**SECTION 48 14 00 – BIPV PV SYSTEMS OVER STANDING SEAM METAL ROOF SYSTEMS**

1. GENERAL
   * + 1. SUMMARY
          1. Section includes architectural Standing Seam Metal panels integrated with flexible thin-film PV module fully adhered with a self-adhesive to the surface of the Metal Roof panel substrate where indicated on the drawings. Also included, are all necessary trims, fasteners and sealants, BIPV modules and ridge cap and/or cable tray(s) as required for a weathertight installation. Standing seam Metal panels shall be secured to the structure with concealed clips and fasteners in the side joints. Metal panels may be mechanically seamed or snapped-locked assembled depending on the roof slope and metal panel profile.
          2. Flexible thin-film PV modules ***[shall] or [shall not]*** be factory laminated by the Standing Seam Manufacturer to the surface of the Metal Roof panel substrate. The Standing Seam Roof Manufacturer shall coordinate with the Architect on locations and appearance of all BIPV Standing seam panels and Ridge and/or Mid Roof cable trays. All locations must be approved by the Architect prior to installation.
          3. Flexible thin-film PV modules [***shall] or [shall not]*** be installed in the field by the Standing Seam Roofing Contractor to the surface of the Metal Roof panel substrate. The Standing Seam Roof Contractor shall coordinate with the Architect on locations and appearance of all BIPV Standing seam panels and Ridge and/or Mid Roof cable trays. All locations must be approved by the Architect prior to installation.
          4. The PV array in this document shall be grid connected and ***[shall or shall not]*** not include battery storage or any backup power components. The PV system shall feed AC power into the local service when solar energy is available and shall immediately disconnect from the grid upon loss of grid power to the service as per IEEE and local utility regulations.
          5. The PV system shall comply with these specifications, the construction document drawings, all applicable codes and all local authorities having jurisdiction and all applicable incentive program guidelines. The equipment includes, but not limited to, architectural Standing seam Metal Roof systems (Section 07 41 00), flexible CIGS laminate PV modules and wire management system by the Roofing Contractor. Inverters, wire, conduit, junction boxes, combiner boxes, AC/DC disconnects; panel grounding system monitoring and other related equipment shall by furnished by the Electrical Contractor.
          6. Fall arrest protection per OSHA 1926 Subpart M shall be provided for all work on top of BIPV Standing Seam Roof and Standing Seam Contractor shall offer safe protection to Electrical Contractor to connect BIPV module connectors in the Ridge and / or Mid Roof cable trays.
          7. The Standing Seam Metal Roof Contractor shall notify the Construction Manager a minimum of 5 days before closing in of Ridge Cap and / or Mid Roof cable trays so the Electrical Contractor can be notified to complete wiring on Roof
          8. Electrical Contractor shall provide access to equipment for maintenance and service as required by the manufacturer’s instructions and/or applicable codes.
          9. The Electrical Contractor shall coordinate with the Owner/Architect on locations and appearance of all exposed equipment, including but not limited to Inverters, wire, conduit, junction boxes, combiner boxes, AC/DC disconnects, system monitoring and other related equipment. All locations must be approved by the Owner/Architect prior to installation.
          10. The Electrical Contractor shall be responsible for electrical tie in of the PV system to the main Utility Box per drawings.
          11. The Electrical Contractor shall comply with all requirements of Division 26 – ELECTRICAL in the specifications and with the conditions of the Contract.
          12. The Electrical Contractor shall provide and install all electrical system labels and signage as required by NEC 690.51 and local authorities.
          13. The Prime or Roofing Contractor shall comply with the general conditions of this specification for requirements for submittals, testing, training, warranty, permits, fees, clean up and all other general items, in addition to any specific requirements of this section.
          14. Work shall comply with the requirements set forth by all applicable codes, standards, local authorities, utilities and manufacturer’s instructions/recommendations.
          15. The Electrical Contractor shall examine the architectural and electrical drawings to determine related requirements.
          16. All work, including equipment, materials and installation shall conform to the Uniform Building Code (UBC), NFPA-70, The National Electrical Code and Uniform Fire Code, editions under local jurisdiction. Check with local Fire Marshall for PV module placement for Roof top access at perimeter eaves, rake, valleys and ridge. Certain PV module placement may require Fire Marshall waivers.
          17. Related Sections:

Section 07 41 00 Architectural Standing Seam Metal Roof Systems

Section 07 62 00 Sheet Metal , Flashings and related work

Section 07 92 00 Sealants

*Section [****26 10 00 Medium-Voltage Electrical Distribution****].*

Section *[****26 20 00 Low-Voltage Electrical Transmission****].*

Section [48 14 00 Solar Energy Electrical Power Generation Equipment].

Section [***48 19 00 Electrical Power Control Equipment****].*

Section [**\_\_\_\_\_\_**].

* + - 1. REFERENCES
         1. Definitions:

NOCT: Normal operation cell temperature.

STC: Values of standard test conditions.

* + - * 1. Reference Standards:

American National Standards Institute (ANSI):

ANSI/UL 1703 Standard for Flat-Plate Photovoltaic Modules and Panels.

International Electrical Commission (IEC):

IEC 61646 Thin-film terrestrial photovoltaic (PV) modules - Design qualification and type approval.

IEC 61730-1 International Standard - Photovoltaic (PV) module safety qualification - Part 1 - Requirements for construction

IEC 61730-2 International Standard - Photovoltaic (PV) module safety qualification - Part 2 - Requirements for testing.

Underwriters Laboratories, Inc. (UL):

UL 250 Grounding.

UL 580 Standard test for Wind Uplift

UL 741 Inverters

UL 790 Standard Test Methods for Fire Tests of Roof Coverings.

UL 1703 Standard for Flat-Plate Photovoltaic Modules and Panels.

IEEE Standards

IEEE 1262 PV Module Qualifications for Performance and Reliability

IEEE 929 Inverter Interconnection Standard

* + - 1. ADMINISTRATIVE REQUIREMENTS
         1. Coordination: Coordinate work of this Section with work of other trades for proper time and sequence to avoid construction delays. Comply *with* ***Section [01 31 00 - Project Management and Coordination].***

**[\_\_\_\_\_\_].**

* + - * 1. Preinstallation Meetings: Conduct preinstallation meeting [**one week**] prior to commencing work of this Section. Comply with **Section [01 31 19 - Project Meetings].**

**[\_\_\_\_\_\_].**

* + - * 1. Sequencing: Sequence work of this section in accordance with ***Section [01 12 16 - Work Sequence] [and manufacturer's written recommendations for sequencing construction operations].***

**[\_\_\_\_\_\_].**

* + - * 1. Scheduling: Schedule work of this Section in accordance with ***Section [01 32 13 - Scheduling of Work].***

**[\_\_\_\_\_\_].**

* + - 1. ACTION SUBMITTALS
         1. General: Submit listed submittals in accordance with Contract Conditions and ***Section [01 33 00 - Submittal Procedures].***
         2. Product Data: Submit specified products as follows:

Manufacturer's product data, including manufacturer's Data product sheet.

Manufacturer’s installation guide

Catalog pages illustrating products to be incorporated into project.

* + - * 1. Shop Drawings: Indicate information on shop drawings as follows:

Layout and orientation of modules.

Roof surfaces and slopes.

Location of inverter, combiner box and disconnects.

Penetration plan.

Mounting details.

Electrical connection details.

String, wiring, and grounding plan details.

* + - 1. INFORMATION SUBMITTALS
         1. General: Submit listed submittals in accordance with Contract Conditions **and *Section [01 33 00 - Submittal Procedures].***
         2. Test and Evaluation Reports:

Certified test reports showing compliance with specified performance characteristics and physical properties.

* + - * 1. Manufacturer's Instructions: Submit manufacturer's storage and installation instructions.
        2. Source Quality Control: Submit documentation verifying that PV components specified in this Section are from a single manufacturer.
        3. Manufacturer’s Reports: Manufacturer's shall submit copies of Project Pre-Notification and Request for Warranty forms to ***[Architect] [Owner] [Consultant*].**
        4. Qualification Statements:

Submit letter of verification for Manufacturer's Qualifications.

Submit letter of verification for Installer's Qualifications.

* + - 1. CLOSEOUT SUBMITTALS
         1. General: Submit listed submittals in accordance with Contract Conditions and ***Section [01 33 00 - Submittal Procedures].***
         2. Operation and Maintenance Data:

Submit operation and maintenance data for installed products in accordance with **Section *[01 78 23 - Operation and Maintenance Data]*. Include:**

Manufacturer's instructions detailing maintenance requirements.

* + - * 1. Warranty Documentation: Submit warranty documents specified.
      1. QUALITY ASSURANCE
         1. Qualifications:

Manufacturer:

Having 5-years’ experience manufacturing components similar to or exceeding requirements of project.

Having sufficient capacity to produce and deliver required materials without causing delay in work.

Capable of providing technical support during construction.

Installer:

Acceptable to the PV and Roof manufacturer, experienced in performing work of this section and has specialized in installation of work similar to that required for this project.

Electrical Contractor licensed

* + - 1. DELIVERY, STORAGE & HANDLING
         1. Delivery and Acceptance Requirements:

Deliver material in accordance with manufacturer's written instructions.

Deliver materials in manufacturer's original packaging with identification labels intact and in sizes to suit project.

* + - * 1. Storage and Handling Requirements:

Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

* + - * 1. Packaging Waste Management:

Separate waste materials for recycling in accordance with ***Section [01 74 19 - Construction Waste Management and Disposal].***

Remove packaging materials from site and dispose of at appropriate recycling facilities.

Collect and separate for disposal ***[paper] [plastic] [polystyrene] [corrugated cardboard****]* packaging ***material [in appropriate onsite bins]*** for recycling.

Fold Metal and plastic banding. Flatten and place in designated area for recycling.

Remove pallets from site and dispose

* + - 1. WARRANTY
         1. PV Module Manufacturer’s Standard 25-year Power Warranty
         2. Inverter Manufacturer’s Standard 15-year Warranty
         3. Wire Management System’s Standard 25-year Warranty
         4. The Standing seam Metal Roof Contractor shall issue a separate five (5) year warranty against defects in installed materials and workmanship, beginning from the date of substantial completion of the installation.
         5. Electrical Contractor shall warrant that the PV Electrical work conforms to the Contract requirements and is free of defects.
         6. Any defective materials or inferior workmanship during installations and/or the warranty period shall be corrected immediately to the satisfaction of the Owner/Architect.
         7. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Standing Seam Roof Manufacturer shall provide a five (5) year workmanship warranty for thin-film PV modules factory laminated to the manufacturer’s Standing seam Metal Roof panels. Manufacturer's warranty is in addition to, and does not limit, other rights Owner may have under other Contract Documents.

PV Module Warranty Term:

Freedom from Defects in Materials and Workmanship: 5 years, commencing on date of substantial completion.

90 Percent of Minimum Power Output: 10 years, commencing on date of substantial completion.

80 Percent of Minimum Power Output: 25 years, commencing on date of substantial completion.

1. PRODUCTS
   * + 1. SOLAR ELECTRIC PV MODULES
          1. Manufacturer: Miasole Hi-Tech

Contact: Miasole 2590 Walsh Ave Santa Clara, CA 95051 USA 408-919-5700 [WWW.Miasole.com](http://WWW.Miasole.com)

Single Source Responsibility: Provide components and materials specified in this section from a single manufacturer.

Substitution Limitations:

Substitutions: Request for substitutions must be submitted in writing with backup documentation twenty-one (21) days prior to the bid date. Substitute PV module must be flexible laminate modules based on a CIGS technology and provide a minimum of 15% power efficiency and meet the current module power output, performance and warranties including full adhesion. *Rack mounted crystalline PV system will not be considered due to Roof’s load limitations or wind zone or building design.*

* + - * 1. Description:

Regulatory Requirements:

In accordance with ***Section [01 41 00 - Regulatory Requirements].***

***[\_\_\_\_\_\_].***

Sustainability Characteristics:

**[\_\_\_\_\_\_].**

Compatibility:

Ensure components and materials are compatible with specified accessories and adjacent materials.

**Flexible PV Module Size: FLEX 02N Series (115-watts to 130-watts)**

Length: 102.3 inches (2598 mm).

Width: 14.6 inches (370 mm).

Height: 0.1 inches (2.5 mm).

Weight: 0.6 pounds per SF.FT.(2.9 kg) with adhesive

**Flexible PV Module Size: FLEX 02NL Series (265-watts to 305-watts)**

Length: 233.2 inches (5923 mm).

Width: 14.6 inches (370 mm).

Height: 0.1 inches (2.5 mm).

Weight: 0.6 pounds per SF.FT.(2.9 kg) with adhesive

Material Composition: Flexible polymer encapsulated Copper- Indium – Gallium – Diselenide (CIGS) photovoltaic modules with factory applied self-adhesive/release film, bypass diodes and MC4 compatible connectors.

* + - * 1. Performance/Design Criteria:

Certified according IEC 61646.

Certified according to IEC 61730

Complies with UL 790, Class A slope 1/12 Class C 1.5/12+.

Listed to ANSI/UL 1703.

CEC listed

UL 580 wind uplift tested

* + - * 1. **Model FLEX 02N 125-watts PV module with self-adhesive and MC4 connectors.**

Maximum Power (Pmax): STC 1000W per m2: 125W.

Voltage at Pmax (Vmpp): STC 1000W per m2: 31.8V.

Current at Pmax (Impp): STC 1000W per m2: 3.94A.

Short Circuit Current (Isc): STC 1000W per m2: 4.35A.

Open Circuit Voltage (Voc): STC 1000W per m2: 39.6V.

Module Efficiency: 16.4 percent.

Power Tolerance: +5/-0

Temperature Coefficient of Isc: 0.003 % /degree C.

Temperature Coefficient of Voc: -0.36 degrees % / degree C.

Temperature Coefficient of Pmpp: -0.40 % / degree C.

NOCT: 48 % / degrees C.

Maximum Series Fuse Rating: 10A.

Application Class, IEC 61730: Class A.

Maximum System Voltage:

NEC Rating: 600V.

IEC Rating: 1000V.

* + - * 1. **Model FLEX 02N 130-watts PV module with self-adhesive and MC4 connectors**.

Maximum Power (Pmax): STC 1000W per m2: 130W.

Voltage at Pmax (Vmpp): STC 1000W per m2: 32.5V

Current at Pmax (Impp): STC 1000W per m2: 4.00A.

Short Circuit Current (Isc): STC 1000W per m2: 4.35A.

Open Circuit Voltage (Voc):STC 1000W per m2: 40.1V.

Module Efficiency: 17.0 percent.

Power Tolerance: +5/-0

Temperature Coefficient of Isc: 0.008 % /degree C.

Temperature Coefficient of Voc: -0.36 degrees % / degree C.

Temperature Coefficient of Pmpp: -0.40 % / degree C.

NOCT: 48 % / degrees C.

Maximum Series Fuse Rating: 10A.

Application Class, IEC 61730: Class A./ C

Maximum System Voltage:

NEC Rating: 600V.

IEC Rating: 1000V.

* + - * 1. **Model FLEX 02NL 285-watts PV module with self-adhesive and MC4 connectors.**

Maximum Power (Pmax): STC 1000W per m2: 285W.

Voltage at Pmax (Vmpp): STC 1000W per m2: 72.3V

Current at Pmax (Impp): STC 1000W per m2: 3.94A.

Short Circuit Current (Isc): STC 1000W per m2: 4.54A.

Open Circuit Voltage (Voc): STC 1000W per m2: 90.0V.

Module Efficiency: 15.8 percent.

Power Tolerance: +10/-0

Temperature Coefficient of Isc: 0.003 % /degree C.

Temperature Coefficient of Voc: -028 degrees % / degree C.

Temperature Coefficient of Pmpp: -0.40 % / degree C.

NOCT: 48 % / degrees C.

Maximum Series Fuse Rating: 10A.

Application Class, IEC 61730: Class A.

Maximum System Voltage:

NEC Rating: 600V.

IEC Rating: 1000V.

* + - * 1. **Model FLEX 02NL 305-watts PV module with self-adhesive and MC4 connectors**.

Maximum Power (Pmax): STC 1000W per m2: 305W.

Voltage at Pmax (Vmpp): STC 1000W per m2: 75.3V

Current at Pmax (Impp): STC 1000W per m2: 4.05A.

Short Circuit Current (Isc): STC 1000W per m2: 4.57A.

Open Circuit Voltage (Voc):STC 1000W per m2: 92.1V.

Module Efficiency: 16.9 percent.

Power Tolerance: +5/-0

Temperature Coefficient of Isc: 0.008 % /degree C.

Temperature Coefficient of Voc: -0.28 degrees % / degree C.

Temperature Coefficient of Pmpp: -0.40 % / degree C.

NOCT: 48 % / degrees C.

Maximum Series Fuse Rating: 10A.

Application Class, IEC 61730: Class A./ C

Maximum System Voltage:

NEC Rating: 600V.

IEC Rating: 1000V.

* + - 1. ACCESSORIES
         1. Wire Management System

Solar Raceway 6 Cairn Street Rochester NY 14611 USA 585-328-2011 [www.solarRaceway.com](http://www.solarRaceway.com) [info@solarraceway.com](mailto:info@solarraceway.com)

.

* + - * 1. Inverters – Based on System Size

Minimum Inverter Efficiency: 97% (year 1). See degradation requirements below.

Indoor inverter placement is preferable, in proximity to the Utility net-meter and REC meters; do not place exterior-rated inverters on south or west facades

Inverter capacity must be >= 105% of array DC Standard Test Conditions (STC) Wattage

Consider string inverters where possible, to reduce need for combiner boxes.

Quantities and sizes:

* < 50 KW capacity: 2-3 equally sized inverters (if possible given Roof layout and interconnection voltage).
* Between 50 and 100 KW capacity: 3-5 equally sized inverters (if possible given Roof layout and interconnection voltage)
* > 100 KW capacity: approx. one inverter per 20-30 KW capacity, equally sized,

no single inverter to exceed 40 KW.

* + - * 1. Basis of Design: ABB (Power-One), Solectria, SMA, or approved equal

1. EXECUTION
   * + 1. EXAMINATION
          1. Verification of Conditions: Verify that conditions of substrates previously installed under other sections or contracts are acceptable for product installation in accordance with manufacturer's instructions prior to solar electric module installation.

Inform *[****Owner****] [****Architect****] [****Consultant****]* of unacceptable conditions immediately upon discovery.

Proceed with installation only after unacceptable conditions have been remedied *[****and after receipt of written approval from*** *[****Owner****]**[****Architect****]**[****Consultant****]].*

[**\_\_\_\_\_\_**].

* + - 1. PREPARATION
         1. Ensure Roof structure is adequate to support solar PV module(s).
         2. Surface Preparation: Prepare surface in accordance with manufacturer's written recommendations and coordinate with ***Section [01 71 00 - Examination and Preparation].***

***[\_\_\_\_\_\_].***

* + - * 1. ***Demolition/Removal:***

***[\_\_\_\_\_\_].***

* + - 1. FLEXIBLE PV MODULE INSTALLATION
         1. Coordinate installation of components in accordance with ***Section [01 73 19 - Installation****]* and PV module manufacturer's written installation instructions.
         2. Coordinate PV module work with work of other trades for proper time and sequence to avoid construction delays.
         3. Roofing Contractor shall install PV modules over Roof manufacturer’s approved Standing Seam Metal Panel for BIPV integrated solar arrays.
         4. Metal panel to be from 16.00-inches (406.4mm) to 20-inches (508mm). Metal panel shall have no pencil beads or striations and shall have a flat pan. When the height of the seam leg exceeds 2.0-inches (50.8mm), Contractor shall use an 18-inch wide panel to reduce shading of the module.
         5. Do not place PV module j-box behind the Z-closure. Do not cut or penetration the flexible PV module.
         6. On new construction projects, Metal Roofing Contractor shall apply the flexible thin film PV modules on the ground. Metal Standing Seam Panel shall be placed on a solid substrate and be fully supported. Remove any protective film. Clean Metal Standing Seam Panel with Isopropyl alcohol (IPA) 70% and a clean rag. Allow alcohol to flash off and dry. Change rags frequently.
         7. On existing Standing Seam Metal Roofs, power wash roof and repair any seams or metal panels and flashings. Clean Metal Panel surface with Isopropyl alcohol (IPA) 70% and a clean rag.
         8. Place flexible PV module on Standing Seam Metal Panel with the j-box located up slope. PV module placement shall account for set back from ridge cap Z-closure and as required by the local Fire Marshall and building code.
         9. Use the same PV module application method for new Roof Panels or existing Roof Panels.
         10. Lift up module at j-box area – keep centered and remove the first 18-to-24 inches of adhesive release film. Set module down and apply hand pressure to seat and then roll with a silicone hand roller applying sufficient pressure to insure PV module is fully bonded to the Metal panel substrate.
         11. Lift up back end of the flexible PV module and continue to peel back the self-adhesive release film while using a hand bond module smoothly to the Metal Panel substrate avoiding the creation of any air bubbles or fishmouths. Once entire module is bonded to the Metal Panel substrate, roll out module with the silicone hand roller applying sufficient pressure to insure PV module is fully bonded to the surface.
         12. Following the architect approved Roof and module layout plan. Install Metal Panels onto the Roof according to the Metal Roof Manufacturer’s written guidelines.
         13. Once all the Standing Seam Metal Panels and PV modules are installed. Install the wire management system. Do not close Ridge Cap or Mid-Roof Wire Management until the work has been inspected.
      2. WIRE MANAGEMENT SYSTEM
         1. Roofing Contractor shall install Mid-Roof Wire Management .per the project drawings. Mid-Roof Wire management shall be attached to the Metal Roof Panel substrate with a two-sided tape adhesive or and approve Metal Roof Panel Clamp.
         2. Electrical Contractor shall enclose all PV module power conductors and connected the strings within the Wire Management Systems. Electrical Contractor shall ground the Wire Management System and complete the wiring to the remainder of the Balance of System Components.
      3. MANUFACTURER’S TECHNICAL SUPPORT
         1. Manufacturer Services:

Roof and PV manufacturers shall review manufacturer’s Project Pre-Notification Form completed by the installer and upon approval shall submit immediately **to [Owner] [Architect] [Consultant].**

Roof and PV Manufacturers shall review Installer’s Roof plan and module layout to verify the planned module installation meets module and Roof manufacturer’s requirements and upon approval shall submit immediately to **[Owner] [Architect] [Consultant].**

Submit copies of approved permit and one-line drawings to Architect, Owner, Roof Manufacturer and PV Manufacturer.

* + - 1. COMMISSIONING & SYSTEM STARTUP
         1. Electrical Contractor shall provide complete commissioning of the PV system.
         2. Roofing Contractor shall verify that all flexible PV modules and wire management systems are installed to the requirements of the BIPV module drawings, specifications and manufacturer’s written instructions.
         3. Electrical Contractor shall verify that all components are installed and connected according to the requirements of the PV electrical drawings, specifications and manufacturer’s written instructions.
         4. Before starting up or operating the system Electrical Contractor shall check continuity of all conductors and grounding conductors to verify there are no faults and that all equipment has been properly installed. Check factory instructions to see that installations have been made accordingly. Check equipment for any damage that may occurred during shipment, after delivery, or during installation. Replace any damaged equipment.
         5. Before starting or operating the system Electrical Contractor shall obtain a final inspection approval and final inspection from local utility. Electrical Contractor shall be present on site for both of these inspections.
         6. Electrical Contractor shall test all equipment to ensure specified capacity and performance of the system. The Electrical Contractor shall notify the **[Architect] [Owner] [Consultant]** a minimum of five (5) days prior to the test so that an Owner’s representative may witness the test. Electrical Contractor shall replace any electrical equipment, system or work found deficient during the test except non-working PV modules. Roofing Contractor to replace any non-working PV modules.
         7. PV Module Test: During the daytime while the sun is shining mid-day on the PV array, measure the short circuit current and open current of each string (in isolation from other parallel strings) and verify the output is consistent with the PV manufacturer specifications.
         8. Contractor shall make final adjustments to all inverters and monitoring equipment so that they will be placed in an acceptable operating condition. Adjustable parameters shall be set so that the PV system will produce the maximum possible amount of energy on an annual basis.
         9. Replace all damaged and/or malfunctioning equipment.
         10. Provide PV manufacturer, Roof system manufacturer and owner’s representative with as built drawing of the Roof and PV module layout, including location of inverters.
      2. CLEANING
         1. Perform cleanup in accordance with ***Section [01 74 00 - Cleaning and Waste Management] and Section [01 74 13 - Progress Cleaning].***
         2. Upon completion, remove surplus materials, rubbish, tools and equipment in accordance with **Section [01 74 23 - Final Cleaning**].
         3. Waste Management:

Coordinate recycling of waste materials with ***Section [01 74 19 - Construction Waste Management and Disposal].***

Collect recyclable waste and dispose of or recycle field generated construction waste created during demolition, construction or final cleaning.

Remove recycling containers and bins from site.

[**\_\_\_\_\_\_**].

* + - 1. CLOSEOUT ACTIVITIES
         1. Training: Contractor shall coordinate training in accordance with ***Section [01 79 00 - Demonstration and Training].***

Instruct [**Owner's**] designated maintenance personnel in care, adjustment and operation of solar electric module system.

Provide competent instructor for not less than *[****1****] [****one-hour****] [****two-hour****] [****three-hour****] [****four-hour****]* training session(s) after completion and acceptance of work.

Forward statement *to [****Owner****] [****Architect****] [****Consultant****]* countersigned by maintenance personnel confirming that these instructions have been provided.

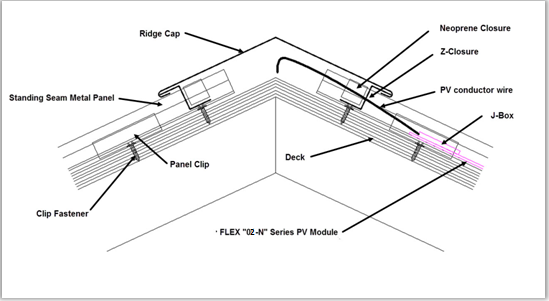
Submit PV module manufacturer’s Request for Warranty form for review and approval.

Submit metal roof system manufacturer’s Request for Final Inspection to Roof manufacturer.

Submit copies of PV module warranty, Inverter and Roof system warranty to Architect, Consultant and Owner.

* + - 1. PROTECTION
         1. Protect installed product from damage during construction in accordance with **Section [01 76 00 - Protecting Installed Construction].**
         2. Repair damage to adjacent materials caused by solar PV module installation.
         3. [**\_\_\_\_\_\_**].
      2. MAINTENANCE
         1. Coordinate maintenance requirements with ***Section [01 78 00 - Closeout Submittals] [01 93 13 - Facility Maintenance Procedures] [and] Section [00 78 23 - Operation and Maintenance Data].***
         2. **[\_\_\_\_\_\_].**

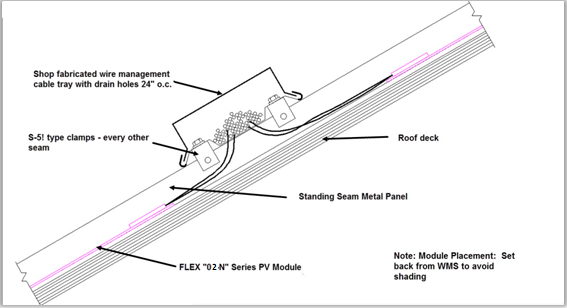
**End Section**

****

**Figure: Typical Ridge Cap Detail**

**DO NOT INSTALL THE J-BOX BEHIND THE Z-CLOSURE. THIS WILL SHADE THE FLEX MODULE SOLAR ACTIVE AREA AND AFFECT POWER OUTPUT. DO NOT PLACE A FASTENER THROUGH THE FLEX MODULE – THIS WILL VOID THE MODULE WARRANTY.**

**DRILL A HOLE SIZED THROUGH THE SHEETMETAL Z-CLOSURE TO ALLOW THE CONDUCTOR CABLES INTO THE RIDGE CAP AREA TO BE USED AS A WIRE CHASE. INSTALL A SPLIT RUBBER GROMMET TO THE SHEETMETAL HOLE TO AVOID DAMAGING THE CABLES AND SEAL THE HOLE WITH A CAULK.**

****

**Figure 1 Mid-Roof WMS**