MPL Shutter Installation Maintenance Procedure

I. Purpose:

The MPL sun shutter is a redundant safety device to prevent direct sun light from entering the lidar. During normal operation, the dual shutters are energized to hold them in the open position. The shutters close under three conditions: AC power to the system is lost, the control timer closes the shutter, or the solar cells detect direct sunlight. The shutter assembly consists of a roof port, dual shutter assembly, heated glass lens, compressor, timer, and solar sensors. The system also has an optical grade heated window. The heated window is used to prevent condensation on the window surface.

II. Cautions and Hazards:

None.

III. Requirements:

None.

IV. Procedure:

A. Initial installation at SNL:

The MPL sun shutter is installed as noted below.

1. Remove port cover from the ISO container.

2. Place and align 24-inch diameter gasket with port's barrel nuts. ***Align? How specific?***

3. Place MPL port assembly on top of gasket per **Figure 1**. Align port assembly so that the two instrument tubes are aligned in a north / south orientation. Bolt down with 1/2-13 UNC stainless steel bolts. Tighten bolts to 40-50-inch pounds of torque.

4. Place and align 12-inch diameter gasket with window's bolt holes.

5. Place MPL heated window on top of gasket per **Figure 2**. Make sure that the silver bus bars and wires are fed down through the 8 inch diameter tube. Secure glass with attached clamps. Tighten bolts until snug and gasket slightly deforms.

6. Secure glass heater wire to the inside surface of the tube with velcro tabs.

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7. Place and align 7-inch diameter gasket with 4.5 inch diameter penetrations bolt holes.

8. Place the 4.5-inch diameter black tube assembly on top of gasket. Insert #10-24 UNC stainless flathead steel bolts through the tube assembly flange, gasket, and MPL port assembly per **Figure 3**.

9. From the inside of the ISO, mount the solar cell sensor tube assembly to the bolts inserted in step 8. Secure assembly with washers and nuts. Tighten bolts/nuts till snug and gasket slightly deforms per **Figure 3**.

10. Mount uni-strut frame to ISO wall/ceiling per **Figure 4**. *(Uni-strut frame will be fabricated at SNL.)*

11. Mount shutter assembly to uni-strut frame with 1/4-20 UNC stainless steel bolts per **Figure 5**. *(Figure 5 will be generated after SNL installation.)*

12. Attach air-line to cylinder and compressor which is located in the MPL rack.

13. Connect microswitches on shutter and the test light momentary switch to the datalogger computer. *How is this done? Is this system actually hooked to datalogger?*

14. Connect solar cell lead to the terminal block.

15. Connect the test lamp to the terminal block.

16. Install timer

   a) Open timer cover.

   b) Remove control panel screw and open control panel.

   c) Insert two AA Alkaline batteries in the battery holder in the back panel; battery installation is necessary for the controller to operate.

   d) Confirm that the transformer power is DISCONNECTED. Failure to do this blows the zone-line fuse. **How do you confirm?**

   e) With power disconnected, press the reset switch to ensure the controller is ready for operation.

   f) Close the panel; be sure not to damage wires. Secure panel with screw.

   g) Plug in transformer.

17. Turn on AC power strip.

B. On-site installation:

1. Remove port cover from the ISO container.

2. Place and align 24-inch diameter gasket with port's barrel nuts.

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3. Place MPL port assembly on top of gasket per **Figure 8**. Align port assembly so that the two instrument tubes are aligned in a north/south orientation. Bolt down with 1/2-13 UNC stainless steel bolts. Tighten bolts to 40-50-inch pounds of torque. ***How do you measure this? Is this a special tool? How is this installation different from SNL integration?***

4. Place and align 12-inch diameter gasket with window's bolt holes.

5. Place MPL-heated window on top of gasket per **Figure 2**. Make sure that the silver bus bars and wires are fed down through the 8-inch diameter tube. Secure glass with attached clamps. Tighten bolts until snug and gasket slightly deforms.

6. Secure glass heater wire to the inside surface of the tube with velcro tabs.

7. Mount uni-strut frame to ISO wall/ceiling per **Figure 4**.

8. Mount shutter assembly to uni-strut frame with 1/4-20 UNC stainless steel bolts per **Figure 5**.

9. Attach air-line to cylinder and compressor which is located in the MPL rack.

10. Connect microswitches on shutter and the test light momentary switch to the datalogger computer.

11. Connect solar cell lead to the terminal block.

12. Connect the test lamp to the terminal block.

C. Timer Programming Instructions:

1. Set the current day.

    a) Press the blue "**TODAY**" key on the panel.

    b) Press the yellow key which corresponds to today.

    c) Press the "**ENTER**" key. Today's day is now entered and is shown by a bracket under the appropriate name on the display.

2. Set the time of day.

    a) Press the blue "**TIME**" key.

    b) Press the appropriate yellow number keys to enter the present hour and minutes; the numbers are displayed.

    c) Next set AM or PM by pressing the purple "**AM PM**" key once or twice. The AM and PM setting toggles back and forth with each press.

    d) Press the white "**ENTER**" key to set this time.

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3. Set zone run time (a run time is the duration each zone runs at a given time).

    a)   Press the blue "**Zone**" key. The display shows "ZONE _____" with the underline flashing.

    b)   Press the yellow "**1**" key. The display will show that zone number 1 and the current programmed run time for the zone.

    c)   Press the yellow keys to change the run time to any amount between 0 and 999 minutes. (A conservative starting point is "**60**.")

    d)   Press the white "**ENTER**" key to set this run time zone.

4. Set start times (a start-time is the time of day the controller begins the run time).

    a)   Press the blue "**START TIME**" key. The display will show "START TIME _____" with the underline flashing.

    b)   Press the yellow key numbered "**1**" for the start-time. The display flashes the currently programmed start-time number and start-time.

    c)   Press the yellow number keys to enter desired start-time (11:30 AM suggested - assuming solar noon is 12 PM).

    d)   Press the purple "**AM PM**" key once or twice for AM or PM.

    e)   Press the white "**ENTER**" key to set the start-time.

5. Set the day schedule.

    a)   Press the blue "**DAY SCHED**" key. The display shows the programmed day with raindrops flashing under the days of the week.

    b)   Use the yellow keys with day names to switch a particular day on or off. (Normal operation is to have all the days ON).

    c)   Press the white "**ENTER**" key to save the day schedule.

6. Semi-automatic operation.

    a)   To start the program at abnormal times, press the purple **START / STOP CYCLE** key.

    b)   To stop the cycle, press the purple **START / STOP CYCLE** key.

7. Manual operation.

    a)   To turn zone 1 ON, press the blue "**ZONE**" key.

    b)   Press the yellow zone number "**1**."

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    c)   If the flashing time needs changing, enter the desired time and press the white "**ENTER**" key.

    d)   Press the purple "**MAN ON/OFF**" key.

    e)   To turn OFF a zone which is operating, press the purple "**MAN ON/OFF**" key.

    f)   Turning the system OFF temporarily.

    g)   Press the "**OFF RAIN**" key to suspend all cycles; note the display shows "OFF" at the upper right.

    h)   To continue operation, press the key again; the display shows "AUTO" at the _____.

8. Battery check.

    a)   A fresh set of AA alkaline batteries should last for two years. When the batteries weaken, the display automatically flashes "BAT" to let you know they need changing within the next one to two months. You are allowed about thirty seconds to change the batteries without affecting the program in memory. It is quicker to change one battery at a time. If the display shows wrong information or the keys do not respond, disconnect the transformer, press the reset switch on the printed circuit board near the batteries, and reprogram. **NOTE**: The controller does a battery check once a day at midnight so "BAT" continues to flash until midnight.

9. Verification of programming.

    a)   You can check stored information at any time. Simply press the blue function key and the yellow keys needed to review the requested information. The display flashes the data for fifteen seconds before returning to the current status display. Information cannot be changed without using the white "**ENTER**" key.

10. Initial set up and operation.

    a)   **<u>Cover lidar lens</u>** with lens cap to prevent solar exposure during installation procedures.

    b)   Turn on power to all equipment (timer, compressor, large DC power supply which powers the window and small DC power supply which powers the solar cell test lamp).

    c)   Bypass the timer's program by pressing the "**OFF RAIN**" key. Note the display shows "OFF" at the upper right.

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d) Adjust the window DC power supply to _____ volts. The window should heat to _____ degrees centigrade.

e) Test solar cells by pressing the momentary switch connected to the solar cell test lamp. Lamp should come on in 1 second and stay on for 10 seconds. During operation, the shutters should fall into the safe position.

Note what time the sun's rays exit the lidar tube (see **Figure 6**). Ten minutes prior to that time the next day make the following adjustment:

(1) Loosen the lock nut on the solar cell positioning rod.

(2) Lower the rod until the shutters open.

(3) Tighten the lock nut.

(4) Check to see if shutters closed prior to sun's rays exiting the lider tube.

(5) If shutter does not close prior to sun's rays exiting the lidar tube, raise the solar cell positioning rod in the solar cell detection tube.

(6) Recheck the system the next day.

(7) If system operates as specified in step #4, bring timer back on-line by pressing the "**OFF RAIN**" key. Note the display shows "AUTO" at the _____.

f) Test timer by manually activating timer.

(1) To turn zone 1 ON, press the blue "**ZONE**" key.

(2) Press the yellow zone number "**1**."

(3) Enter the desired length of test (2 minutes); press the white "**ENTER**" key.

(4) Press the purple "**MAN ON/OFF**" key.

(5) To end the test early, press the purple "**MAN ON/OFF**" key.

11. Daily operation.

a) Clean outside MPL windows with distilled water and dry with a soft towel at 11:30 AM. Verify that windows are free from condensation.

b) Drain condensation from water trap on the compressor.

c) Test solar cell circuit by pressing the test light momentary switch. (Note that shutter closes.)

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    d)   Test timer by manually activating timer.

    e)   To turn zone 1 ON, press the blue "**ZONE**" key.

    f)   Press the yellow zone number "**1**."

    g)   Enter the desired length of test (2 minutes); press the white "**ENTER**" key.

    h)   Press the purple "**MAN ON/OFF**" key.

    i)   To end the test early, press the purple "**MAN ON/OFF**" key.

    j)   Verify that the window DC power supply is operating at _____ volts.

V. References:

None

VI. Attachments:

1. Troubleshooting Chart.

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Attachment 1. Troubleshooting Chart.

Trouble Shooting

PROBLEM	PROBABLE CAUSE	REMEDY
Solar cell test light not operating	- Burned out bulb	- Remove solar cell positioning rod. Replay bulb. Do not touch bulb with bare fingers. Always use a clean oil free cloth when handling new bulbs.
	- Blown fuse in DC power supply.	- Turn off power to DC power supply - Replace fuse
	- Broken wire	- Examine wire for breaks. Replace wire if broken
Solar cells not closing the shutter when test light is on.	- Broken wire	- Examine solar cell wires for breaks Replace wire if broken
	- Damaged solar cell	- Interrogate each solar cell under bright light with a volt meter. If solar cell produces less than _____ volts, replace cell.
Timer's automatic cycle does not begin at set start time	- AM/PM set wrong - In rain mode - Today is "nonwatering" day. - Was running manually at time of start.	- Enter correct time - Press ON/OFF RAIN button - Correct day schedule or today's day - Do not run manually at start time
Timer's zone display on but shutter down.	- Fuse blown - No voltage to transformer - Bad transformer	- Replace fuse - Restore power - Replace transformer
Display is off or has scrambled segments and/or reset won't work.	- No batteries - Weak batteries - Corroded battery contacts	- Install batteries and reset - Replace batteries and reset - Clean battery contacts and reset

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PROBLEM	PROBABLE CAUSE	REMEDY
Display is black	- Display is hot	- Let display cool off
Compressor labors to get up to speed.	- Pressure release valve of the pressure regulator needs to be reset.	- Toggle pressure relief valve with screwdriver blade.

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