected for safe operation. A 20 amp circuit breaker is located on the control panel. Power cord color code:

Black = power;
white = neutral;
green = safety ground

6.4 The Water System

During the condensation cycle, the water is heated by a heating element located under the water pan. Water vapor fills the test chamber, which reaches 100 percent humidity at equilibrium. Vapor continually condenses on the test panels, which are kept at a lower temperature by room air on their back surface. Condensation runs off the test panels and back into the water pan.

The condensation on the test panels has a high degree of chemical purity because the water becomes distilled as it vaporizes from the pan. A vent slot around the top of the water pan assures that the condensing vapor is saturated with oxygen. Some vapor will escape through this vent and some will be lost from around the panels.

Water Level

The water pan should always contain 10-25 mm of water during operation of the unit. A drain hose is located on the underside of the unit. When draining the unit, it's a good idea to clamp shut the tube between the water feed and the machine

Cathodic Protection

If the water pans glass lining should chip, a magnesium anode provides cathodic protection to the pan's

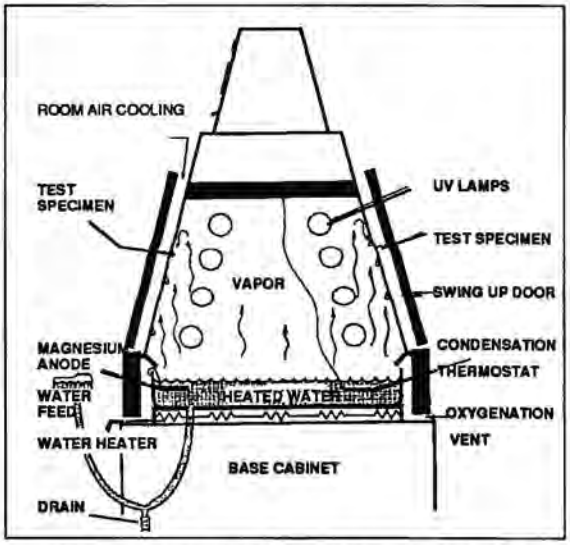


Figure 7. Simplified Cross Section of Q-U-V during Condensation Cycle

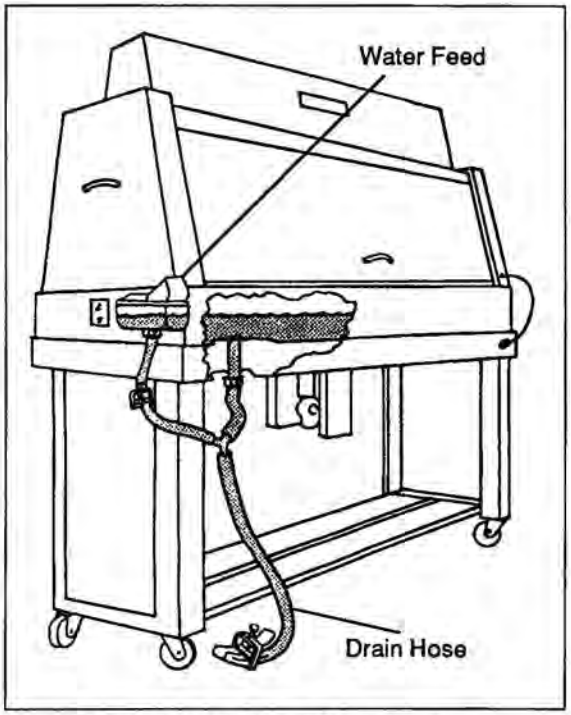


Figure 8. Water Level Control System

iron substrate. The anode is immersed in the water and electrically connected to the pan by a wire. If the glass lining chips, exposing the iron substrate, a galvanic cell will form with magnesium as the anode, iron as the cathode, and water the electrolyte. This cell is in effect an iron/magnesium battery generating an E.M.F. of about 1 volt. The voltage causes sacrificial corrosion of the magnesium and cathodic protection of the iron. Under these conditions, the iron cannot rust. The magnesium anode should be replaced whenever it corrodes completely away.

Water Cleaning

Dirty water in the pan does not affect the test, because only pure vapor condenses on the test samples. However, the water should be cleaned whenever enough scum forms on the water's surface to prevent evaporation, or when solids accumulate 1/8 inch (3mm) in the bottom. To clean the pan, first slide out the water pan cover Most labs drain the pan, although some simple remove the scum with a wet/dry vacuum cleaner. It's not necessary to remove all the scale from the bottom of the pan, since a thin layer doesn't hurt and may even act as an extra protective coating.

Water Connection

A water supply should be connected to the Water Feed unit on the right rear of the unit. Distilled water is not required, since the water that contacts the panels is distilled when it vaporizes from the water pan. However, a distilled or deionized water source can reduce periodic clean-out of solids which collect in the bottom of the water pan. Water consumption is roughly 8 liters per day.

Do NOT pretreat the water with a "water softener", as this merely exchanges sodium ions for the ions previously in your water supply. A "water softener" can increase the corrosivity of the water.

To connect water supply, drill 1/4 inch (6 mm) hole in water pipe. It is not necessary to drill plastic or copper supply lines because the valve is self-piercing. Install saddle valve as shown. Connect saddle valve to water feed valve with 1/4 inch (6 mm) tubing.

Be sure the Q-U-V is reasonably level, so that water covers the entire bottom of the water pan.

If your water supply has an exceptionally high content of suspended solid particles, such as rust, the 1.3 mm orifice in the water feed valve may clog. If you experience clogging problems, install a small filter before the water feed.

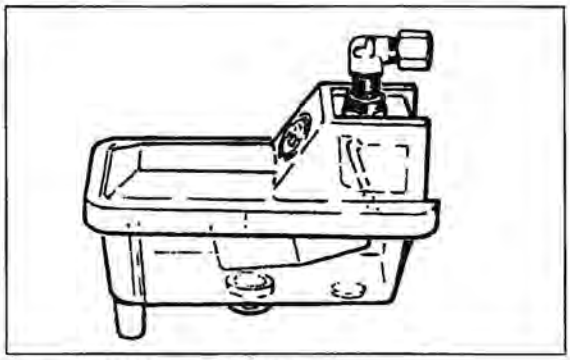


Figure 10. Water Feed Unit

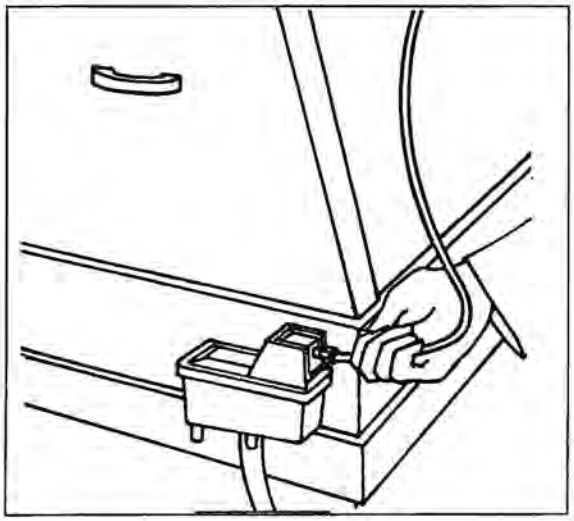


Figure 9. Water supply is added to the Water Feed Unit

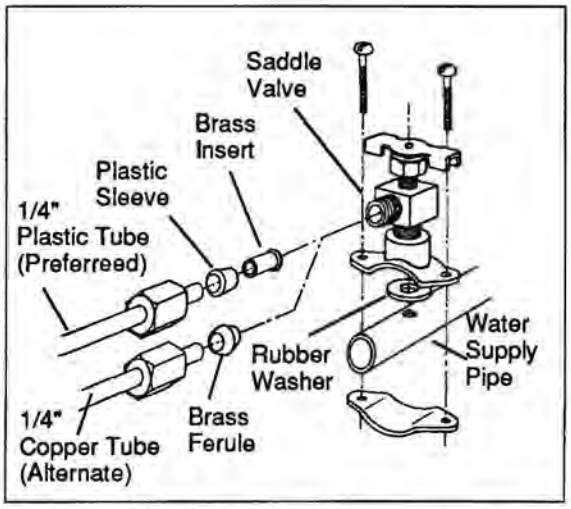


Figure 11. Q-U-V Water Supply Connection for Water Feed. (Plastic tubing is supplied with the Q-U-V but copper tubing may also be used.)

7.1 UV Lamps and Solar Eye Irradiance Control System

Solar Eye Operation

How the Solar Eye Irradiance Control Works

The Solar Eye is a precision light control system. You choose the exact level of irradiance (the rate at which light energy falls on a unit area of surface). The Solar Eye maintains the correct irradiance automatically. The controller monitors the UV intensity via four sensors at the sample plane. A four channel feedback loop system compensates for any variability by adjusting the power to the lamps.

Programmable Light Intensity

Figure 12 shows a close up of the Solar Eye Irradiance Controller. You can operate the Solar Eye at various levels for different applications. A push-button irradiance setting allows you to fix the exact irradiance level. Simply use the up and down arrows to adjust the irradiance Set Point. The controller increases or decreases the power to the lamps to maintain your chosen set point. In a few seconds, the actual irradiance displays will show the same irradiance as the set point. It is good practice to calibrate the Solar Eye system whenever you change the irradiance set point.

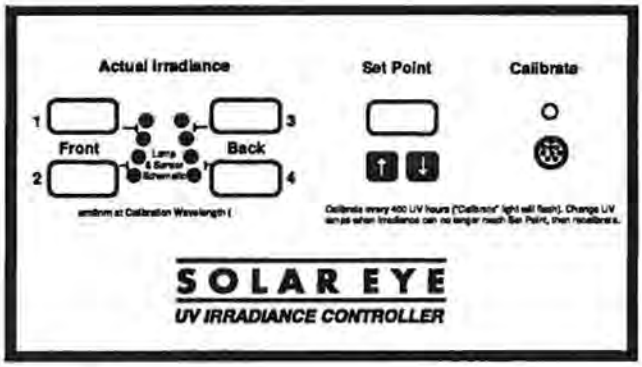


Figure 12

For very high irradiance exposures, the irradiance Set Point can be set at a near maximum level. This level will differ, depending upon which lamp type you are using. Do not set the irradiance at the *absolute* maximum because the controller needs a few % leeway to compensate for differences in output from lot to lot

Why Irradiance Control?

In addition to speed, one advantage that laboratory weathering testers have over actual outdoor exposures is reproducibility of results. To achieve this reproducibility, testers must have control of the critical parameters of light, moisture, and temperature. Control of irradiance in a laboratory tester is particularly important because:

- Changes in light intensity (i.e. brightness) may affect the speed of a material's deterioration.
- Changes in light wavelength, or Spectral Power Distribution (SPD), may affect both the speed and the type of material degradation.

Q-U-V's that do not have the Solar Eye controller use a lamp replacement and rotation system to compensate for lamp aging. This system works well for many applications, but it has an inherent limitation. The replacement/rotation system cannot compensate for lot-to-lot differences in lamps or for differences in ambient temperature. Also, there is always some small drop in irradiance between rotations (for a detailed discussion see Q-Panel Bulletin L-8010, Controlled Irradiance in Laboratory Weathering).

Today's increasingly stringent test requirements call for better control of critical parameters and maximum reproducibility of test results. The Solar Eye meets those requirements.

variability and ambient temperature. See "Recommended Irradiance Set Point Guide" —Section 7 for further discussion.

For example, with the UVA-340, you could set the Solar Eye to simulate any of the following sunlight conditions:

- So called "Average Optimum" (equivalent to March/September sunlight) for "average" or low UV exposures (**Figure 13**).
- Solar Maximum (equivalent to noon summer sunlight) for quick results without sacrificing correlation (**Figure 13**).
- Maximum UV (75% higher than a Q-U-V without Solar Eye) for fast results (**Figure 13**).

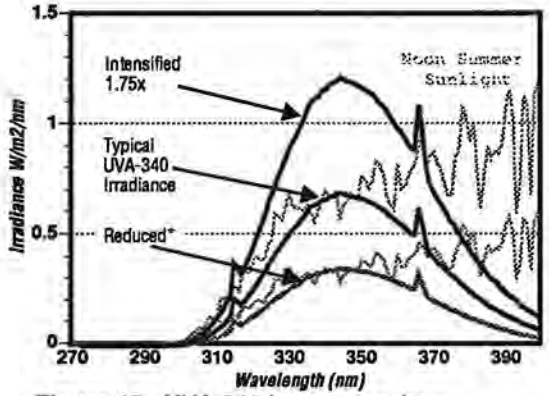


Figure 13 . UVA-340 lamps at various irradiance levels

Using UVB-313 lamps, you can operate at Maximum UV for extremely fast tests, for Quality Control applications or for testing very durable materials. You can also set the irradiance level to be equivalent to the QFS-40 lamp and reap the benefits of greatly enhanced lamp life (**Figure 14**).

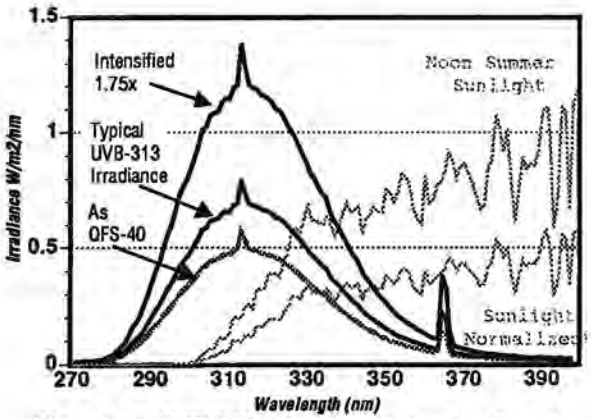


Figure 14. UVB-313 lamps at various irradiance levels

Irradiance Displays

The Solar Eye controller shows the actual Q-U-V irradiance at a glance. Whenever the tester is in the UV cycle, digital displays show both the irradiance Set Point and the Actual Irradiance measured by each of the four sensors.

The Solar Eye controller has a built-in clock and, after 400 hours of lamp operation, the "Calibrate" light on the controller will light up (**Figure 15**). When this occurs, it is time to calibrate the system. (The "Calibrate" light will also light up for five seconds every time the Q-U-V switches into the UV cycle. This indicates that the system is energized and the timer is operating properly.)

Figure 15. Calibrate light c omes on when it is time to calibrate the system.

Low Irradiance Alarms

The Solar Eye controller has a built-in alarm system. If the irradiance measured by any of the sensors drops more than 5% below the Set Point for more than 10 minutes, the "Actual Irradiance" digital display will begin to flash. Re-calibrate the controller. If the lamps still cannot reach the Set Point, replace the two lamps that the flashing sensor controls.

If the irradiance drops 30% (e.g., if a lamp fails to light) an audible alarm will also sound after 10 minutes. Shut off the Q-U-V and determine the cause of the alarm. If necessary to locate the source of the problem, you can turn the Q-U-V back on. The alarm will not begin to sound again until another 10 minutes has passed.

Irradiance Sensors

There are four UV sensors (Figure 16) built into special black panels in the center of the sample exposure area. There are two sensors in the front and two in the back of the Q-U-V. Each sensor monitors the irradiance of two lamps. The Solar Eye controller adjusts the power to each two lamp ballast to maintain the programmed irradiance set point. Each sensor must be calibrated separately. Sensor lenses should be periodically cleaned with a clean, soft cloth.

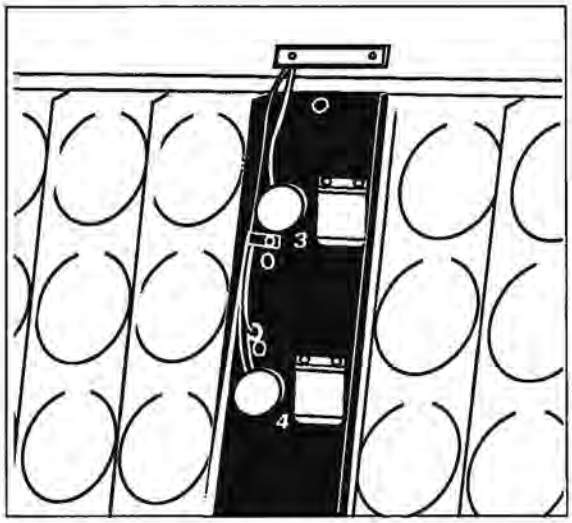


Figure 16. UV sensors are located in sample mounting areas.

UV Baffle

A special system of UV baffles (patent pending) creates exceptionally uniform irradiance from the top to the bottom of the sample plane. In competitive testers lacking these baffles, the UV intensity is significantly lower at the extreme top and bottom of the sample mounting area than it is near the middle. One reason for this is that samples in the center of the sample plane receive UV from several lamps at once, while samples at the top and bottom are effected by only one lamp. A second reason is that some UV light from the lamps in each bank travels across the chamber and adds to the UV striking the samples on the other side. Most of this crossover UV hits in the center of the sample exposure area. The UV baffles selectively block and reflect UV crossing over from side to side, thus correcting the top-to-bottom irradiance profile. The baffles consist of aluminum strips running parallel to the lamps. One type of UV baffle is located between the center lamps in each bank. A second baffle is near the top of the test chamber, midway between the front and back of the chamber (See Figure 17).

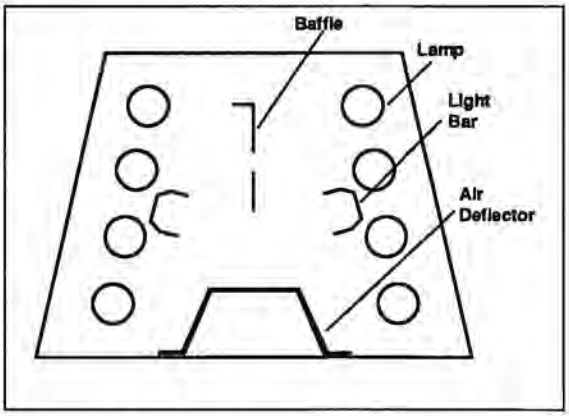


Figure 17. A special system of UV Baffles gives uniform irradiance.

7.2 CR-10 Calibration Radiometer

The CR-10 Calibration Radiometer was specially developed for the Solar Eye Irradiance Control system. It allows you to calibrate the system quickly and easily. Although it is a necessary accessory to the system, you can use a single radiometer to calibrate any number of Q-U-V's.

The CR10 Radiometer consists of

1. Radiometer sensor
2. Calibration connection cable
3. Radiometer
4. Radiometer carrying case
5. An optional 9V wall plug converter allows you to measure standard Q-U-V's in your lab (For U.S. customers, this is available from The Q-Panel Company as Part Number IC-1440. It may also be purchased from most local electrical parts suppliers).

The radiometer is designed to calibrate the Solar Eye sensors. It has been set at the factory to measure fluorescent UV lamps. It can be used for either UV-A or UV-B lamps. It should not be used to measure sunlight, xenon arc lamps or other visible light lamps.

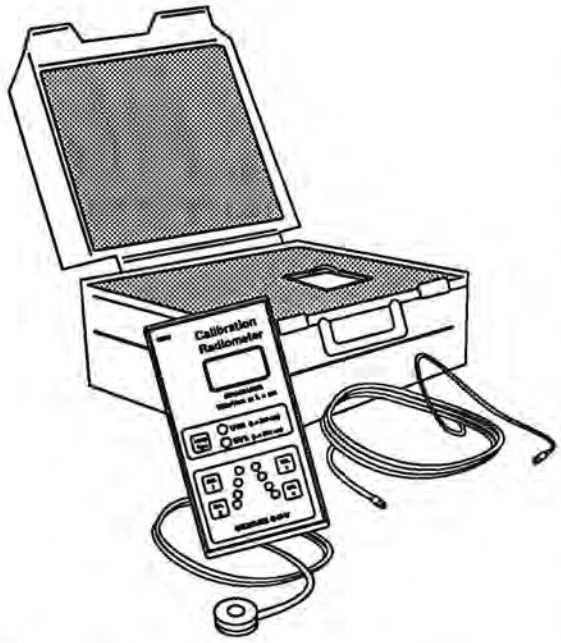


Figure 18. CR-10 Radiometer with Case

The radiometer sensor assembly, as well as the Solar Eye sensors, are designed to filter out the blue wavelengths which the Q-U-V lamps emit and to detect only the invisible UV wavelengths. The sensors do not filter out the red wavelengths. Q-Panel fluorescent UV lamps emit no red wavelengths, so this is not a problem. The CR10 radiometer will not give accurate measurements of light sources which do emit red wavelengths, such as sunlight, xenon arcs and cool-white fluorescent lamps. If used to measure these other sources, the number displayed by the radiometer will be much higher than what the UV intensity actually is.

Care of your CR10 Radiometer

Your radiometer has been calibrated in $W/m^2/nm$ at 310 nm for UV-B lamps and 340 nm for UV-A lamps. The radiometer itself must be returned to Q-Panel periodically for re-calibration. This is to adjust for any changes which may occur over time. We recommend that it be re-calibrated be every six months.

The CR10 radiometer is a precision instrument. Store it in its carrying case, in a safe place, away from extremes of heat, cold or high humidity. The sensor "window" must be kept clean for accurate results. We suggest periodically cleaning it with alcohol and a clean soft cloth. If you drop the radiometer or the sensors, you may have to send it back to Q-Panel for re-calibration.

7.3
AutoCal (Patent Pending)

With the AutoCal feature, you can calibrate your Solar Eye system in seconds. The "Calibrate" light even tells you when it's time to calibrate. The controller's built-in clock will cause this light to come on after 400 hours of lamp operation. When this occurs, it is time to calibrate the system.

The Solar Eye controller greatly increases usable lamp life because you operate the lamps until they can no longer reach the set-point. When any of the "Actual Irradiance" displays on the controller begins to flash, the lamps corresponding to that display are operating at at least 5% below the Set Point. Calibrate the controller. If the lamps still cannot reach the Set Point, replace the two lamps that the sensor controls and re-calibrate the system,

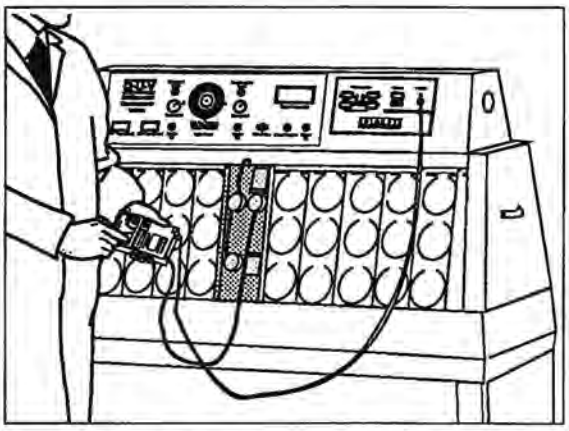


Figure 19. AutoCal lets you calibrate your Solar Eye system in seconds.

Radiometer Controls

1. **Actual Irradiance Display.**
2. **Lamp Type Selector.**
3. **CAL 1. Push to calibrate sensor number 1.**
4. **CAL 2. Push to calibrate sensor number 2.**
5. **CAL 3. Push to calibrate sensor number 3.**
6. **CAL 4. Push to calibrate sensor number 4.**

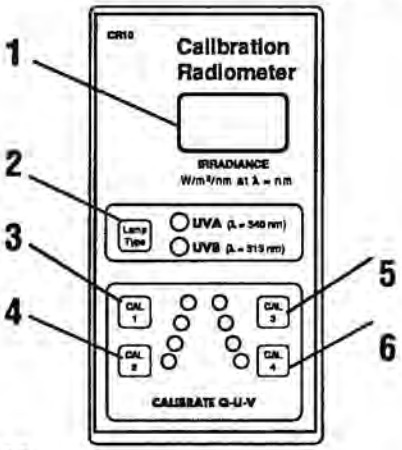


Figure 20

Calibration Procedure

For the most accurate results, calibrate the system when the Q-U-V is in the UV Cycle and at normal operating temperature. For example, if the Q-U-V is operating at 70°C UV temperature, calibrate the system when the Q-U-V is at 70°C The Solar Eye sensors have a temperature coefficient and therefore, if they are calibrated at a temperature different from the operating temperature, they will not be accurately calibrated when the operating temperature is reached.

1. Locate the four built-in Solar Eye sensors in the Q-U-V's sample mounting area. Two sensors are mounted on the front of the Q-U-V and two are mounted on the back. You will find them on the black aluminum panels. Wipe each sensor clean with a soft cloth.

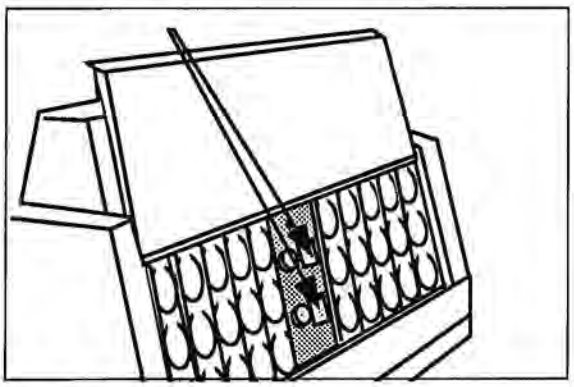


Fig. 21

2. Plug the Calibration Connection Cable into the radiometer and into the Solar Eye controller on the Q-U-V control panel. The radiometer gets its power from the Q-U-V via the Solar Eye controller.

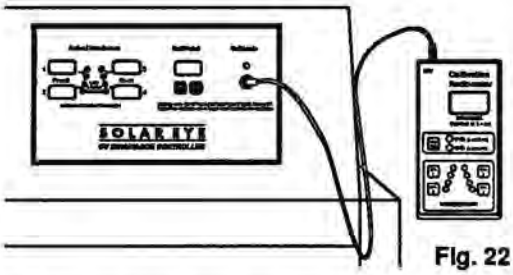


Fig. 22

3. Select the lamp type (i.e., UV-A or UV-B) by pushing the "Lamp Type" button on the radiometer. Be sure that the lamp type you have chosen is the same as the type of lamps used in the Q-U-V. The radiometer will read "0.00" until a lamp type is chosen.

Fig. 23

4. Place the radiometer sensor into Calibration Port number 1 on the black panel next to the Solar Eye Sensor Number One). The display on the radiometer will show the actual irradiance at the sample plane.

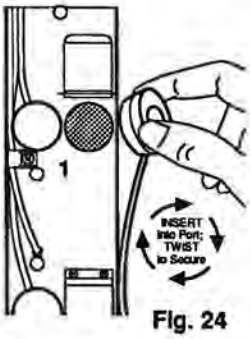


Fig. 24

5. Push the "Cal 1" button. This sends a signal to the Solar Eye Irradiance Controller telling it the actual irradiance. The controller automatically updates the calibration for that sensor.

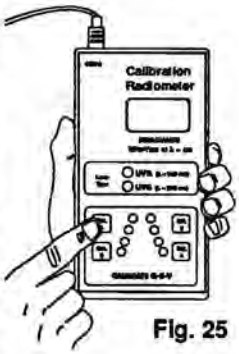


Fig. 25

6. Place the radiometer sensor into Calibration Port number 2. Push the "Cal 2" button. Repeat this process for each of the sensors.

Calibration is so easy that there is little chance for operator error. The Solar Eye's built-in computer takes care of everything. Calibration takes only seconds and it doesn't interrupt your test.

Don't forget to return your CR10 Radiometer to The Q-Panel Company *every six months* for re-calibration.

Door Interlock Override

On QUV's equipped with door interlocks, the lamps would normally turn off when the door is opened to calibrate the UV sensors, making calibration impossible. However, when the Calibration Cord is plugged into the Solar Eye Controller, a special Override Circuit allows the lamps to remain on even if the door is open. When the Controller senses that the Calibration Cord is in place, it actuates the Interlock Override Relay, which allows electrical power to bypass the door interlocks and operate the lamps.

7.4 Recommended Irradiance Set Point Guide

The following is intended as a guide. If you are operating to a particular test method or material specification, be sure to consult the appropriate document for exact requirements.

If you have any questions on this, or any other part of this manual, please call The Q-Panel Company at 216/835-8700.

Matching the Irradiance of a Standard QUV

The QUV with Solar Eye Irradiance Control compensates for differences in exposure temperature. The irradiance stays at the set point regardless of the room temperature or the QUV chamber temperature. Fluorescent lamps normally operate most efficiently at temperatures of about 40°C The UV exposure temperature has an effect on the lamp output. The higher the test temperature, the lower the lamp output. In other words, QUV's without Solar Eye Controllers give a different irradiance at each different exposure temperature. This normally causes no problem because the increase in material degradation due to higher temperature usually more than compensates for the reduced degradation due to lower UV light output.

If you want your Solar Eye irradiance to match that of a QUV without the Solar Eye, you must set a different irradiance level for each UV exposure temperature. The table below gives our recommended settings.

Temp.	UVA 340	UVB 313	QFS 40	UVA 351
45°C	0.85	0.69	0.53	0.85
50°C	0.83	0.67	0.51	0.83
55°C	0.80	0.65	0.49	0.80
60°C	0.77	0.63	0.47	0.77
65°C	0.75	0.61	0.46	0.75
70°C	0.72	0.59	0.44	0.72
75°C	0.70	0.57	0.43	0.70
80°C	.0.67	0.55	0.41	0.67

Maximum UV Tests

Some laboratories want to run their QUV testers at a high irradiance for the fastest results possible. For very high irradiance exposures, the irradiance Set Point can be set at a near maximum level. This level will differ, depending upon which lamp type you are using. Do not set the irradiance at the absolute maximum because the controller needs a few % leeway to compensate for differences in output from lot to lot variability and ambient temperature. Following is our recommended maximum irradiance set point by lamp type.

You will probably find that you can achieve much higher irradiance values than those shown below, especially with new lamps. It will not damage the QUV if it is run at these higher levels. However, it should be understood that, due to lot-to-lot variability in lamp manufacture, we cannot guarantee that future lots of lamps will operate at an irradiance above the levels shown below.

LAMP TYPE:	UVA 340	UVB 313	QFS 40	UVA 351
Maximum Recommended UV Set Point	1.35	1.10	0.77	1.35

Although we do not recommend Maximum UV tests for those trying to achieve the best correlation with actual outdoor weathering results, this approach is perfectly valid for Quality Control applications and for testing very durable materials. Remember, test results from Maximum UV exposures may not correlate well with outdoor tests or even with normal QUV tests. Using higher irradiance may significantly reduce lamp life expectancy.

7.5
Lamp Life Expectancy

The Solar Eye can greatly extend your usable lamp life. With the standard QUV, each lamp is operated for 1600 hours and then discarded. The Solar Eye controller greatly increases usable lamp life because you operate the lamps until they can no longer reach the set-point. Typical lamp life is extended 3 times or more over that of a standard QUV. Actual lamp life will vary by the lamp type and the level of operating irradiance. Higher irradiance levels will significantly reduce life expectancy.

Lamp Replacement

When any of your lamps fall 5% below the set-point, the corresponding Solar Eye display will begin to flash. Calibrate the Solar Eye system. If they still cannot reach the set-point, it is time to replace them. It is not necessary to replace all of the lamps in your QUV. Replace only the two lamps that are controlled by the particular sensor that corresponds to the flashing display on the Solar Eye Controller. **Always shut off the main power before replacing lamps. It is important that you replace both of these lamps at the same time to insure uniform irradiance.** If you replace only one lamp, there will be a significant discrepancy in the top-to-bottom irradiance uniformity.

Lamp Cooling

Fluorescent lamps are mercury vapor lamps. The coolest spot on the bulb wall controls the mercury vapor pressure. Because fluorescent lamps work most efficiently at about 40°C, the QUV has fans at each end of the control housing to cool the ends of the lamps. These lamp cooling fans pull room air over the ends of the lamps (air from these fans does not enter the test chamber). The lamp cooling fans operate during the entire UV cycle to help the lamps operate more efficiently. The end covers (i.e., the two trapezoid shaped metal covers that go on each end of the QUV and conceal the ends of the lamps) must be in place to properly direct the air over the ends of the lamps. To check the fan's operation, listen for a faint hum at either end of the control housing.

7.6
Choice of Lamps for the QUV

Four types of fluorescent UV lamps are now available for the QUV: two types of UV-B lamps and two UV-A lamps The particular application determines which lamp should be used. All of these lamps produce mainly ultraviolet rather than visible or infrared light, and all are electrically the same as an ordinary 40 watt fluorescent. The lamps differ in the total amount of UV energy emitted and in the wavelength spectrum. Differences in lamp energy output or wavelength spectrum can cause significant differences in test results.

Wavelength Regions of the UV Spectrum

The UV spectrum is divided into three regions:

UV-A Region, 315 to 400 nanometers
UV-B Region, 280 to 315 nanometers
UV-C Region, below 280 nanometers

Fluorescent UV lamps are usually categorized as UV-A or UV-B lamps, depending on the region into which most of their output falls.

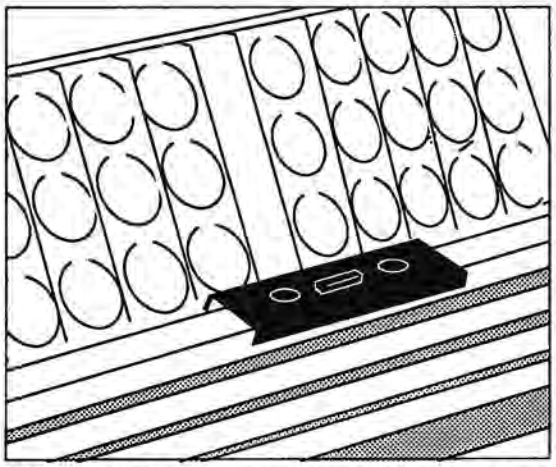


Figure 26. The sensor panel must be removed and may be hung to the side to allow for lamp replacement.

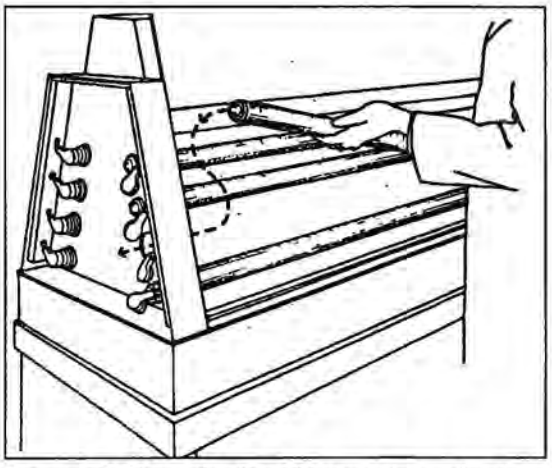


Figure 27. Replacing the UV lamps is as simple as changing ordinary fluorescent tubes. Always shut off the main power before changing lamps.

UV-B Lamps

The UV-B region includes the shortest wavelengths found in sunlight at the earth's surface and is responsible for most polymer damage. Because of this, fluorescent UV-B lamps are the most widely used lamps for simulating the damage caused by outdoor sunlight. For most applications, they are the fastest and most cost efficient lamps. Two types of UV-B lamps are available. They emit different amounts of total energy, but produce the same UV wavelengths in the same relative proportions. The peak emission of these lamps is at 313 nm. Most of their output is in the UV-B region, with some output in the UV-A and visible regions. The two types of UV-B lamps are:

UVB-313. This lamp is designed specifically for QUV testing. Compared to the older QFS-40 lamp, the UVB-313 gives substantially higher UV output, faster tests, improved uniformity and a significantly lower price.

QFS-40. Also known as FS-40 or F40 UVB, this is the original UV-B lamp and has been used in the QUV for many years.

UV-A Lamps

For certain applications, the longer wavelength spectrum emitted by UV-A lamps is recommended. UV-A's are especially useful for tests comparing generically different types of polymers. Because UV-A lamps have no UV output below the normal solar cut-off of 295 nm, they usually do not degrade materials as fast as UV-B lamps, but they give enhanced correlation with actual outdoor weathering. Most of the UV-A lamps' energy falls into the UV-A region, with a small amount in the visible and the UV-B.

UVA-340. This lamp's special phosphor produces an energy spectrum with a peak emission at 340 nm. The UVA-340 is the best available simulation of sunlight in the critical, short wavelength UV region between 365 nm and the solar cut-off of 295 nm.

UVA-351. This is the recommended lamp for simulating sunlight filtered through window glass. It is most useful for indoor or automotive interior applications. These lamps are manufactured to our specifications to produce closer control than commercially available UV-A sources.

Lamp Application Guideline

UVB-313: most coatings, also comparison tests between generically similar formulations. Allows maximum acceleration.

QFS-40: (F40 UVB) Automotive exterior coatings specifications.

UVB Lamps vs. Sunlight

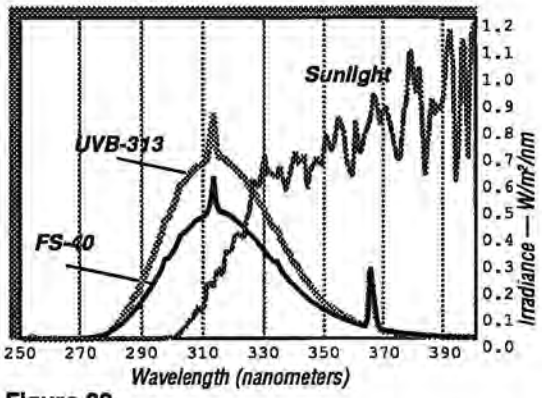


Figure 28

UVA-340: Especially useful for comparison tests between generically different formulations. Other recommendations include: most plastics)notably - vinyls, ABS and urethanes), textiles, pearlescent pigments and UV stabilizers.

UVA-340 vs. Sunlight

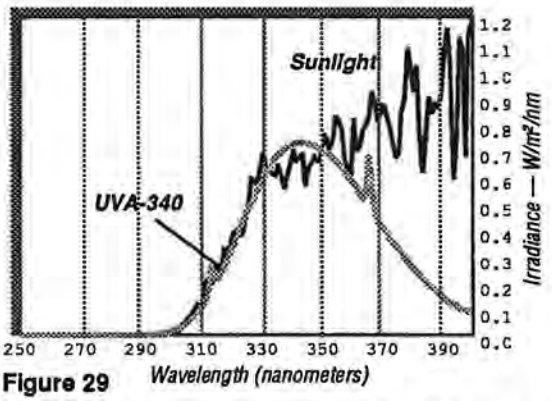


Figure 29

UVA-351: Indoor lightfastness or "sunlight through glass" exposure simulations.

UVA-351 vs. Sunlight thru Glass

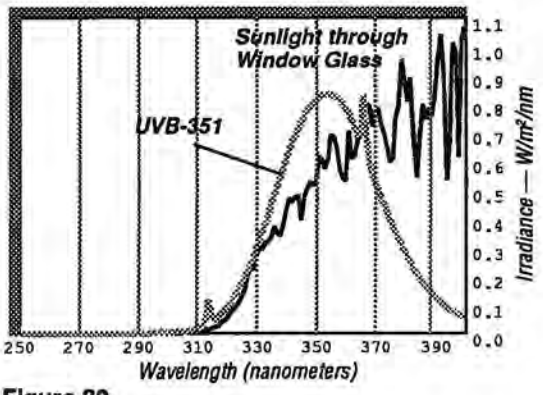


Figure 30

Do Not Mix Different Types of Lamps

Mixing different types of lamps in a QUV will produce major inconsistencies in the light falling on the samples. Some users want to put UV-A lamps on one side of the Q-UV and UV-B lamps on the opposite side. Do not o this either. A small amount of UV from the lamps in each bank travels across the chamber and adds to the UV striking the samples on the other side. If you have different types of lamps on opposite sides of your QUV, you will get stripes of different types and severity of degradation (usually visible as a striped pattern). See section on UV Baffle for further explanation.

8.0 Temperature Control

8.1 UV Cycle Temperature Control

Most of the heat during the UV cycle is provided by the lamps. However, precise control of temperature is achieved by means of a thermostatic system which provides either heated air or room temperature air as required. The main elements of this system are as follows:

Blower

The Air Blower is located on the underside of the unit. It operates continuously throughout the UV cycle.

Air Distribution

Air from the Blower enters the test chamber through the air pipe in the center of the water pan. An aluminum Air Deflector directs the air throughout the test chamber. An aluminum Water Pan Cover insulates the air from the cooling effects of the water. The air eventually vents to the room through the air vent slot around the top of the water pan.

Air Heater

This is located in the air tube above the blower, and heats the air from the blower when necessary.

Thermostat

The UV thermostat actuates the air heater when heat is needed and turns off the heater when cooling is needed. The nickel sensor bulb for the UV thermostat is attached to the aluminum baffle in the center of the chamber. The control knob for setting the UV thermostat is on the control panel.

If thermostat is at maximum but heater cycles on and off before reaching the desired temperature, this indicates that the thermostat's temperature range is set too low. To increase thermostat's temperature range, remove thermostat knob and turn adjusting screw in thermostat shaft in a counterclockwise direction.

8.2 Condensation Cycle Temperature Control

During the condensation cycle, temperature is controlled by thermostatic control of the water heater. The condensation thermostat and power input are similar to the controls for the UV cycle. The sensor bulb for the condensation thermostat is immersed in the water pan.

The air blower and heater do not operate during most of the condensation cycle. However, the blower is operated for the first few minutes of the condensation cycle to provide a rapid cooling of the test chamber. The Condensation Cooling Timer sets the length of time that the blower operates. It has been preset at the factory for 15 minutes. To adjust the time of the cool down cycle, see **Section X.**

8.3 Temperature Measurement and Calibration

The QUV test temperatures are measured by a black-panel-thermometer arrangement. The thermometer consists of a digital display and a remote sensor. The sensor is mounted on a black panel (along with Solar Eye sensors No. 3 & 4) in the center rear of the Q-U-V sample mounting area and measures test sample temperature.

The thermometer measures the temperature, but does not control it. Temperature control is accomplished by separate thermostats for UV and Condensation.

Thermometer Calibration

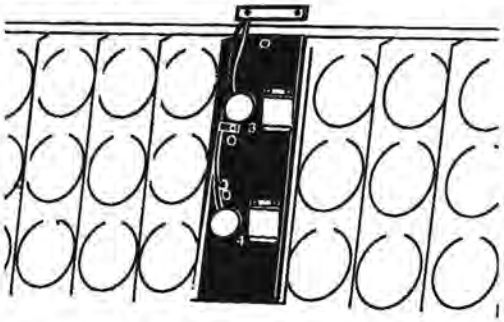
All thermometers require occasional calibration to insure accuracy. To assure accurate temperature readings, calibrate the thermometer every six months. To calibrate:

1. Locate the black aluminum panel mounted in the rear sample area of the QUV. Unfasten the black panel by loosening the thumb screw at the top center of the panel.

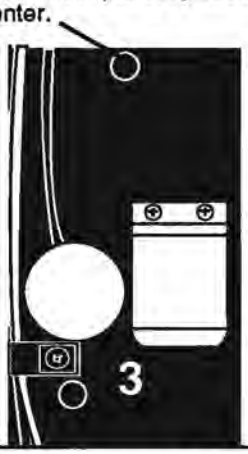
2. The thermometer sensor is located on the opposite side (i.e. inside) of the panel behind a

Calibrating the QUV SE Temperature Sensor

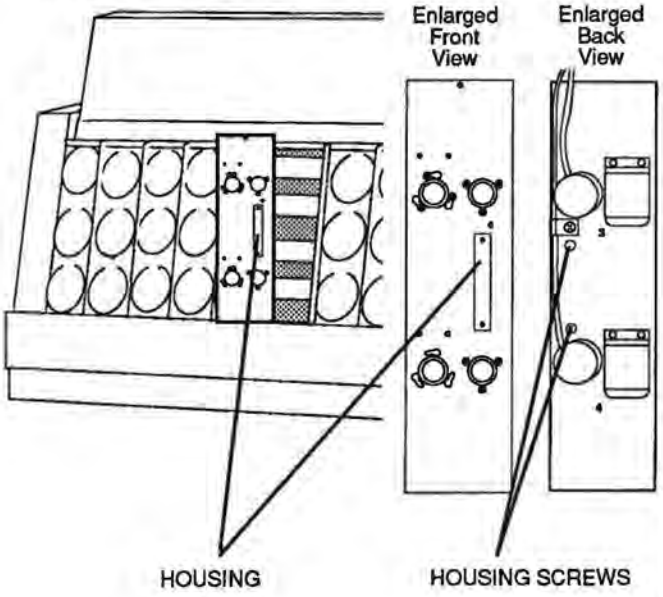
1. Locate the black sensor panel mounted in the rear sample area of the Q-U-V.



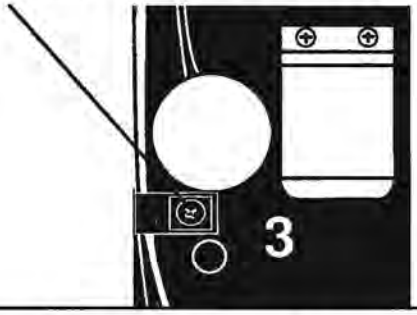
2 Unfasten the black sensor panel by loosening the thumb screw at the top center.



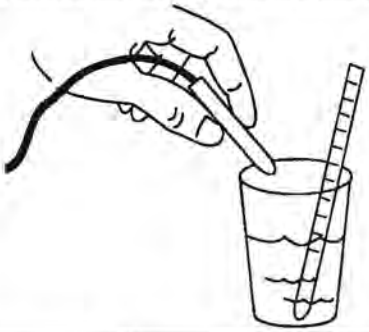
3. Turn the sensor panel around to locate the thermometer sensor housing . The housing is attached by two thumb screws found on the reverse side of the panel. Loosen these screws, remove the housing and set it aside.



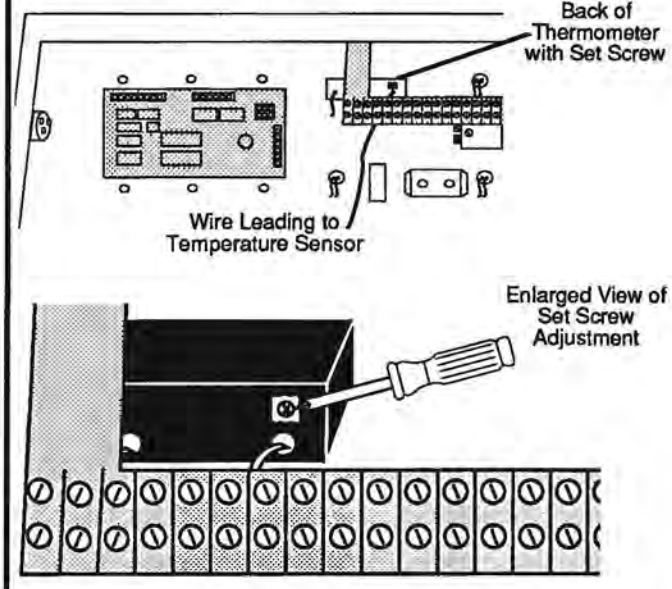
4. Next, remove the clip located above the top thumb screw by using a Phillips head screw driver. This will free the sensor from the sensor panel. Set the panel aside.



5. Place the thermometer sensor in a cup of hot water along with a calibrated mercury-filled glass thermometer. Set the cup on top of the Q-U-V and allow a minute for the temperatures to stabilize. If the Q-U-V thermometer does not agree with the calibrated mercury thermometer, recalibrate.



6. To recalibrate, remove the rear access panel from the back of the Q-U-V control panel. Locate the back of thermometer. On the upper right corner of the thermometer is a Philips head set-screw. With a small screwdriver, turn the set-screw until the two thermometer readings match.



housing block . To remove the housing, loosen the two thumb screws found in the center of the back of the black panel). Set the housing aside.

3. Rotate the black panel to a horizontal position so that the thermometer sensor falls free. Place the thermometer sensor in a cup of hot water along with a calibrated mercury-filled glass thermometer. Allow a minute for the temperatures to stabilize.

4. Compare the readings. The water will be cooling during this process, so be sure to read the two thermometers at the same time. A large insulated cup will minimize this problem. If the QUV thermometer does not agree with the calibrated mercury thermometer, you should re-calibrate it.

5. To re-calibrate, remove the rear access panel from the back of the QUV control panel. Locate the back side of the thermometer. On the upper right corner of the thermometer is a Philips head set-screw. With a small screwdriver, turn the set-screw until the two thermometer readings match.

9.0 Start Up Procedure

9.1 Choosing Cycles and Temperatures

UV temperature is usually set at either 50°C, 60°C, or 70°C (122°F, 140°F or 158°F). Condensation temperature is usually set at either 45°C, or 50°C, (113°F, or 122°F). This provides a wide range of test severity, because a 10°C change in temperature can increase the rate of deterioration reactions by up to 2:1. Condensation temperature should be a minimum of 40°C to insure adequate heat transfer for condensation to occur.

Because condensation requires about an hour to fully develop, use at least a 2 hour condensation cycle unless an exceptionally mild wetness exposure is desired.

The most common cycle times are a cycle of 4 hours of UV followed by 4 hours of condensation, or a cycle of 8 hours of UV followed by 4 hours of condensation. Other cycles are used, including 16UV/8 cond., 4UV/8 cond. and 6UV/6 cond.

Different cycles are required to simulate different types of outdoor exposure and to test different classes of materials. Experimentation is recommended. A good cycle for initial tests is 4 hours of UV at 60°C followed by 4 hours of condensation at 50°C.

Cycle Timer

The 24 hour cycle timer has 96 tabs representing 15 minutes each. Each tab pulled to the outside position programs 15 minutes of UV. Each tab pulled to the inside position programs 15 minutes of condensation. The 24 hour period can be split up into any combination of UV and condensation periods. UV and condensation cannot be programmed to occur simultaneously.

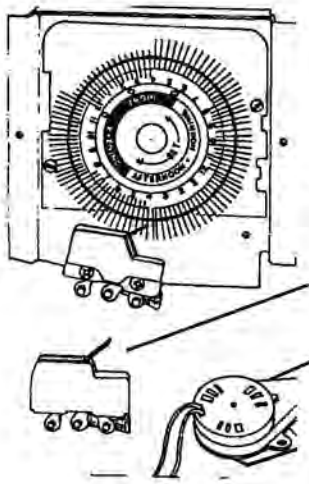


Figure 31
CV-261 Cycle Timer Assembly (includes switch and motor)

Test Duration

Test duration depends entirely on the material. Air dry alkyd paints may require only 250 hours (10 days). Some coil coatings may require 2,000 hours (12 weeks) or more. Roofing materials are commonly exposed for up to 5,000 hours.

UV Cycle

- Turn on the Main Power. Rotate the Cycle Timer to the UV period.
- "Ultraviolet Cycle" indicator light should come on. "Blower On" light should come on.
- UV lamps should light within one minute.
- Solar Eye Irradiance Controller "Set Point" and "Actual Irradiance" displays should illuminate. (To choose an irradiance set point, see **Section 7.4.**)
- Calibrate the Solar Eye Irradiance Control system **(see section 7.3).**
- Listen at each end of the control panel housing for the lamp cooling fans.

- Rotate the Cycle Timer to the condensation period. Tester should switch into Condensation Cycle mode

Check UV Cycle Heating

- Turn thermostat to highest setting. Heater On light should go on.
- Check blower on underside of machine to make sure it's on.
- Feel air tube above blower to make sure air heater is operating.
- Check thermostat shut-off by turning back until Heater On lamp goes off.

UV Cycle Temperature Setting

To set the temperature for the Ultraviolet Cycle, use the following procedure:

- Start the UV cycle.
- Turn the UV Thermostat to the highest setting, Heater On Light should come on.
- Wait until Panel Temperature reaches desired temperature. Slowly turn back until Heater On light goes out. Do not turn back farther.

9.3 Condensation Cycle

Check Water System

- Float valve should open when float is depressed, close tight when float is raised.
- Water in pan?
- Check for excessive filth, scum, and sludge.

Condensation Cooling Timer

At the end of a UV Cycle, the chamber air temperature is usually fairly hot. The Condensation Cooling Timer operates the blower to cool off the chamber air temperature and to bring fresh. cool laboratory air into the chamber.

The Condensation Cooling Timer is mounted inside the control housing. It is set at the factory for 15 minutes. The Condensation Cooling Timer is a time delay relay (TDR). It controls the functions of the blower (Number 13 on **Control Panel Parts Schematic, Section 13.6**, Control Panel Functions). The functions of the Condensation Cooling Timer are as follows:

1. The blower remains on during the entire UV Cycle.
2. The blower is off during most of the Condensation Cycle
3. At the start of the Condensation Cycle, the Condensation Cooling Timer will operate the blower for 15 minutes. This 15 minute interval is adjustable. The timer has been set at the factory to an interval appropriate for most labs and tests. It may be adjusted by removing the rear access panel to the control housing. The timer is visible at the right end of the housing. It can be adjusted by turning the knob.

Check Condensation Cooling Timer

- Rotate Cycle Timer to Condensation.
- Condensation Cycle pilot should light.
- Blower on pilot light should light.
- Air blower should remain on until Cooling Timer runs for 15 minutes (i.e., until timer runs down to zero). It should then shut off.

Check Condensation Heating

Turn Condensation Cycle Thermostat until Heater On light goes on. Turn back until Heater On light goes off.

Condensation Temperature Setting

The procedure for setting condensation temperature is similar to the procedure for UV temperature. To set the temperature for the Condensation Cycle, use the following procedure:

- Start the Condensation Cycle.
- Turn the Condensation Thermostat to the highest setting, Heater On light should come on.
- Wait until Panel Temperature reaches desired temperature. Temperature equilibrium is generally reached an hour after the start of the condensation cycle. Slowly turn back until Heater On light goes out. Do not turn back farther.

9.4 Thermometer

Check thermometer calibration by placing bulb in cup of warm water with glass thermometer. (See Thermometer Calibration, **Pg. 18**)

10.0 Daily Checkout Procedure

During the UV Cycle Check:

- Panel temperature is correct.
- Solar Eye Irradiance Controller shows that the "Actual Irradiance" is the same as the "Set Point" irradiance.
- Solar Eye "Calibrate" light. If illuminated, calibrate the system.

During Condensation check that:

- Panel Temperature is correct.
- Samples are wet with condensation.
- No obvious vapor leaks around samples.

11.0
Six Month Maintenance

- Calibrate the thermometer (Section 8.3)
- Clean the water pan
- Return the radiometer to Q-Panel for calibration

12.0
Test Sample Mounting

The standard test sample holder accommodates 2 panels 3 x 6 inch (75 x 150 mm) or 1 panel 3 x 12 inch (75 x 300 mm). Other sample holders are available to accommodate wider, thicker or odd shaped samples. Call Q-Panel for details.

An essential feature of Q-U-V's condensation system is that panels actually form the side wall of the test chamber and provide the closure that keeps the hot water vapor inside the chamber. Room air on the back side of the panels cools them to a few degrees below the vapor temperature. This temperature difference causes liquid water to condense on the panels.

The swing-up door covering the panels does not seal, but instead allows room air to reach the backs of the test panels. However, the swing-up door does regulate the way that convection currents cool the panels, and it reduces fluctuations in panel temperature due to drafts and room temperature changes.

Thick specimens of insulating material, such as wood or rubber, may exhibit inadequate condensation because of poor heat transfer. To increase condensation, increase heat transfer by: 1) propping open the swing-up door 10 or 20 mm with a bent aluminum test panel; 2) moving the Q-U-V to an air-conditioned room; 3) increasing the condensation cycle temperature.

12.1
Sample Mounting Precautions

The test panels are actually the side wall of the test chamber. To seal in vapor, it's important to have all panel holders in place, and it's important to have all holders filled with test specimens or blank panels. Missing panels will cause vapor loss, poor condensation, and loss of temperature control. In addition, mount the test panels so that the holes are masked by the holder, and close all gaps larger than 1/32 inch (1 mm).

The rubber end seals are necessary to prevent the vapor from escaping. Install the seals with the end marked "TOP" up.

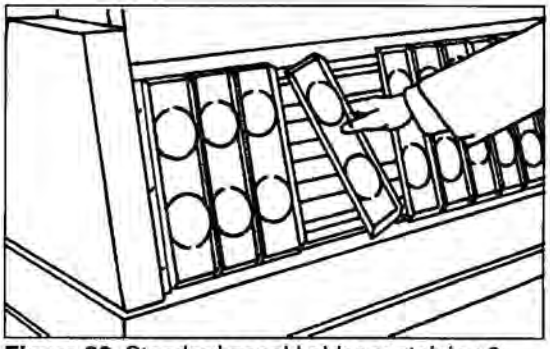


Figure 32. Standard panel holder containing 2 panels 3 x 6" (75 x 150 mm) is installed by resting it in a slot on the QUV's frame.

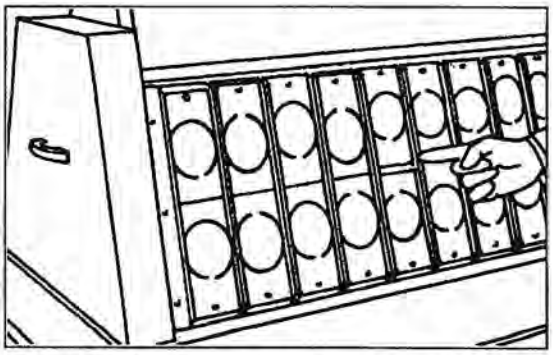


Figure 33. To seal in vapor, have all panel holders in place and all holders filled with test specimens or blank panels. Close all gaps largen than 1/32 inch (1mm).

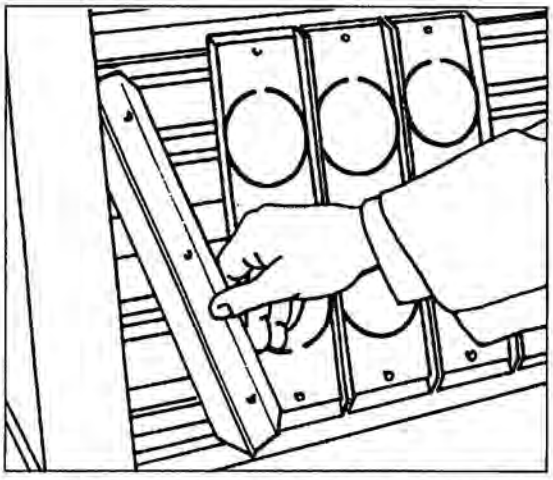


Figure 34. The rubber end seals are necessary to prevent the vapor from escaping. Install the seals with the end marked "TOP" up.

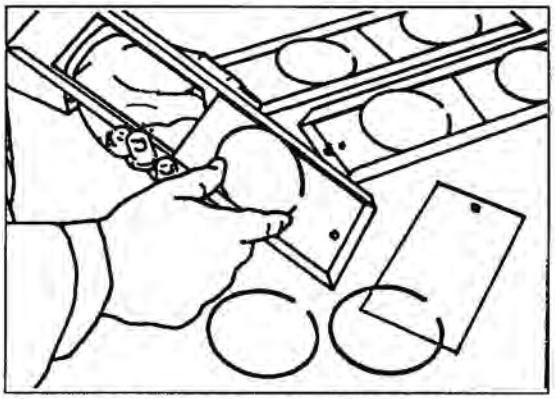


Figure 35. Flat panels up to 1/4" thick (6 mm) are fastened to the holders by snap-in rings. Simply push the ring snuggly against the panel. For proper tension, keep the opening of the ring in the center of the holder, away from the edge, as shown. To remove the ring, pick up one side near the operning.

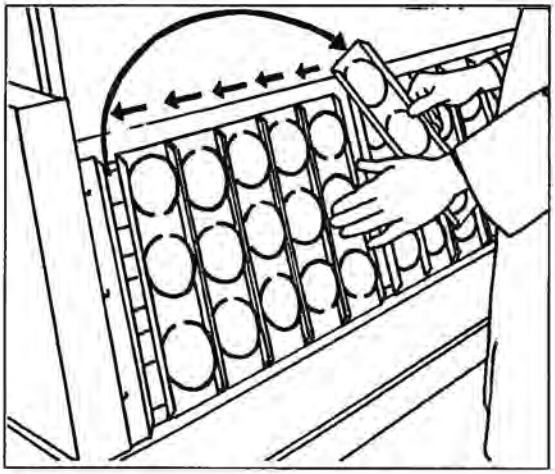


Figure 36. The extreme right and left hand panel holders receive slightly less UV than the other holders, due to the fact that these holders are close to the ends of the lamps. We recommend that you compen-sate for the UV difference by moving the left-end and right-end panel holders to the center positions once a week (or at intervals equal to 1/6 of your test duration).

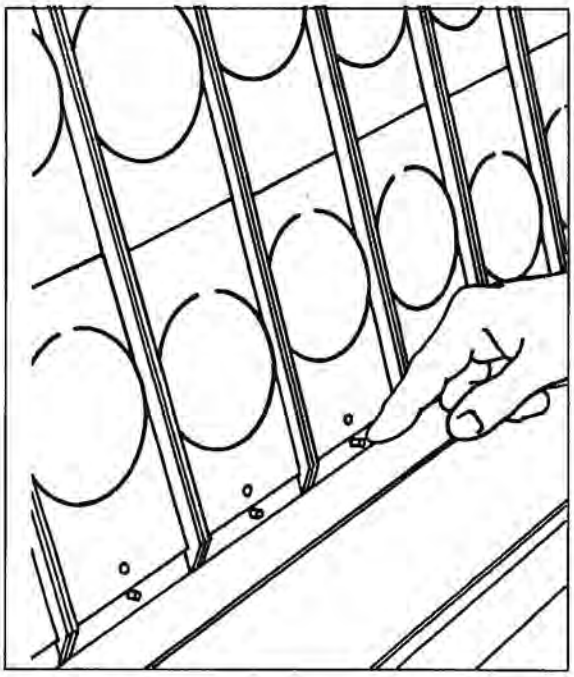


Figure 37. A small cylindrical stop keeps the test panels from falling down. Install the panel holders with this stop at the bottom.

Figure 38. All 26 panel holders stack conveniently for carrying to another room for sample analysis. Simply cradle them in your arm and stack, alternating flanges up and flanges down.

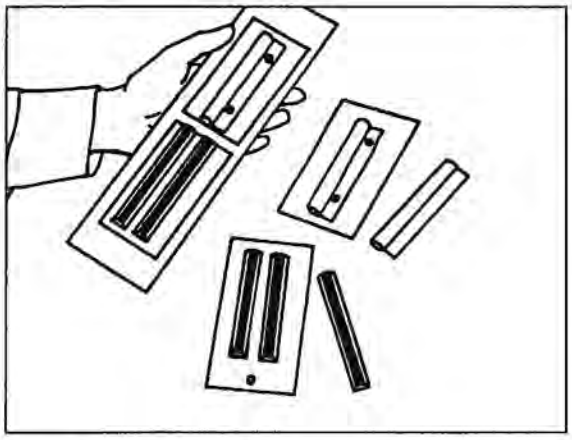


Figure 39. To mount odd-shaped samples, first attach them to a 3 x 6" (75 x 150 mm) aluminum blank. Then mount the blank in the standard panel holder. Use water-resistant glue or fasteners made of corrosion-resistant metal (brass, aluminum or stainless steel — not plated steel). To insure adequate cooling for condensation, odd shaped parts should be mounted to give reasonably good thermal contact with the blank panel.

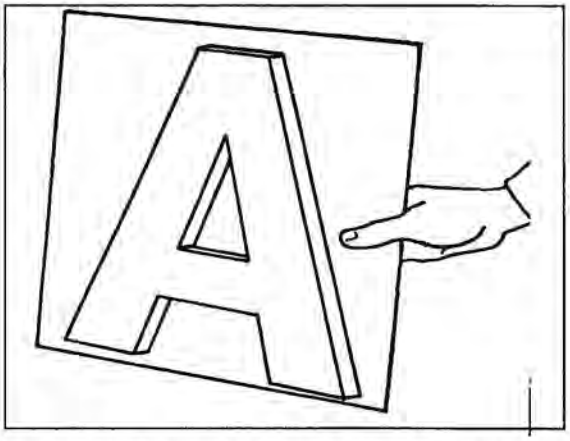


Figure 41. Extra large samples can be mounted to a large aluminum blank which is installed on the frame in place of several holders. The blank must be 12.75" high (325 mm) and exactly as wide as the

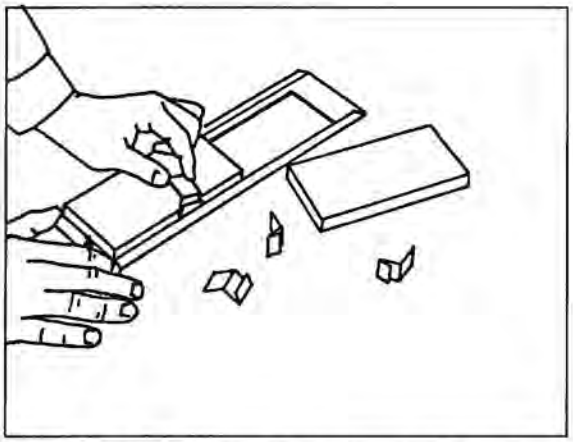


Figure 40. For samples thicker than 1/4" (6mm), such as wood, use the optional Thick Panel Retainer springs. Part No. V-133.

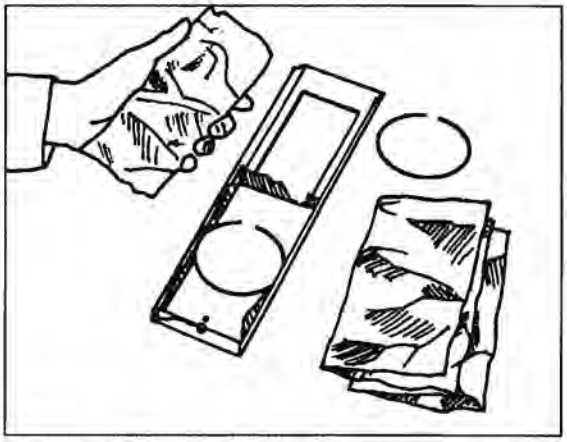


Figure 42. Thin , flexible film samples are mounted by simply wrapping them around an aluminum blank.

13.0 Repairs & Troubleshooting

The Q-U-V is designed so that virtually all repairs can be made by the user.

Solar Eye Repair

Malfunctioning Solar Eye Controllers may be returned for repair on a repair/replacement basis. Solar Eye sensors may be replaced as needed.

Indicator Lights

The indicator lights are designed for an average life in excess of 10 years. For replacement, just snap the light out of the control panel.

Reminder Notes

We notice that people often leave pieces of adhesive tape on the Q-U-V to remind them when to remove samples etc. Instead of adhesive tape, we recommend No. 653 "3M Post-it Note Pads", available at any office supply store.

13.1 Troubleshooting guide: Problems and Their Causes

UV Cycle: Not enough heat; all else OK.

1. Thermostat or power input switch not set at maximum.
2. Air Heater burned out. ("Heater" light on — feel pipe above blower for heat.)
3. Blower worn out. ("Blower" light on, but blower not operating.)
4. Thermostat or power input control broken. ("Heater" light will be off). Note: Be sure that pilot lights aren't merely burned out.
5. Thermostat range set too low. ("Heater" light cycling on and off at highest thermostat setting.)

UV Cycle: Two fluorescent lamps will not light.

1. One of lamps defective, or one of lamps unplugged.
2. Rubber lamps socket loose or broken.
3 Ballast worn out.

(NOTE: If a lamp burned out or the socket is loose, the ballast will shut down. Main power must be turned off and then back on to restart the ballast).

Condensation Cycle: Not enough heat.

1. Empty space in specimen rack allowing vapor to escape.
2. Thermostat or power input not set at maximum.
3. Condensation Cooling Timer not shutting off blower at end of set interval. (Check "Blower" light.)
4. Thermostat range set too low. ("Heater" light cycling on and off at highest thermostat setting.) **See Section 8.**
5. No water in water pan.
6. No heat: If "Heater" light off, Thermostat or power input broken. If "Heater" light on, heater burned out. Note: water heater almost never burns out. Be sure everything else is working before you order a heater.

Stays on one Cycle; will not change. (Cycle Timer broken)

1. Cycle changes when timer dial is turned manually: timer motor is worn out.
2. Cycle won't change when dial is turned: timer switch is broken.

No power at all.

1. Circuit breaker tripped. Push to reset.
2. Main power switch or circuit breaker broken.

13.2 Non-Repairable Parts

A number of Q-U-V parts are not repairable. When these parts fail, they must be replaced instead of repaired. These parts include, fans, blowers, thermometer, thermostats, switches, heaters, hour meters, circuit breakers, and ballasts.

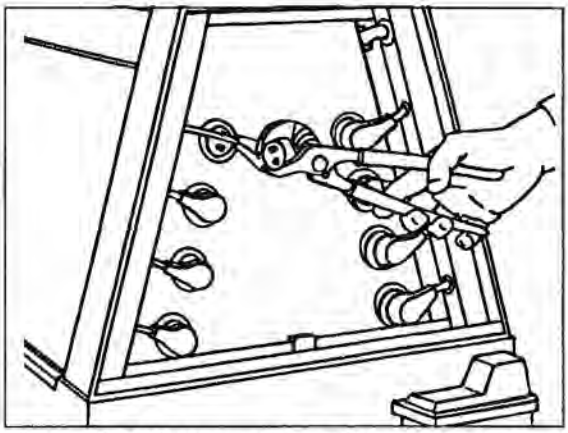


Figure 43. Maintenance Note: If the rubber socket is loose and falls off the lamp pins, squeeze the socket with a pair of pliers. This will tighten up the brass bushings inside the socket

13.3
Disassembly Instructions

To Change Water Pan or Water Heater
(serial Number 89-5212-38 and up)

1. Before replacing water heater, check electrical resistance with an ohm meter. Connect ohm meter to water heater leads in bottom frame in front of front panel. Intact heater has resistance of 5Ω to 20Ω. Broken heater has resistance of infinity.
2. Unplug electrical and disconnect water. Drain water pan. Remove lamps. (Mark lamps to indicate proper position.)
3. Inside the trapezoid frame, remove the screw holding the wire cover channel. Disconnect the four wires for blower, air heater and water heater. Unscrew the electrical conduit from the trapezoid frame (number 3 on drawing), and pull the wires out of the trapezoid frame.
4. Remove plastic drain hose above the "Y" connector (number 4 on drawing).
5. Remove the aluminum plate on the front underside of the bottom frame.
6. Remove four nuts (number 6 on drawing) underneath bottom frame. Lift off side frame and everything above it.

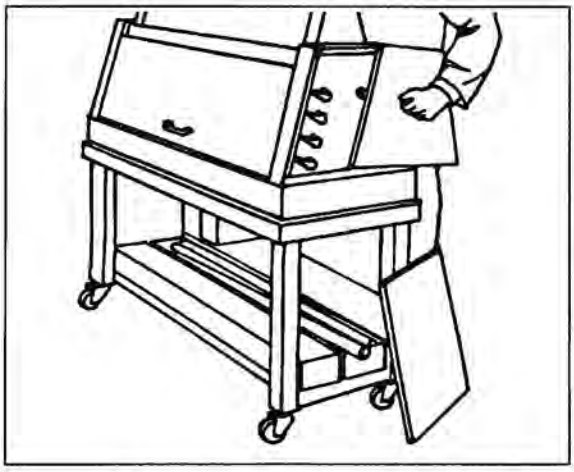


Figure 44. Spare lamps are stored in the base of the QUV. They can be removed from the back of the machine or through the snap-off end panels. The upper (trapezoidal) end panels also snap off to allow easy access for unplugging the lamps.

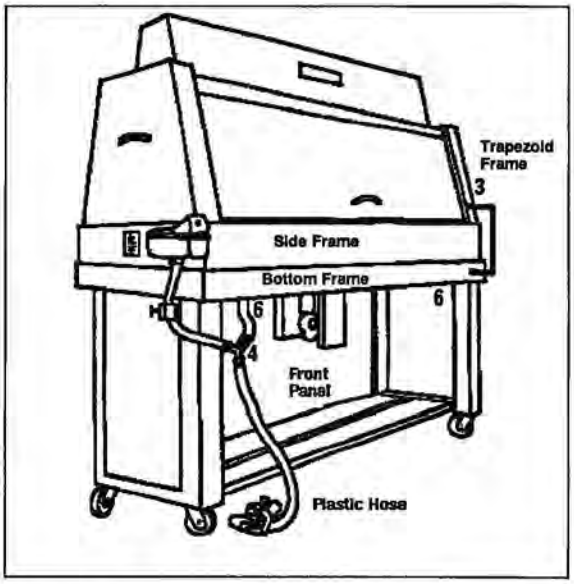


Figure 45

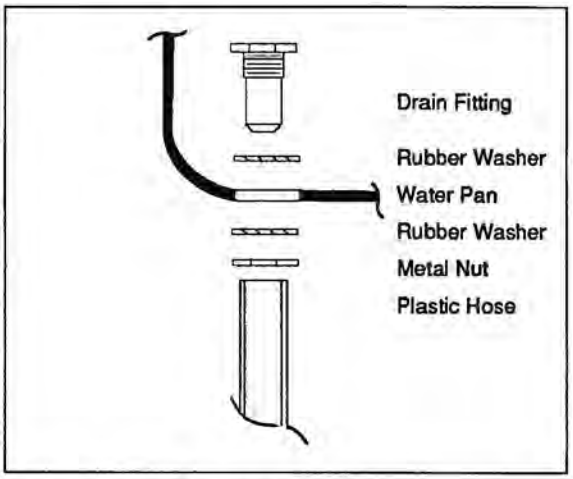


Figure 46. Drain Assembly

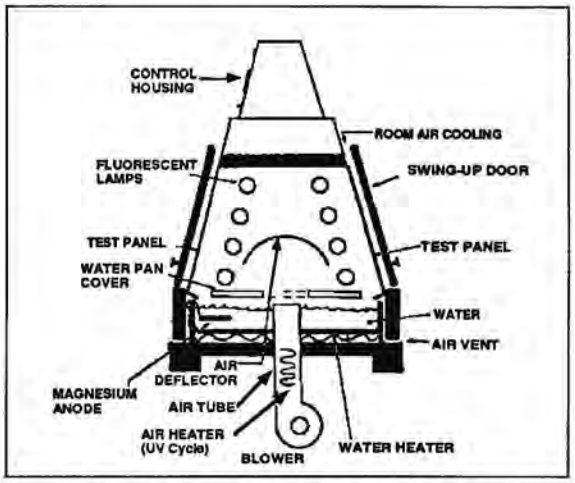


Figure 47. Simplified Cross Section of the QUV

13.4
Control Panel Parts

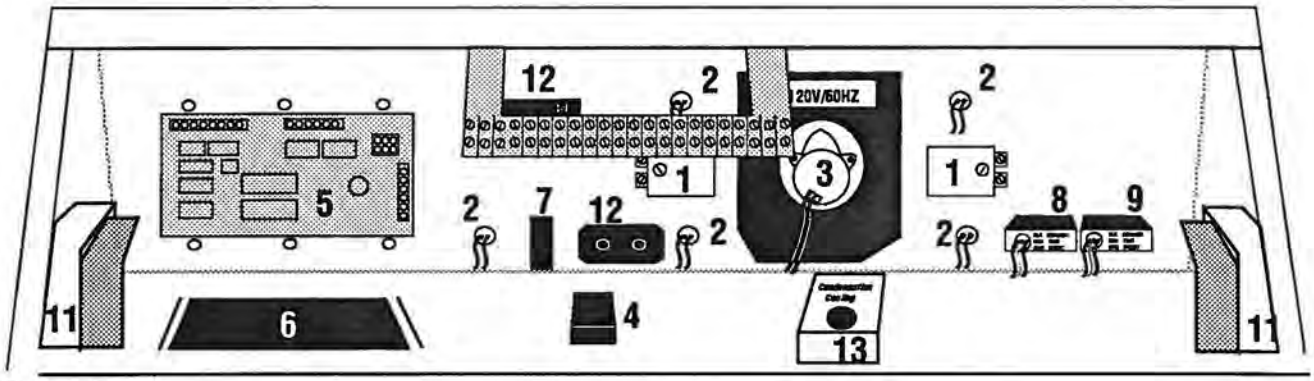


Figure 48

1.	CV-236	Thermostat
2.	CV-238/CV-239	Indicator Light
3.	CV-261	Cycle Timer Assembly
4.	IC-1280	Solar Eye Transformer
5.	IC-1290	Solar Eye Controller
6.	IC-1300/IC-1305	Ballast
7.	IC-1355	Circuit Breaker
8.	IC-1360	Hour meter, Non-Reset (Total Time)
9.	IC-1370	Hour Meater, Reset (Test Time)
10.	IC-1400/IC-1405	Thermometer
11.	IC-1500/IC-1505	Lamp Cooling Fan
12.	V-156	Main Power Switch
13.	V-166	Condensation Cooling Timer

13.5
Chamber Interior

A.	CV-236	UV Thermostat
B.	V-134B	Air Deflector
C.	CV-236	Condensation Thermostat
D.	V-138	Orifice Cap
E.	CV-212	Air Pipe
F.		Drain Hose

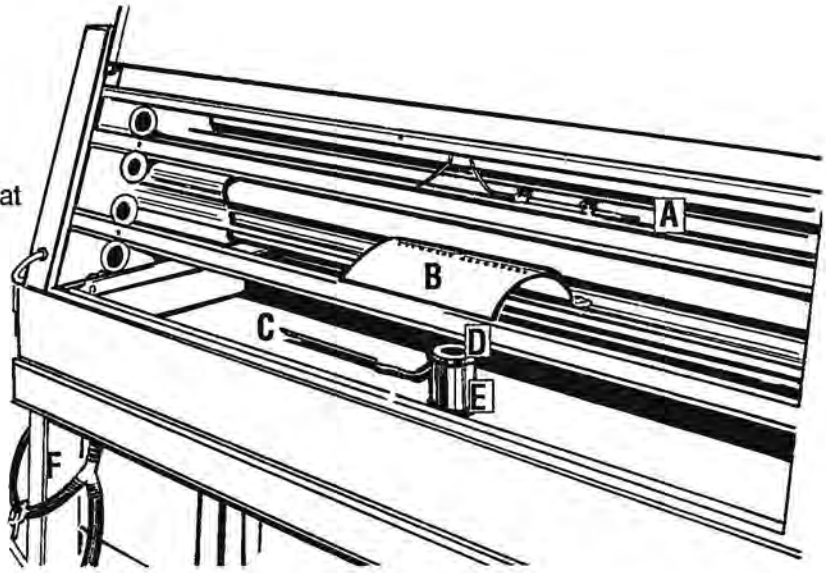


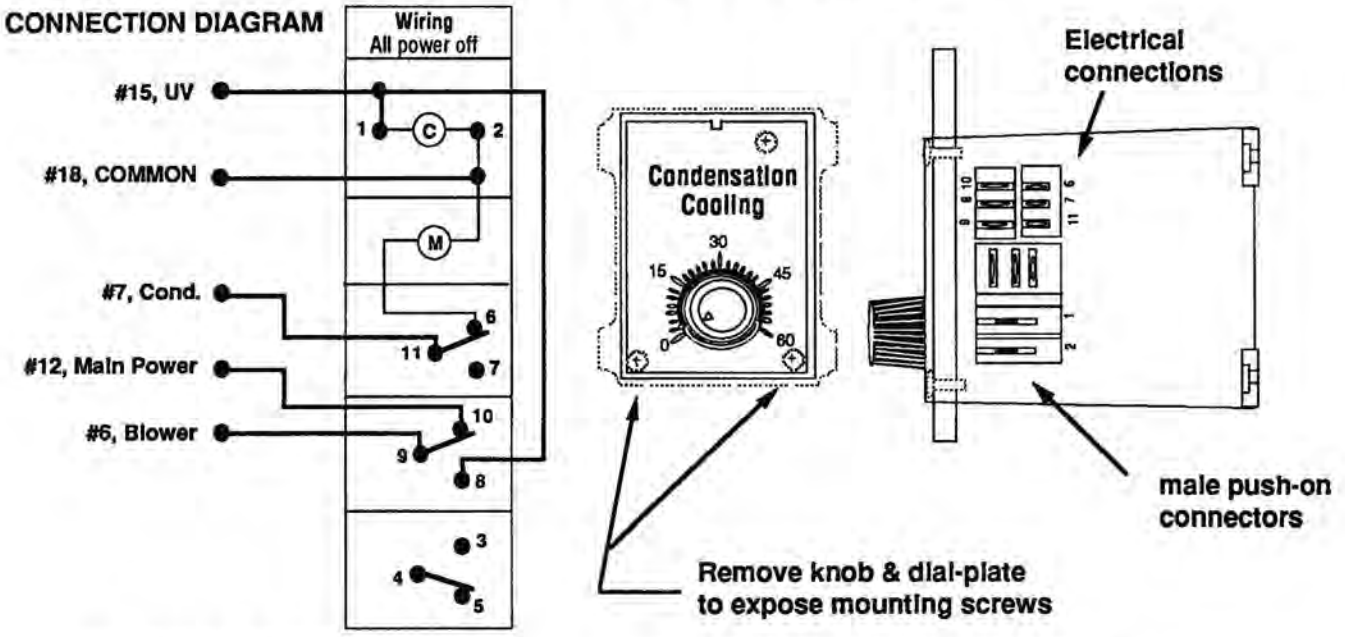
Figure 49

13.6 Condensation Cooling Timer

This timer is wired to provide the following functions:

1. The blower remains **ON** throughout the *UV* period.
2. The blower is normally **OFF** during the *Condensation* Period.
3. To provide cooling, the blower is run for a short interval at the start of the *Condensation* period. The interval is set by the timer dial.
4. When "Water Options" switch is set to **SPRAY AT START OF CONDENSATION,** it activates the spray solenoid valve for the interval set on the timer dial.

Figure 50



OFF-DELAY OPERATION — timing begins when start signal is off (clutch de-energized); (Cond.) timer resets when clutch is energized. (UV)

TIMER COMPONENTS			TIMING SEQUENCE		
Item	**Wiring** All power off	**Operation**	**Before Start**	**During Timing**	**End of Cycle**
Clutch Coil	1 C 2	When de-energized, engages tooth clutch; also actuates instantaneous contact. When energized, timer resets to before start condition.	(UV) energized	(Cond) de-energized	(Cond) de-energized
Motor	M	Drives cam toward zero (or end of cycle) position when tooth clutch is engaged.	de-energized	energized	de-energized (by D2)
Delayed Contact D2	6 11 7	Tripped by motor-driven cam at end of cycle. *‡Resets to position shown when clutch so leonoid is energized.	6 11 7	6 11 7	6 11 7
Delayed Contact D1	10 9 8	Tripped by motor-driven‡ cam at end of cycle (after dial-set time). Resets to position shown when clutch is energized.	10 9 8	10 9 8	10 9 8
Instanta-neous Contact	3 4 5	Transfers to the *before start* condition when the clutch solenoid is energized.	3 4 5	3 4 5	3 5

NOTES: *Assumes sustained start signal (longer than dialset time).
‡A tripping differential is provided: D2 trips approximately 2% later than D1.

13.7
Replacement Parts List

This is the list of parts for Model QUV/SE. See other lists for Models QUV, QUV/HO & QUV/SO. Give serial number of tester when ordering parts. Prices subject to change withou prior notice.

120V/60 100V/60	100V/50	230V/50 200V/50	Part Name
CR10			Calibration Radiometer for QUV/SE
n/a	n/a	n/a	Re-Calibrate CR10 Radiometer (recmd 2x/yr)
CV-153		CV-154	Blower
CV-207			Magnesium Anode w/instructions
CV-218A			Water Feed Assembly
CV-218A-V			Water Feed Valve Only
CV-230		CV-231	Water Heater (very seldom breaks)
CV-232		CV-233	Power Input Switch
CV-236			Thermostat with tube of Silastic
CV-238		CV-239	Indicator Light
CV-256		CV-257	Air Heater (CV-256 1100W) (CV-257 1000W)
CV-261	CV-261.3	CV-261.2	Cycle Timer Assembly
CV-261D			Dial for Cycle Timer
CV-261M	CV-261M.3	CV-261M.2	Motor only for CV-261
CV-261S			Microswitch only for CV-261
IC-1125			SE, Sensor Assembly
IC-1280			SE, Transformer
IC-1285			SE, Interlock Relay (5vdc coil)
IC-1290			SE, Controller
IC-1296			SE, Alarm
IC-1300		IC-1301	SE, Ballast Assembly
IC-1351		n/a	SE, 120V GFCI (ground fault interrupter)
n/a	n/a	IC-1352	SE, 230V GFCI (ground fault interrupter)
IC-1355		V-158.1	SE, Circuit Breaker
IC-1360			SE, Total Time Meter
IC-1370			SE, Test Time Meter (reset)
IC-1375			SE, Joule Counter (reset)
IC-1380		IC-1385	SE, Voltage Adaptor
IC-1403			SE, Thermometer & Sensor
IC-1404		IC-1405	SE, Thermometer Power Supply
IC-1440	n/a	n/a	SE, Wall Plug Adaptor (9V) for CR10
IC-1500		IC-1505	SE, Lamp Cooling Fan
IC-1510			SE, Fan Cord Set
IC-1520		CV-234.1	Power Cord w/strain relief
IC-1525		n/a	Power Cord Plug (120V only)

(Continued on page 29)

13.7
Replacement Parts List

When ordering parts specify Q-U-V serial number, Volts, Hz and Part Number.

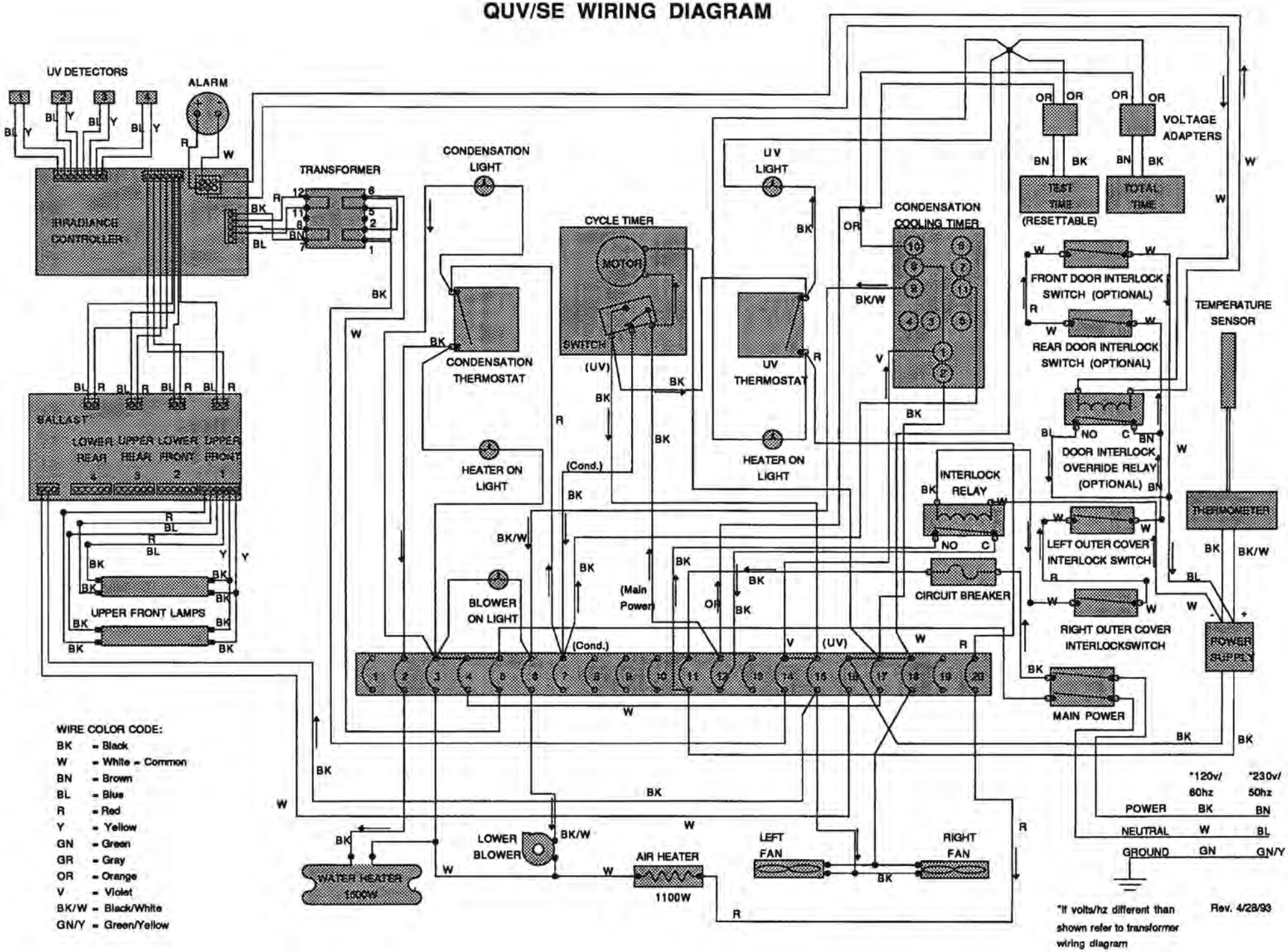
PART NO. 230V/50Hz	PART NO. 120v/60Hz	PART NAME
	CV-218A	Water Feed Assembly
	CV-218A-V	Water Feed Valve only
CV-213	CV-230	Water Heater
	CV-234	Power Cord with grommet (0.75" hole)
	CV-236	Thermostat
CV-239	CV-238	Indicator Light
CV-257	CV-256	Air Heater
CV-261-230V	CV-261	Cycle Timer Assembly
CV-261M.2	CV-261-M	Motor Only for CV-261
	CV-261-S	Microswitch Only for CV-261
	CV-261-D	Dial Only for CV-261
	CV-278	Drain Fittings with washers
	IC-1055	Temperature Sensor Housing
	IC-1060	Temperature Sensor Gasket
	IC-1065	Calibration Cable
	IC-1125x	UV Sensor
	IC-1320	Radiometer Carrying Case
	IC-1280	Solar Eye Transformer
	IC-1290	Solar Eye Controller
IC-1305	IC-1300	Ballast
	IC-1355	Circuit Breaker
	IC-1360	Hour Meter, Non-reset (Total Time)
	IC-1370	Hour Meter, Reset (Test Time)
IC-1405	IC-1403	Thermometer
IC-1505	IC-1500	Lamp Cooling Fan
	V-106	Lamp Gasket (silicone rubber)
	V-131.3	Panel Holder, 3 inches (75 mm)
	V-132.3	3 inch Retaining Ring for Panels
	K-133	Thick Panel Retainer
	V-138	Orifice Cap
	V-141	Safety Goggles
CV-154	CV-153	Air Heater Blower
	V-155	Rubber Lamp Sockets
	V-156	Main Power Switch (On/Off)
V-167	V-166	Condensation Cooling Timer
	732.5	Silicone Rubber Sealant, 5 oz. tube
	K-210	Water Pan Assy.(Pan, air pipe, drain fitting, pan hold-downs)

13.8
Test Panels

Part No.	Description
A-36	Aluminum, mill finish. 0.025 x 3 x 6 inches, (0.6 x 75 x 150 mm)
AL-36	Aluminum, chromate treated, 0.025 x 3 x 6 inches, (0.6 x 75 x 150 mm)
QD-36	Steel, smooth finish, 0.020 x 3 x 6 inches, (0.5 x 75 x 150 mm)
R-36	Steel, dull finish, 0.032 x 3 x 6 inches, (0.8 x 75 x 150 mm)

Note: Use aluminum panels as blanks to fill empty spaces, and for general testing. Use steel panels to test rust resistance of coatings.

QUV/SE WIRING DIAGRAM



rev. 4/8/93

QUV's for Japan which Require Transformers

line (volts/hz)		QUV internal (volts/hz)	QUV parts
100/50	(Power) BK, (Neutral) W, (Ground) GN → transformer V-149 → (Power) BK, (Neutral) W, (Ground) GN	120/50	all standard 120/60 parts, except 120/50 ballasts, hour meters, cycle timer motor, cond. cooling timer
100/60	(Power) BK, (Neutral) W, (Ground) GN → transformer V-149 → (Power) BK, (Neutral) W, (Ground) GN	120/60	all standard 120/60 parts
200/50	(Power) BR, (Neutral) BL, (Ground) GN/Y → transformer V-149.1 → (Power) BR, (Neutral) BL, (Ground) GN/Y	230/50	all standard 230/50 parts
200/60	(Power) BR, (Neutral) BL, (Ground) GN/Y → transformer V-149.1 → 230/60 (Power) BR, (Neutral) BL, (Ground) GN/Y → transformer V-149.2 → (Power) BK, (Neutral) W, (Ground) GN	120/60	all standard 120/60 parts
230/60	(Power) BR, (Neutral) BL, (Ground) GN/Y → transformer V-149.2 → (Power) BK, (Neutral) W, (Ground) GN	120/60	all standard 120/60 parts

Wire Color Code

BK = Black	BR = Brown
W = White	BL = Blue
GN = Green	GN/Y = Green/Yellow

Other Quality Products from Q-Panel:

Test Panels
Q-Panel is the leading name in standardized steel and aluminum substrates for testing paint, rust inhibitors, plating and adhesives. Our panels minimize metal variation as a source of bias in critical tests. They are priced low enough for use for color matching, samples, or batch records. That's why thousands of labs use millions of panels from Q-Panel every year.

Q-Fog Corrosion Chambers
Cyclic wet/dry corrosion tests degrade in a more realistic manner than conventional salt spray tests. Since a coating's operating environment includes both wet and dry conditions, it makes sense to pattern accelerated laboratory tests after those cyclic conditions. Q-Fog Cyclic Corrosion Testers (CCT) from Q-Panel incorporate the most significant corrosion factors. Q-Fog's all-plastic construction allows for use of different electrolyte solutions which are similar in composition to actual marine or industrial conditions.

QCT Condensation Tester
The QCT Condensing Humidity Chamber tests materials for resistance to moisture. It is especially good for fast blister tests for coatings. The QCT's unique condensation system allows faster tests than conventional humidity cabinets and has been proven in hundreds of laboratories.

QGR Gravelometer Adhesion Tester
The Gravelometer tests the chipping resistance of coatings and plastics by firing standardized gravel at the test sample. Originally designed to simulate the chipping caused by gravel thrown up from the wheels of cars, the QGR is now used for a variety of applications. The QGR conforms to SAEJ400.

Manufactured by:

THE Q-PANEL COMPANY
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