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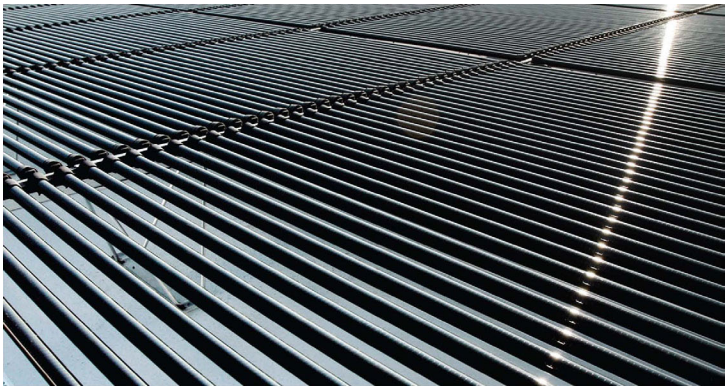

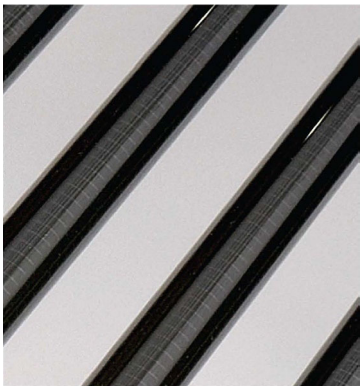

Installation Manual

SL001 Series

Photovoltaic Panels

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Chapter 1 Safety

Safety first.

You will be working on a rooftop. Even a four to six meter fall can cripple or kill. Be careful.

DANGER!

Solyndra panels, like all photovoltaic panels, present one unique hazard to installers: whenever light is present, voltage is present. This is unlike regular electrical work, where power can be switched off. Even at modest levels of illumination, there is enough voltage to kill.

Solyndra panels are equipped with connectors that shield the inner conductor. This makes it difficult to come in contact with the conductors during ordinary handling and installation. Difficult, but not impossible. Always treat the panel electrical connectors as live wires, because they are.

WARNING!

The outer light collecting tubes in Solyndra panels are made from glass. Inside the glass tube is another tube holding the actual photovoltaic material. The space between the tubes is filled with an Optical Coupling Agent (OCA) to optimize its light-collecting ability.

The glass tubes can be broken. If they are, there are three hazards you must deal with:

1. Broken glass.
2. Leaking Optical Coupling Agent (OCA). While the OCA fluid is not toxic, it is slippery. Any spill should be cleaned up immediately.
3. Live voltage from the broken ends of tubes. Tubes still produce voltage when broken.

Your shipment includes a clean-up kit. Instructions on its use can be found in Chapter 9.

Safety Rules

- Crates must always be stacked so panels are oriented with the tubes horizontal, that is, with the panels on ends.
- Two people are required to move each panel.
- DO NOT carry more that one panel at a time.
- Carry and lift panels by the metal frame only.
- NEVER carry or move panels by grabbing the glass tubes.
- NEVER lean or sit on panels.
- DO NOT place anything on panels. This could damage the glass tubes or shade the panels, causing improper operation.
- DO NOT place panels in areas where people could walk on them or trip over them.
- DO NOT carry objects that might obstruct your view of the floor while in the vicinity of the panels.

Solyndra panels are intended to be used over highly reflective surfaces, but no other artificially concentrated sunlight shall be directed onto the panel.

Chapter 2 Site Preparation

This chapter addresses key steps you should take before the panels arrive at the site. While it is beyond the scope of this manual to provide a complete guide to planning your photovoltaic installation, it's important to understand the basic principles of installation. These include:

- Safety.
- Installation of conduit and electrical equipment boxes.
- Planning installation of grounding wires.
- Roof preparation and cleaning.
- Planning panel placement and clearance.
- Planning panel wiring.
- Tools, supplies, and techniques.

Scope

This is an installation manual, and is not intended to be a complete planning and engineering guide. This manual contains instructions and guidance regarding the installation of Solyndra photovoltaic panels. It will be helpful in unpacking, handling and installing Solyndra panels, which have been designed to be modular, efficient and easy to install.

This installation manual is a companion to, and not a substitute for, the use of qualified and experienced solar system designers and electrical equipment installation professionals. Likewise, it is not a substitute for a correctly planned and engineering system design.

The installation of Solyndra panels must take place in compliance with national and local electrical and building codes. These are too numerous to describe here. The use of qualified and experienced local professionals is the best way to ensure compliance with such codes as well as optimum system design, installation, and performance.

A Solyndra panel is part of a complete photovoltaic installation. A properly-engineered installation will meet all applicable fire codes, electrical codes, building codes, and other safety codes. In most cases compliance with these codes involves many components in addition to the Solyndra panels.

Your installation plan should include a detailed description of the wiring methods to be used and a detailed description of the mechanical mounting. These plans should specify, at a minimum:

- Size, type, and temperature rating of all wiring components. Wire should be type USE-2, 12 guage, or better if required by local codes. Note that this is a UV-resistant grade rated for 90°C operation (North America) or 120°C (Europe).
- Solyndra requires a fuse-type device for overcurrent protection.
- Minimum mechanical means of panel mount. Solyndra panels are self-ballasting, that is, held by their own weight.
- Use of materials such that fire rating of roof is maintained. Solyndra-supplied panels and hardware will preserve fire ratings.

Preparation Checklist

Before the panels arrive, you should complete all of the items in the list in Table 1.

Table 1. Site Preparation Checklist

√	Item	Description
	System Design	Site-specific blueprints, wiring diagrams, and BoS for the installation.
	Electrical installation	Conduit and boxes for AC wiring, DC wiring, inverters, monitoring equipment, and all other work, per designer plans.
	Check clearances	Panels clear 23 cm fixtures; check roof against designed layout.
	Insure adequate ground	Provide a ground conductor, per local codes.
	Repair roof and roof fixtures	Repair any problem roof areas; repair any rooftop fixtures.
	Clean roof	Clean the roof to insure maximum reflected light.
	Arrange for rooftop panel delivery	Crates are heavy; a lift or crane is required.

Electrical Equipment Installation

Detailed electrical specifications for Solyndra panels are contained in the corresponding data sheet. The electrical characteristics are within ±10% of the indicated values of I_{SC}, V_{OC}, and ±4% of the indicated values of P_{max} under standard test conditions (Irradiance of 1000 W/M^2, AM 1.5 spectrum, a cell temperature of 25°C, and with panel mounted above a roofing material with a reflective index of 70% or greater).

Even under normal operating conditions, a photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly, the values of I_{SC} and V_{OC} marked on this module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor ampacities, fuse sizes, and size of controls connected to the PV output. Refer to Section 690-8 of the National Electrical Code for an additional multiplying factor of 125 percent (80 percent derating) which may be applicable.

While not necessary, most installers have the conduit, electrical equipment, and inverters installed prior to panel installation. It's easier to do this work before the roof is covered with panels.

Electrical equipment should be placed at the northeast or northwest corner of the array. (This, and all installation instructions in this manual, assume a northern hemisphere installation.) This minimizes cable runs and avoids shadow problems. Other locations are permissible if shade and cable-run calculations have been completed. In all cases, follow your photovoltaic design team's plans as well as all local and national building and electrical codes.

Be sure to have the electrical equipment tested after installation.

Ground Wires

Solyndra recommends that all panels be adequately grounded in order to assure safety in the event of a lightning strike or electrical malfunction. The panels themselves have grounding lugs and straps. You will need a code-compliant earth ground to attach the array ground connection.

The north end of each row of panels in the array will have a ground lug, intended to be connected to a #10 AWG system ground connection. (Use appropriate wire to comply with local codes.)

Be sure a system ground is installed before any panels are placed on the roof, so that panels may be attached to it immediately upon installation.

Roof Preparation

Your panels can cover most, if not all, of your roof. Solyndra panels are designed to fit over items less than nine inches above the roof. The panels can be removed to allow service access to the roof or any fixtures. Inspect your roof and all fixtures well before the panels arrive, and fix or replace any potential problems, as required.

Solyndra panels perform optimally when placed over high-reflectivity roofs. You may wish to have the roof cleaned or the reflectivity tested before installation. No other artificially concentrated sunlight shall be directed onto the panel.

Planning Panel Placement & Clearance

There are four basic guidelines for Solyndra panel installation:

- First and foremost: Follow the plans prepared by the installation designer! This installation manual cannot anticipate every design circumstance, but the installation designer has. Follow the plans, even if they contradict this manual.
- Panels are installed parallel to the roof. Panels should not be installed on any roof with a slope greater than 2 in 12 (9 degrees).
- Where possible, panels should be installed with the tubes aligned on the north-south axis. This optimizes output by optimizing incident sunlight. If panels are otherwise oriented, there can be a slight loss of power.
- Panels should not be installed where they will be shaded for a substantial portion of the day. If the roof has a parapet or wall, space the panels back enough to avoid shadows.
- Panels may require service or cleaning. Allow for access. To reduce the risk of falls, keep the panels a minimum of one meter away from the roof edge, or as local safety codes require.

Solyndra panels stand on mounts, and will fit over roof fixtures up to 23 cm (about 9 inches) high. Measure roof fixtures to insure the panels will clear them. Adjust the panel layout plan or move the fixture if there is a clearance problem.

Planning Panel Wiring

Panel arrays are typically wired as a parallel connection of series strings. The following description provides an overview of common wiring arrangements. It is for illustration only; you should follow the wiring method specified by the designer.

Typically, groups of four panels are wired in series, resulting in a DC voltage of 280 to 320 volts. These strings cane then be wired in parallel if necessary, increasing the available current to meet the requirements of the inverter.

Many PV installations include an Internet-based monitoring system. If yours does, install it and make sure it is operational before installing the panels.

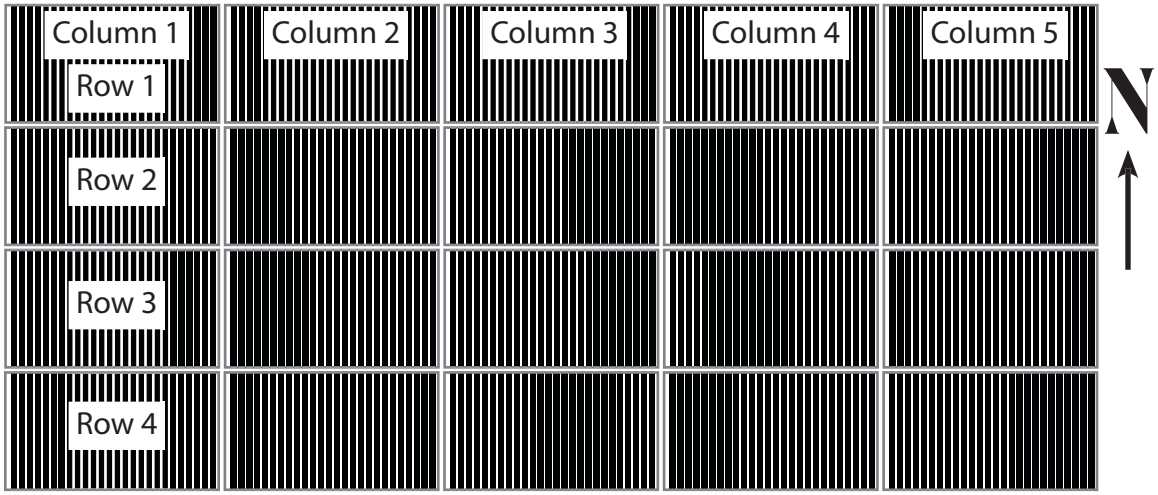
A Note on Panel Installation Terminology

Solyndra panels work best when the tubes are oriented along a north-south axis. It's also important to minimize shade on the panels. Thus, electrical equipment is normally placed on the north side of the array (for northern hemisphere installation).

For purposes of this installation guide, we will assume a north-south orientation, and installation beginning in the northwest corner, that is, the northwest corner is the origin. Each north-south string of panels is a column, and each east-west group is a row.

Note that in most installations, panels are grouped electrically by column first, then row. That is, a columns represents a series string of panels. Columns are then wired in parallel with other columns. Of course, other arrangement are possible in consultation with your qualified solar system designer.

Figure 1. Panel Installation Terminology



Chapter 3 Tools, Supplies, and Techniques

For panel installation, you will need a torque-limiting screwdriver or small torque wrench with a range of 0 to 24 inch-pounds (2.7 N-m). Fasteners must not be overtorqued during the installation process.The frame material on Solyndra panels is aluminum, so it is not necessary to apply excessive torque to the screws. You will need standard and phillips driver bits as well.

Figure 2. Tools Needed for Installation

You will need tools for fabricating Tyco SolarLok connector cables. These include hand crimpers and extraction tools. Tyco SolarLok connectors are attached by stripping the insulation, crimping a pin onto the wire, and assembling the connector. This is shown in Figure 4.

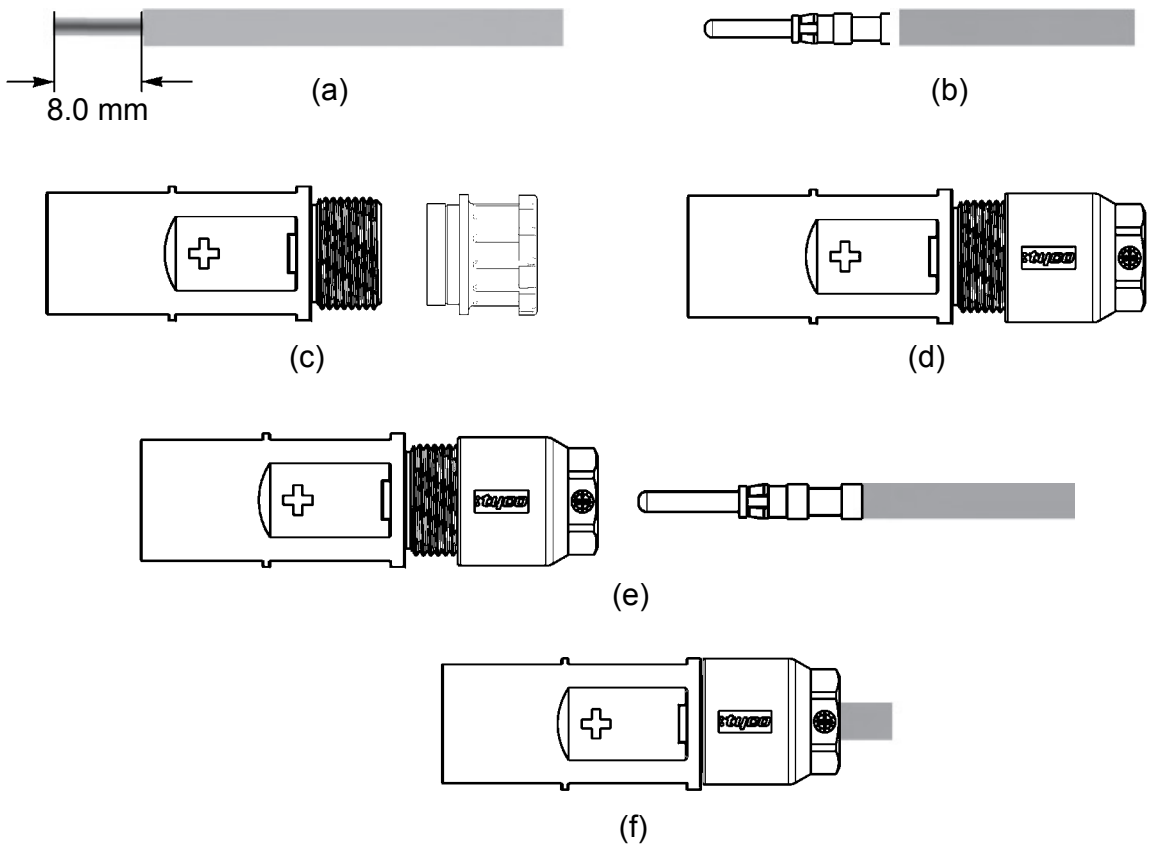
Figure 3. Tyco SolarLok Connector Tools

Cable Stripping Tool
Tyco #1-1579002-2

Crimping Tool
Tyco #1-1579004-2

Extraction Tool
Tyco # 1102855-3

Figure 4. Tyco SolarLok Assembly Steps



(a) Strip the insulation back 8 mm (5/16 in).

(b) Insert the stripped wired into the crimp barrel until it stops. Hold it in place while squeezing the crimp tool until the ratchet releases.

(c) Place the seal/pinch ring combination into the connector housing until it stops.

(d) Place the backshell onto the connector housing.

(e) Push the pin & wire assembly into the connector housing until you hear it click into place.

(f) Tighten the backshell nut to 1.5 N-m.

Chapter 4 Grounding

Solyndra recommends grounding the frames of all panels. Safety requires that Solyndra panel arrays (and all PV arrays) be properly grounded. Correct grounding protects personnel in the event of a panel failure due to breakage, and it protects both personnel and equipment from lightning-related effects.

To avoid electrical shock, ground the panel as soon as it is placed, before doing any other wiring. As the array is built, the first panel of each column should be connected to earth ground as soon as it is placed, using the supplied ground lug or equivalent. As each panel is added, connect a ground strap between it and the previous panel. These connections insure that the aluminum frame is grounded.

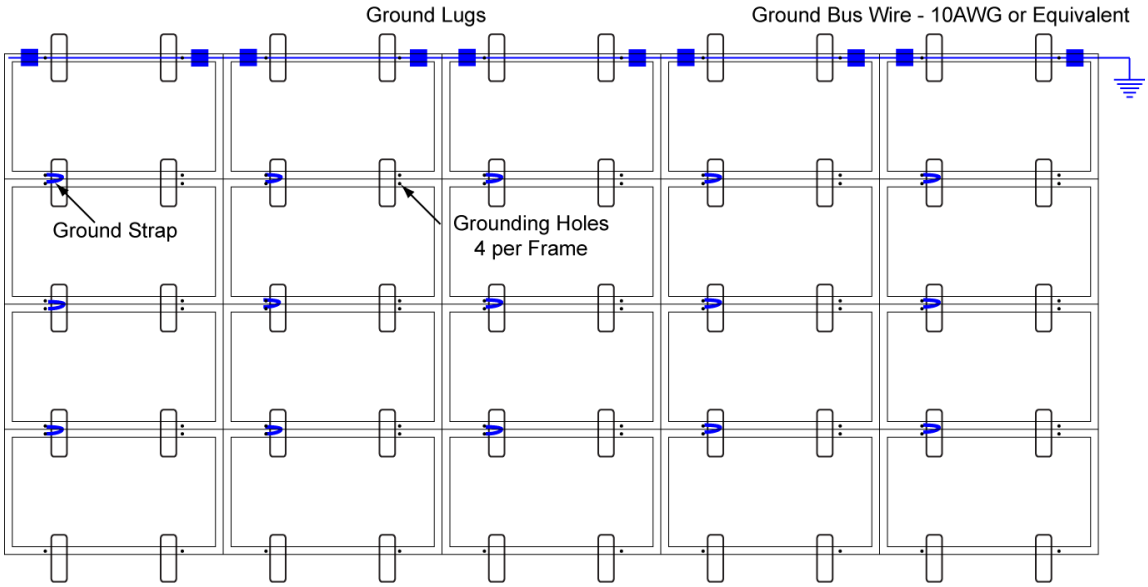
Use a grounding method that meets applicable national and local code requirements. For the US and Canada, these include NEC or CSA C22.1 Safety Standard for Electrical Installations, Canadian Electrical Code Part 1. You may also wish to refer to NEC Article 690 on grounding photovoltaic arrays for specific requirements.

Grounding in the Solyndra system is accomplished by two primary elements: system ground lugs (ILSCO GBL4-DBT) are installed on the first panel in every column. These connect via a 10 AWG solid copper ground wire to system (earth) ground. Panel ground straps are used to insure that the panels in each column are a grounded unit. If local codes require a larger ground wire, you may need to use a different ground lug.

Equipment ground conductors must be connected with stainless steel hardware. Make sure that there is no copper-to-aluminum contact; this will cause rapid galvanic corrosion. A stainless steel washer may be used to isolate copper wire from the aluminum frame.

Solyndra panels can be grounded using a grounding washer or clip system, provided such system has been tested and certified to meet UL467 requirements for bonding and grounding systems, and are installed according to the manufacturer's specifications.

Figure 5. Grounding Connections for Solyndra Array



Chapter 5 Panels & Panel Components

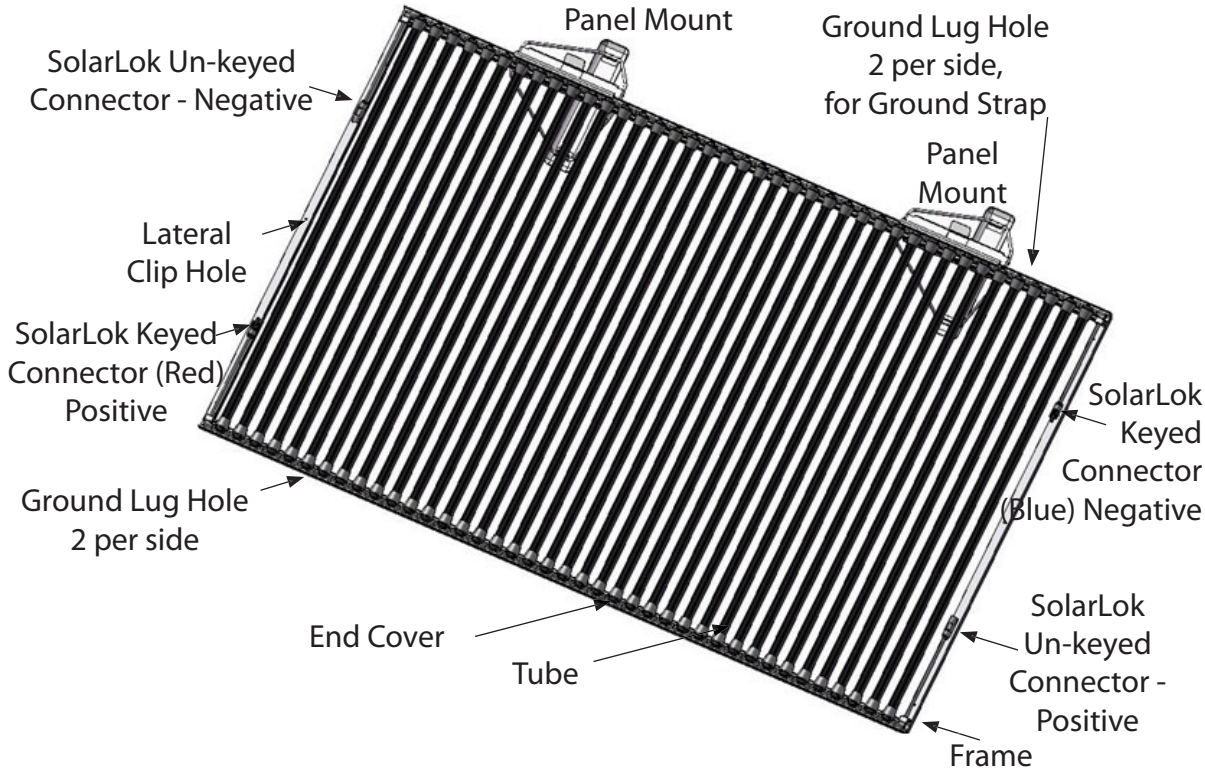
This chapter describes the key components of a Solyndra SL001-Series photovoltaic panel.

Figure 6. Typical Solyndra Photovoltaic Panel Installation

Part Definitions and Identification

Figure 7 shows the major components of a Solyndra PV panel and their names.

Figure 7. Panel Parts and Assemblies



Panel Connectors

Solyndra panels feature a flexible connector system so that panels can be wired in series or parallel. Each panel has a positive keyed connector (marked with red) and a negative keyed connector (marked with blue). In addition, there is a second positive connector that is unkeyed, and a second negative connector that is unkeyed.

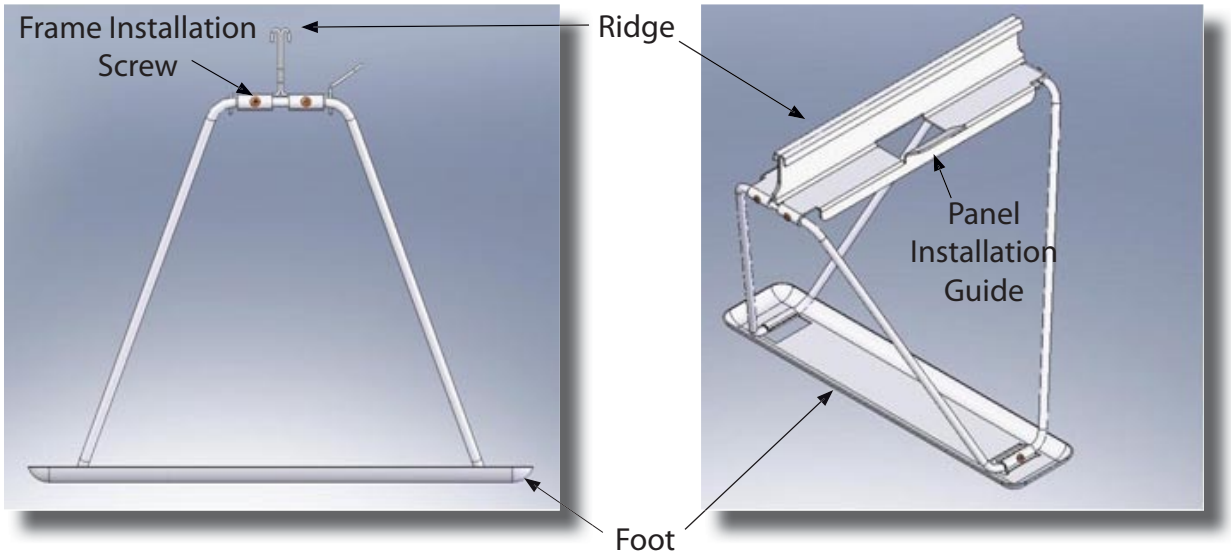
When panels are placed with the short ends abutting, they can be connected in parallel. This is done by connecting the keyed, blue, negative connector to the unkeyed negative connector of the adjacent panel, and likewise connecting the keyed, red, positive connectors to the unkeyed positive connector of the adjacent panel.

Panels abutting along the long edge can be wired in series in a similar manner. Here, the keyed, blue, negative connector is connected to the unkeyed positive connector of the adjacent panel, and the keyed, red, positive connector to the unkeyed negative connector of the adjacent panel.

Panel Mounts

Figure 8 shows a detail of the panel mounts. Note that the mounts are self-ballasting, and do not require any type of roof penetration for mounting. The panel installation guide helps to guide the panel frame into place during installation. The frame installation screws secure the panel to the mount.

Figure 8. Panel Mounts



As an option, Solyndra offers resilient pad material for the bottom the each panel mount foot. There are intended for use on roofs which use a high-reflectivity plastic membrane. Three types are available. Use of this pad material is optional. Check with the maker of the roof membrane material to see if pad use is recommended, or with the building owner. If you elect to use pad material, use the type that matches the roof membrane.

Hardware Kit

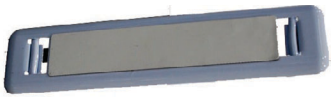
Each panel comes with a hardware kit that includes grounding accessories as well as mounting accessories. ALWAYS ground every panel as soon as it is installed.

There are two sizes of screws. The larger screws are used to attach the panel mounts to the panel. The smaller screws are used for all other purposes. If you need replacement screws, use 301-grade stainless. Do not use plated steel screws.

Table 2. Panel Installation Hardware - Provided as Balance of System

Item	Picture	Part Number	Description
Panel Mount		0040-30175	Panel mount for Solyndra photovoltaic panel. Attached using 1/4-20 screw. Because panels share panel mounts, the number of panel mounts required will vary with each installation.
Panel Mount Screw		0520-30011	1/4-20 x 3/4" Phillips head with star washer, stainless steel, for attaching panel mounts. One needed per panel mount.
General Purpose Screw		0520-00689	10-32 x 1/2" Phillips head with star washer, stainless steel. Used for ground strap (2), lateral clip (2), and ground lug (1). Total number required will vary with installation.
Ground Strap		0011-30029	10 AWG tinned stranded wire with lugs at each end. UL, green jacket. Used between the long side of adjacent panels. Total number required will vary with installation.
Lateral Clip		0020-30213	Used to connect frames together with 10-32 screws. Has teeth on one side; these go against aluminum frame to insure a good connection. Total number required will vary with installation.
OCA Clean-up Kit		0240-30551	Clean up kit in case of panel breakage. One kit needed per building or installation site

Table 3. Panel Installation Hardware - Optional BoS

Item	Picture	Part Number	Description
Cable Tray - Long		0020-30198	Used for routing the home-run cables around the array.
Cable Tray - Short		0020-30199	Used for routing the home-run cables around the array.
Cable Tray Clip		0020-30205	The cable tray clips are installed on the short side of the panel. They are used to support the cable tray that contains the home-run power connections.
SolarLok female connector used for positive lead. Marked with red ring.		0710-00075	Used to connect the home-run cables to the output connection of the strings of the array (1394462-3).
SolarLok female connector used for negative lead. Marked with blue ring.		0710-00077	Used to connect the home-run cables to the output connection of the strings of the array Tyco part number 1394462-4).
SolarLok male connector used for ground, neutral. No color ring.		0710-00379	Used to connect the home-run cables to the output connection of the strings of the array (6-1394461-2).
Type USE-2 #12 AWG		0720-00006	Used to make home-run power cables.
#10 bare copper wire		0720-30061	#10 AWG bare copper wire, suitable for earth ground connections.
Ground Lug		0700-30198	Attaches to panel with a small screw. The wire-clamping portion is open-jawed; permits the use of a continuous length of grounding wire. Also available as Ilsco GBL-4DBT.
Pad, Panel Mount, TPO		0020-30225	Pad for panel mount - TPO type roof membrane junction, at the option of end user.
Pad, Panel Mount, PVC		0020-30226	Pad for panel mount - PVC type roof membrane junction, at the option of end user.
Pad, Panel Mount, EPDM		0020-30227	Pad for panel mount - EPDM type roof membrane junction, at the option of end user.

Chapter 6 Unpacking and Setup

Before starting the panel installation process, review your site preparation checklist (Table 1) to make sure all pre-installation work is complete.

Panels will arrive at the job site fully crated. Have the crates delivered to the roof before uncrating. The crates weigh approximately 450 Kg (1000 lbs), so power equipment is required.

WARNING! Make sure the roof is strong enough to hold the concentrated load of the crate.

Setup is best done in teams. The individual panels are large enough and heavy enough to be awkward for one person to lift or move. It's best to have two people lift, carry, and place the panels.

WARNING! The individual tubes in each panel are glass and will break easily. Never grab or lift the panel by the tubes; they will break. Lift only by the aluminum frame.

Begin by staging all materials, supplies, and tools. Review the contents and make sure that you have everything you need for the installation. In most installations, you will use a resilient pad on the foot of each panel mount. You may wish to attach all these pads before proceeding with assembly.

It's best to have a team of three people for each installation, or if it is a very large installation, five people. In either case, a two-person team will uncrate the panels, attach the mounts, and place the panels. A third person will make the electrical connections at the array.

Figure 9. Typical Panel Crate, and Hardware Staged into Temporary Storage Bins

Figure 10. Panel Mounts, Staged for Installation

Chapter 7 Panel Installation

The installation steps are summarized here, then covered in detail on the following pages.

1. Create the panel layout.
2. Assemble the first panel.
3. Place the first panel.
4. Install the ground wire.
5. Add the next panel.
6. Join the next panel to the array.
7. Make the interpanel electrical connections.
8. Check the panel installation alignment.

Steps 5 to 8 are repeated until the column of panels is complete.

9. Start the next column, via steps 2 to 8.
10. Install the lateral clips.

Steps 9 and 10 are repeated until the array is done.

11. Finalize wire connections.
12. Make the home-run power connections.
13. Connect to the inverter.

Understanding the Panel Mount System

Panel mounts are shared among adjacent panels. Each panel rests on four mounts, but mounts in the interior of the array are shared between two adjacent panels. The first panel in each column has four mounts attached; succeeding panels each have two mounts, and are 'daisy-chained' onto the first panel.

Step 1. Create the Panel Layout

Begin panel installation from the corner closest to the electrical feed and inverter. This is usually the northeast or northwest corner of the array. This manual will refer to that corner as the origin.

Determine that point on the roof, and snap two chalk lines. One should run due east-west from the start point; the other should run due south.

Note: For illustration purposes, it is assumed that your array is oriented north-south. Thus, terms such as east and west will be correct. If the array is oriented differently, please interpret directional terms accordingly.

Step 2a. Assemble the First Panel

Begin installation by having a two-person team remove one panel from the crate. Remember, lift only by the aluminum frame - never grab the tubes.

Orient the panel so the blue-colored Tyco connector is up, as shown. Have the mounts and the 1/4-20 screws used to attach the mounts handy. You should also have a ground strap, a 10-32 screw, and a Phillips screwdriver.

Figure 11. Unpacking the Panels

DANGER! All photovoltaic panels, when exposed to any amount of light, produce lethal voltages. Be careful!

Step 2b. Placing Optional Pads on Feet

In many cases, the design will specify that a plastic pad be place on the foot of the panel mount, so that the pad, rather than the panel mount, contacts the roof surface. If your design specifies the use of pads, place one of the supplied pads on the foot of each panel mount.

Step 2c. Attaching Panel Mounts

While a designated person holds the panel, have your helper place the two mounts along the upper frame rail. Hold them while using a 1/4-20 screw to attach them to the rails. Don't over-tighten the screws. Tighten only to to 24 inch-pounds (2.7 N-m).

These two mounts will also support the neighbor panel in the array.

Figure 12. Attaching the First Two Mounts

Attach a ground strap to a ground hole. The ground holes are just outboard of the panel mounts. Leave the other end of the strap loose; it will be attached to the next panel, after placement.

Note that the last panel in the row does not require a ground strap.

Also install a lateral clip screw, but don't tighten it. Leave about 4 threads exposed.

Figure 13. Lateral Clip Screw

Step 2c. First Panel Only: Adding Two More Mounts

The first panel in each array will have four mounts attached to it. (Additional panels share mounts.) Flip the panel over and rest it in the supplied foam blocks. Do not rest the panel mount edge directly on the roof. It could damage the roof surface.

Install two mounts on the rail as before, but don't install a second ground strap.

Figure 14. Adding Additional Mounts to First Panel

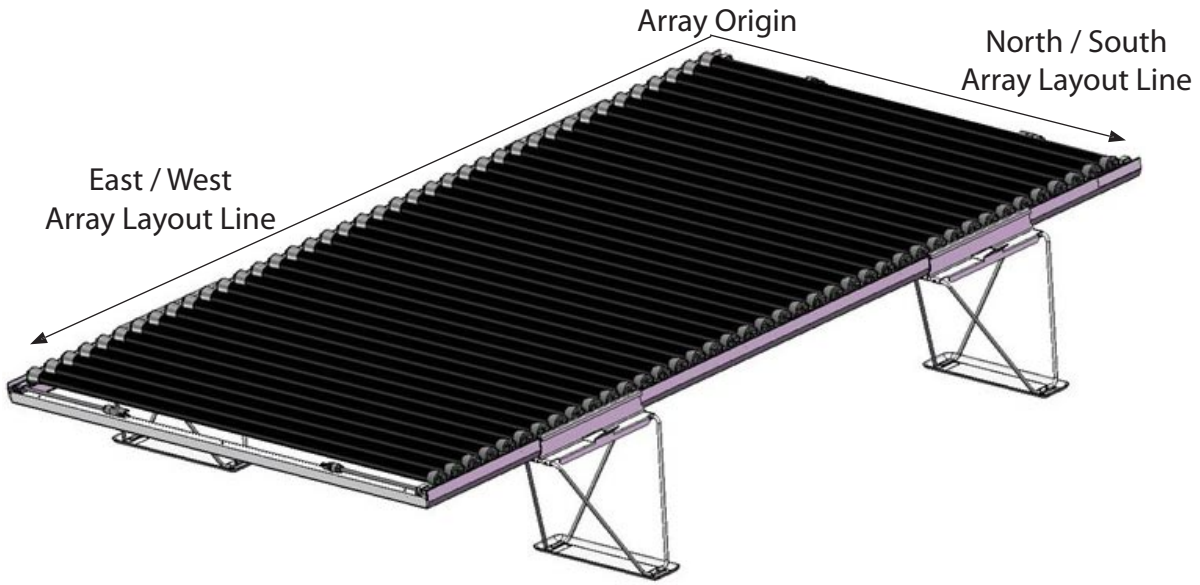
Step 3. Placing the First Panel

Carry the first panel to the starting corner of the array location (usually the northeast or northwest corner), and align it with the chalk lines. Note that the ground strap is oriented on the side AWAY from the corner of the array.

Figure 15. Placing the First Panel

Figure 16 shows the orientation of the panel with respect to the array.

Figure 16. Panel Orientation Relative to Array



Step 4. Installing the Ground Wire

Next, connect the ground lug to the panel frame, using the smaller screw. Tighten only to 24 inch-pounds (2.7 N-m). Then connect the system ground wire to the panel frame.

Note that each panel should be grounded as soon as it is placed. You should maintain the ground connection for the duration of the install period, as well as while in use.

Figure 17. Installing the Ground Wire

Step 5. Adding the Next Panel

The first panel is now installed. The installer crew can begin the second panel, while the person doing electrical connections can proceed with hookup.

Attach just two mounts and a ground strap to the edge of the next panel, as in Step 2. Carry the panel assembly into position.

Figure 18. Adding the Next Panel

Step 6. Joining the Next Panel to the Array

Insert the edge of the panel into the tab on the existing mount, and allow the new panel to pivot, hinge-style, into place. Note that the panel rail engages UNDERNEATH the ridge of the mount. Don't lower the panel all the way yet; make the electrical connections (as shown in the next step) first.

Figure 19. Joining the Panels - Aligning to the Guide

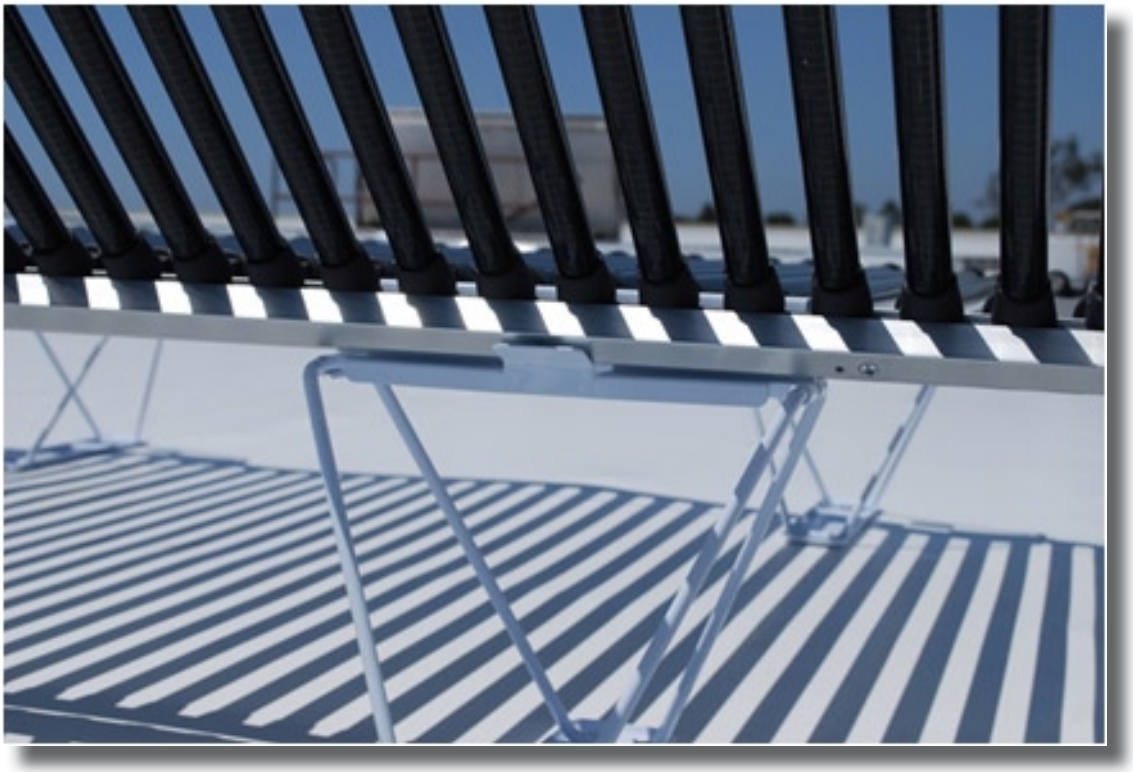
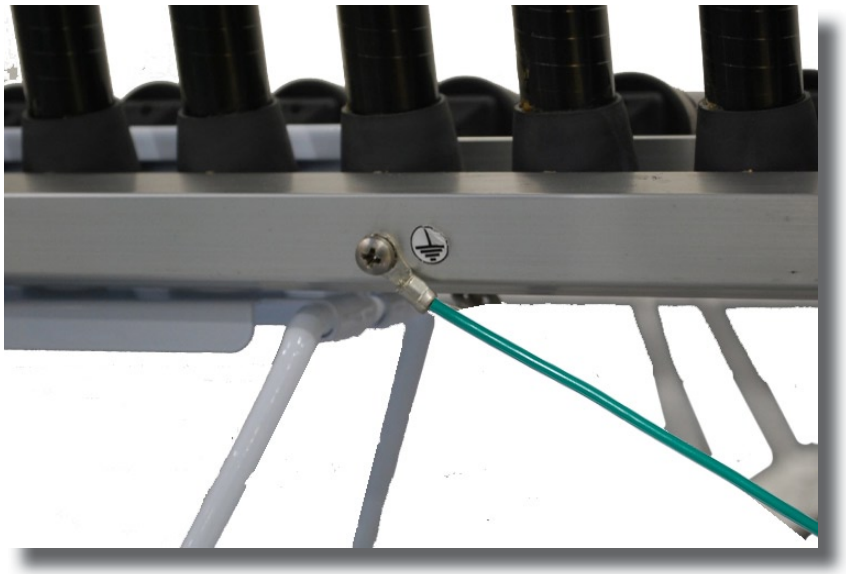


Figure 20. Joining the Panels - Angling Panel Up

Step 7. Making the Interpanel Electrical Connections

Connect the ground strap first. Tighten only to 24 inch-pounds (2.7 N-m).

Figure 21. Connecting the Ground Strap



Then connect both the blue and red power cords on each side of the panel.

Figure 22. Interpanel Electrical Connections

Step 8. Checking Panel Installation Alignment

After making the electrical connections, lower the panel into place. Make sure the ends are correctly aligned with each other, as shown.

Figure 23. Two Panels - Aligned

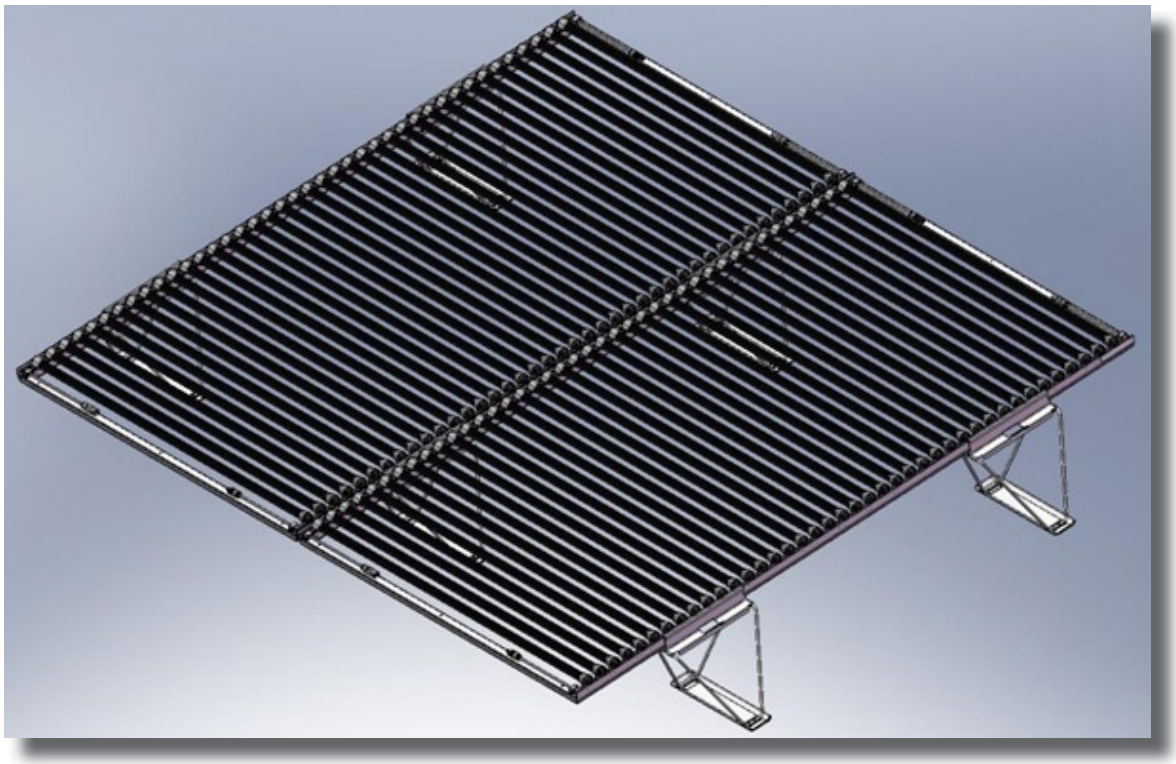
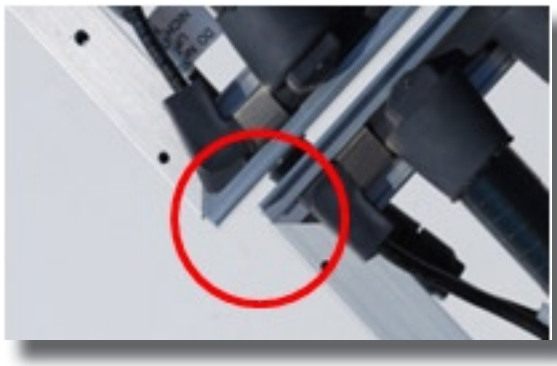


Figure 24. Correct vs Incorrect Alignment

Incorrect Alignment:

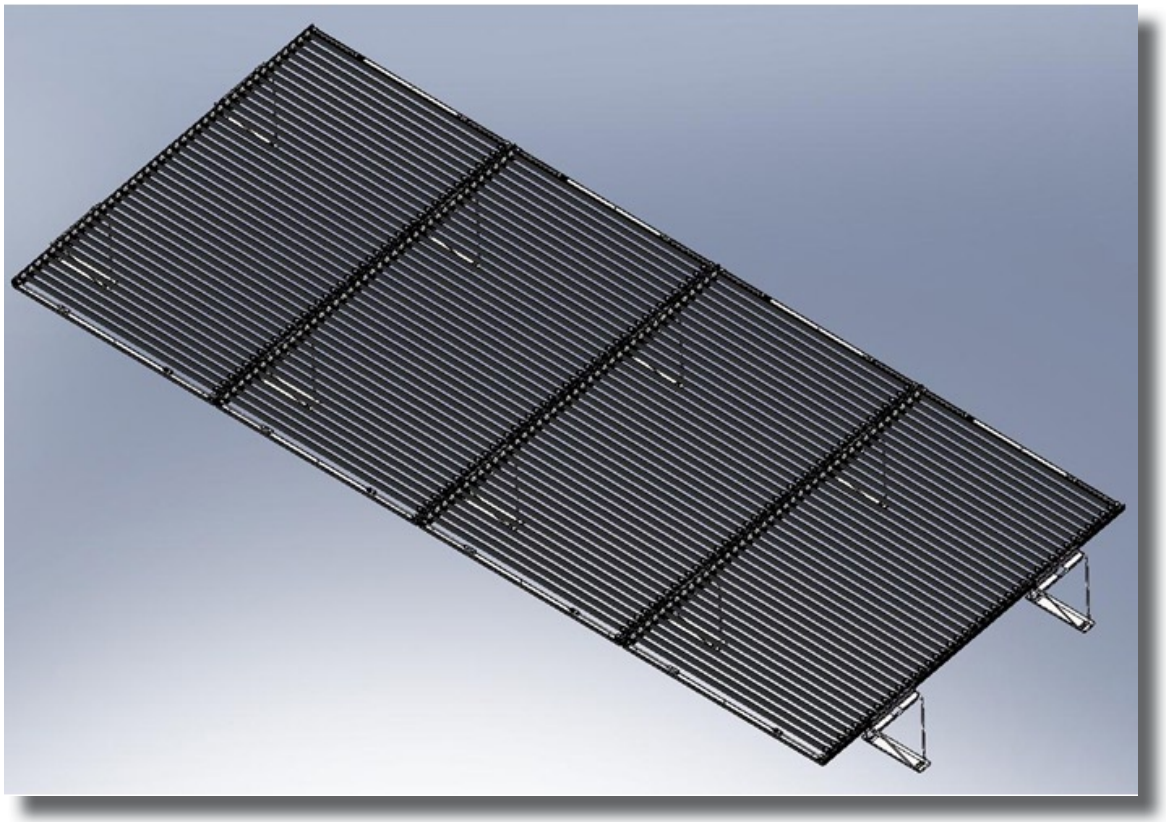


Correct Alignment:

Step 9. The Finished Four-Panel Column

Repeat the installation steps for additional panels to complete a north - south column containing four panels.

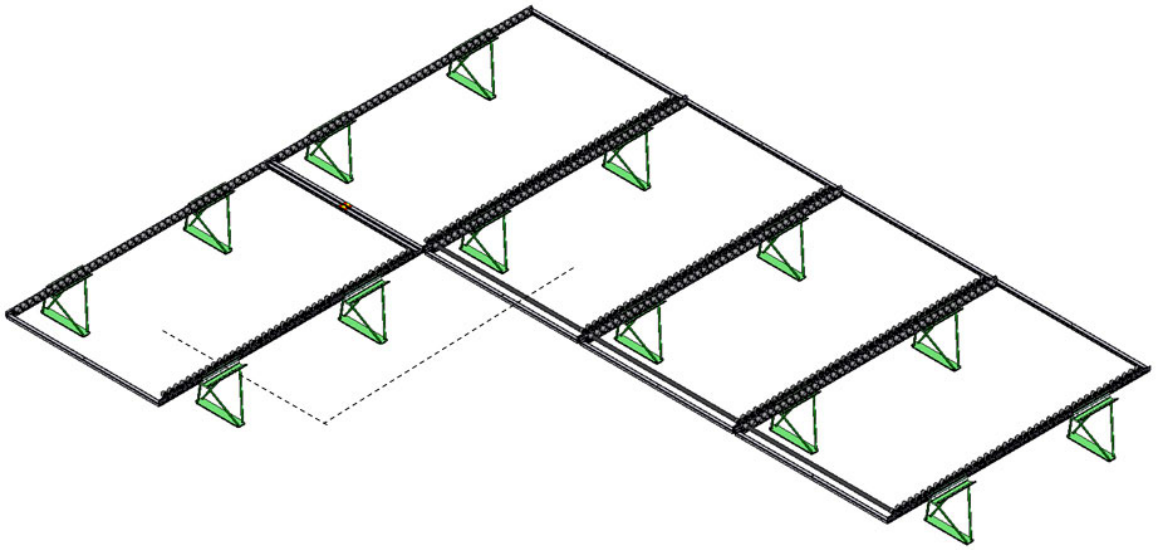
Figure 25. A Completed Four-Panel Column



Step 10. Starting the Next Column

Begin the next column by placing a panel with 4 mounts attached to it. Align the panel approximately 10 mm apart from the previous column.

Figure 26. Row-Column Layout View

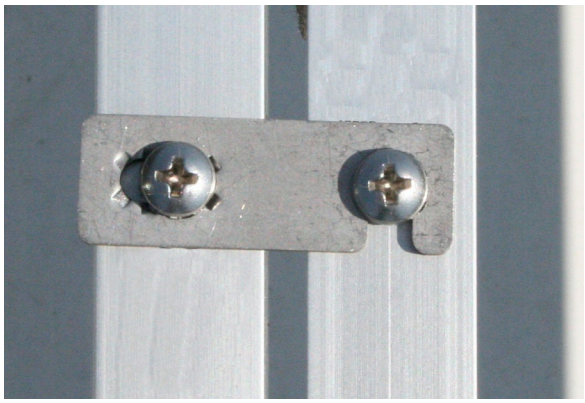


Step 11. Attaching Lateral Clips

As each panel is placed in the second (and succeeding) rows, attach the lateral clip by tightening the previously-installed screws to 24 inch-pounds (2.7 N-m). It's tempting to rest one hand on the tube array for balance, but don't do it.

Figure 27. Attaching Lateral Clips

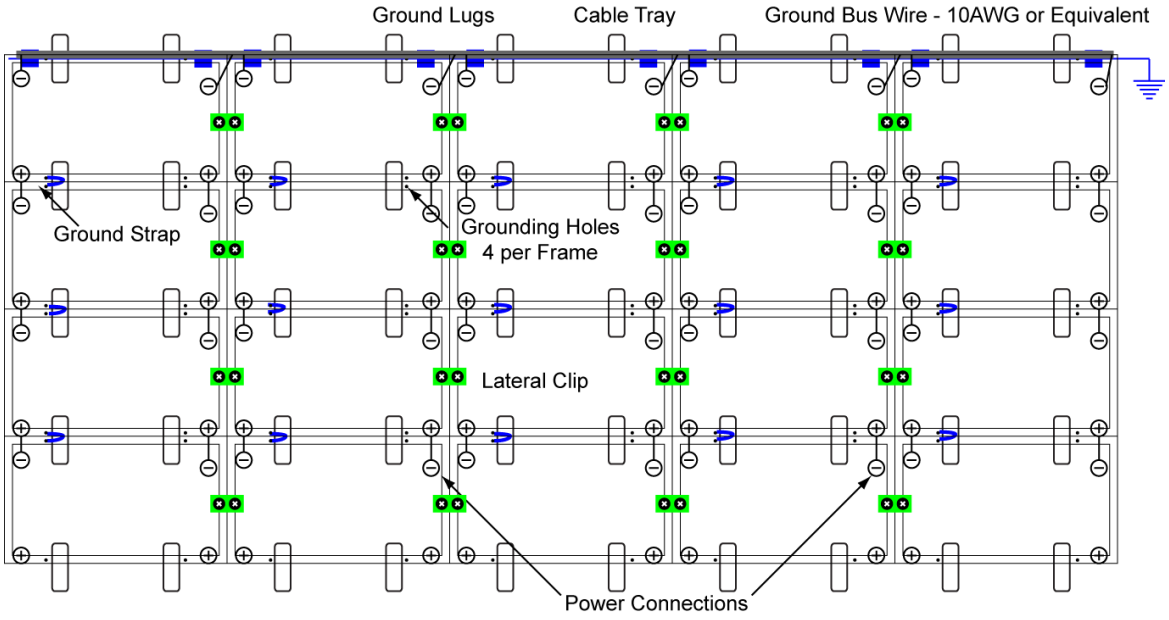
Figure 28. Lateral Clip After Installation



Step 12. Finalizing the Wiring Connections

This schematic shows the connection pattern for the ground straps, lateral clips, and main power connections for a 4 by 5 panel array. Always connect the ground straps and lateral clips as soon as the panel is placed, for safety.

Figure 29. Schematic of Ground Straps, Lateral Clips, and Power Connections



Step 13. Making the Home-Run Power Connections

After all the panels are installed and connected to each other, you will make the final electrical connections. Begin by installing a cable tray mount on each panel at the end of the array, along its short side. Install cable trays on the ends of the array by snapping cable tray into the cable tray mounts. Build Home Run cables to length using Tyco SolarLok® connectors. Connect Home Run cables to North and South strings. Route them through the cable trays to the combiner box location, but DO NOT CONNECT.

Figure 30. Home-Run Power Connections

Step 14. Making the Connections to the Inverter

If your design calls for a combiner box, connect all of the panel cables into it. Then connect its output to the inverter. Otherwise, connect the panel cables directly to the inverter. The output of the inverter is then tied into the grid.

Figures 31 and 32 show typical installations. Your installation will be different. Be sure to follow the plans developed by your installation designer as well as all applicable electrical and building codes.

Figure 31. Typical Combiner Box

Figure 32. Typical Inverter Installation

Chapter 8 Panel Removal

It may be necessary to remove one or more panels for roof access. If so, ground connectivity in the array must be maintained.

Panels must be removed in the reverse order from installation, that is, remove the last panel in a column, and continue removing panels in that column. Leave ground connections in place on each panel until that panel is to be removed.

Two people are required for the task. To remove a panel:

1. Remove the lateral clips.
2. Tip the panel upward
3. Disconnect the power cables.
4. Disconnect the ground strap from the frame.
5. Place the panel where it will not be damaged. If possible, return it to the crate.

Repeat as required until the desired section of roof is reached.

Chapter 9 In Case of Breakage

The Solyndra panel contains a silicone-based Optical Coupling Agent to improve its performance. While this fluid is not toxic, it is slippery. If a panel is broken, you should clean up the spill immediately.

Solyndra supplies a Clean-Up Kit designed expressly for this purpose. The kit is pre-packed in a blue drum, which can be used to hold the material after clean-up. Replacement materials and additional kits are available from Solyndra. The kit is shown in Figure 33, and the contents are listed in Table 4.

WARNING A broken tube still produces voltage. BE CAREFUL when picking up pieces. Wear rubber gloves.

Figure 33. Solyndra Clean-Up Kit

Table 4. Clean-Up Kit Contents

Item	Qty	Unit
Plastic open-top drum, 53 liter	1	each
Plastic bag, 114 liter	2	each
Plastic tie wraps (for bags)	4	each
Plastic dustpan	1	each
Brush for dustpan	1	each
Absorbent mats	40	each
'Simple Green' cleaner, plastic spray bottle	.946	liter
Safety glasses	1	pair
Nitrile (plastic) safety gloves	10	pair
Cut-resistant gloves	1	pair

In the event of panel breakage, immediately stop all other work and clean up the spill. Be sure to keep anyone from walking through the spill area.

1. Put on the safety glasses, nitrile gloves, and cut-resistant gloves.
2. Carefully set the panel to one side. Place a mat (or mats) underneath it to catch any fluid.
3. Pick up all large pieces of broken glass. Temporarily place them in the drum, or another suitable plastic or metal container. (Don't put broken glass in the plastic bags; it will cut the bag.)
   - Be careful; the gloves are cut-resistant but not cut-proof.
   - Broken tubes still produce voltage. DO NOT insert your finger or any metal object inside a broken tube.
4. Use the brush and dustpan to sweep up smaller pieces of glass.
5. Carefully spread the absorbent mats over the spill area.
6. Allow the mats time to absorb the fluid. This only takes a few moments.
7. Pick up the mats and place them in the plastic bags.
8. If there are still puddles of fluid or standing liquid, repeat the mat application.
9. Use the cleaning fluid ("Simple Green" is recommended) to clean up any remaining fluid film. Be sure to clean the bottom of your shoes, and anything else that can in contact with the fluid. Wash the brush and dustpan as well.
10. If possible, remove the stub ends of the broken tubes and place them with the broken glass in the drum.
11. Dispose of the mats and other waste in a manner compliant with all applicable laws. Note that because the fluid is non-toxic, it is permissible for Simple Green-fluid mixtures to flow into sanitary drains in most jurisdictions. Check local laws to be sure.
12. A broken panel cannot be re-used. Package up the broken panel and return it to Solyndra for recycling.

Appendix A Example Wiring Diagrams

Figure 34. System Wiring Diagram - 4 by 5 Panel Array

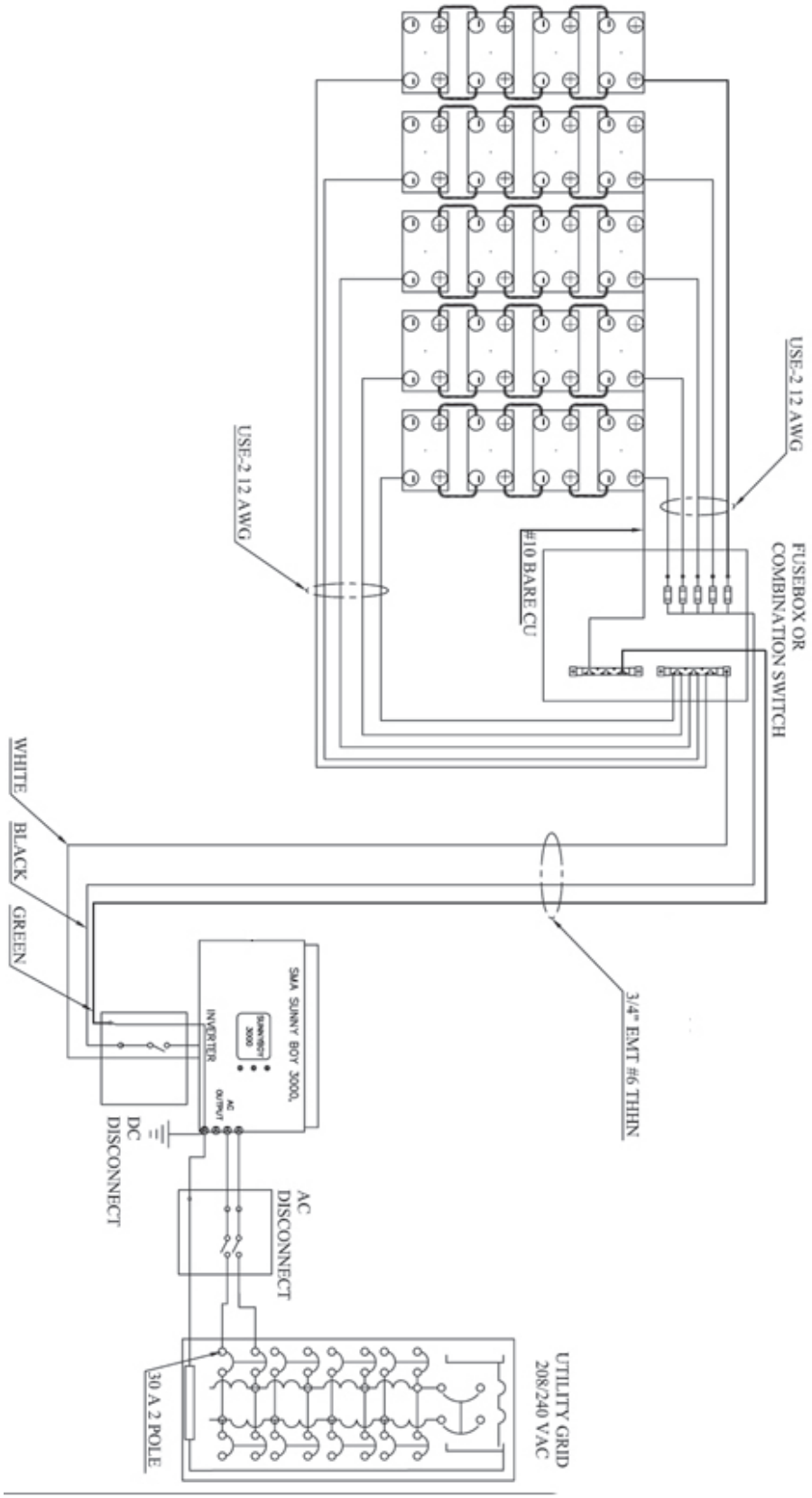
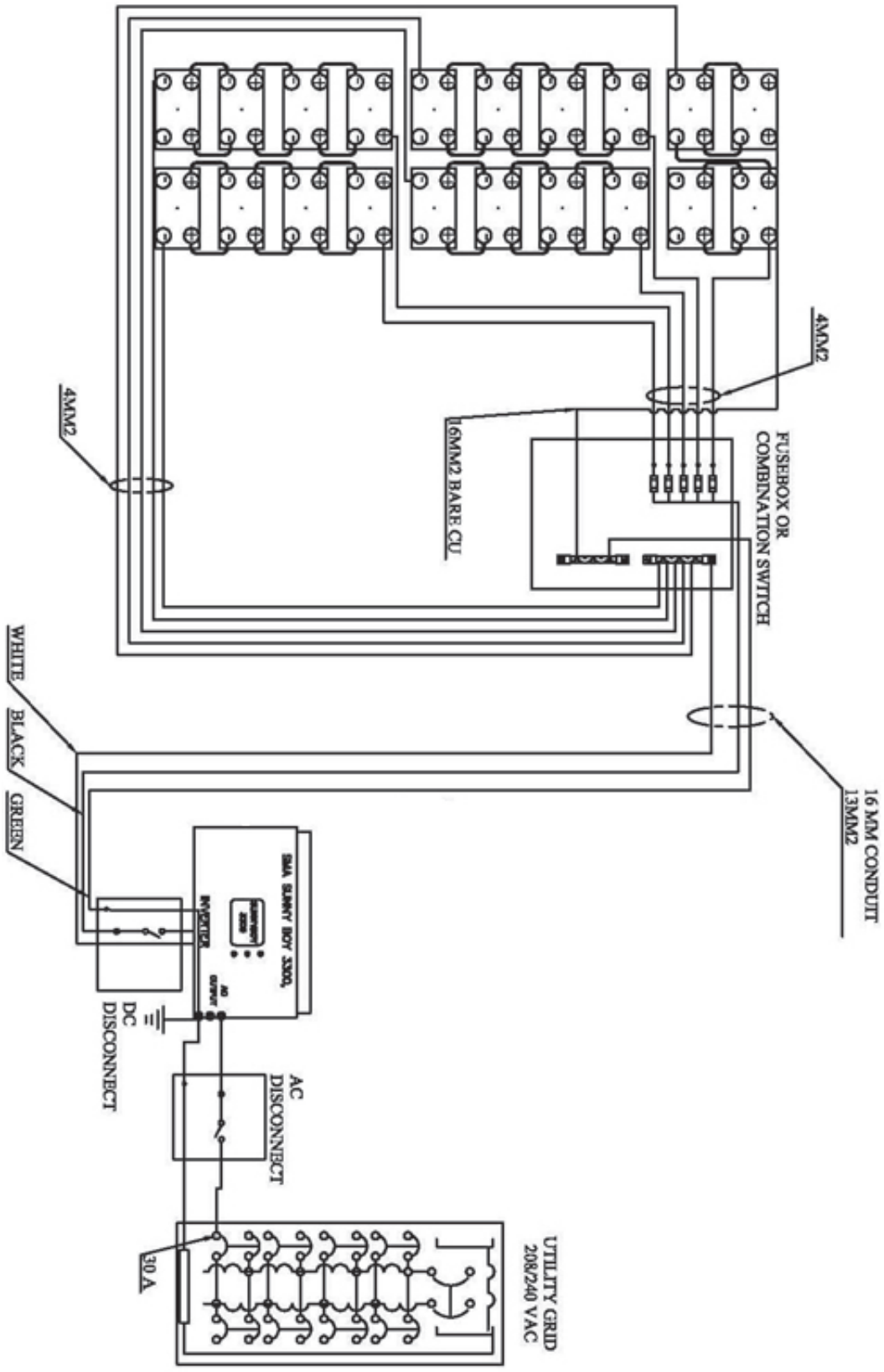


Figure 35. Panel Wiring Diagram - 2 by 10 Panel Array



Revision History

Revision	Part Num	Date	Notes
1.00	0920-30002	18 Aug 2008	Initial Release.
1.01	0920-30002	28 Aug 2008	Corrected fastener torque requirements.
1.1	0920-30002	4 Sep 2008	Updated ground wire photo.
1.2	0920-30002	18 Sep 2008	Changed ground wire photos to new green wire.
1.3	0920-30002	2 Oct 2008	Added new Solyndra logo.

Safety First

DANGER! You will be working on a rooftop. Even a 4 to 6 meter fall can cripple or kill. Be careful.

You can be electrocuted. Unlike regular electrical work, where power can be switched off, a photovoltaic panel produces voltage whenever there is light. Even at modest levels of illumination, there is enough voltage to kill.

WARNING! Solyndra panels are made from glass tubes. The tubes can be broken. If they are, there are two hazards you must deal with:

1. Broken glass.
2. Leaking OCA fluid. While this fluid is not toxic, it is EXTREMELY slippery. Any spill should be cleaned up immediately.

Your shipment includes a clean-up kit. Instructions can be found in Chapter 9.

Safety Rules

- Crates must always be stacked so panels are oriented with the tubes horizontal, that is, with the panels on ends.
- Two people are required to move each panel.
- DO NOT carry more that one panel at a time.
- Carry and lift panels from edge of metal frame.
- NEVER carry or move panels by grabbing the glass tubes.
- NEVER lean or sit on panels.
- DO NOT place anything on panels. This could damage the glass tubes or shade the panels, causing improper operation.
- DO NOT place panels in areas where persons may walk on them or trip over them.
- DO NOT carry objects that might obstruct your view of the floor while in the vicinity of the panels.

Solyndra panels are intended to be used over highly reflective surfaces, but no other artificially concentrated sunlight should be directed onto the panel.