



UL3741 PV HAZARD CONTROL INSTALLATION ADDENDUM

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Introduction and Safety Overview

INTRODUCTION & OVERVIEW

This installation addendum provides a detailed guide on how to install the EkonoRack PV Hazard Control System to meet the UL 3741 Standard requirements. Refer to the *EkonoRack Installation Manual* for a complete assembly guide.



WARNING: To Reduce the Risk of Injury, read all instructions



AVERTISSEMENT: Pour prévenir les blessures, lire toutes les instructions

LIABILITY/DISCLAIMER

The installer of each project is responsible for the safe and proper installation of each system. They are required to supervise all safety programs and precautions for each project site, as well as provide all necessary protection to ensure a safe working environment.

KB Racking does not perform any portion of its mounting system installation and therefore does not have any duty or responsibility for the safe and proper installation.

KB RACKING IS NOT RESPONSIBLE FOR ANY DAMAGES INCURRED ONCE THE SHIPMENT HAS BEEN SIGNED FOR AND RECEIVED.

REFERENCE DOCUMENTS

The images and diagrams in this manual are for reference only. The rules in this installation addendum are to be followed for all projects in conjunction with project specific documents and dimensions provided by KB Racking.

RECEIVING PRODUCT

KB Racking components may have shifted during shipping. Take extra care when moving and unpacking components. Upon receiving parts, ensure the correct type and quantities of parts have been delivered by unboxing all components and checking for any damages. If you have received damaged or missing components, document with photos and immediately notify your KB Racking Project Manager.

PERSONAL & SITE SAFETY

A structural analysis of the roof should be conducted prior to installing to determine the load capacity. Always observe all governing codes and ordinances. Only qualified professionals should install solar modules, DC cabling, and any anti-lightning safety devices. Some safety considerations include:

PPE – While installing the PV system, proper safety equipment should be worn. Wear safety gloves when handling parts. Newly fabricated parts may have sharp edges.

Fall Prevention – If roof/building has a fall distance of 10ft (3m) or greater, appropriate safety measures must be taken (i.e., harnesses) for installation of modules closer than 6.5ft (2m) to roof edges or skylights. KB Racking Inc. requires all arrays to be no closer than 3ft (0.9m), unless otherwise stated, from a building's roof edge to validate wind load calculations and ensure the system is safely ballasted.

Roof Debris – Inspect the roof for damages prior to installation and record any existing damage with a camera. Clean the roof surface and remove all dirt and debris.

Roof Flooding – Ensure proper drainage on the roof. Water accumulations may lower the load reserve of the rooftop and decrease lifespan. Additionally, constant submersion of PV supports in water may damage parts. Consult with a KB Racking Project Manager if this is the case.

Ratings

UL 3741 Listed



CONFORMS TO STD ANSI/CAN/UL 3741

- Max PVHCS System Voltage: 1000VDC

MARKINGS

Product Markings are located on the windshield once per sub-array. Recommended to install windshield with product marking next to grounding location for ease of access.

KB RACKING®		Date of Assembly	
EkonoRack 2.0	AeroGrid	Q1	2024
Conforms to ANSI/CAN/UL STD 3741		Q2	2025
Max System Voltage: 1000VDC		Q3	2026
See Installation Addendum to Achieve UL 3741 Compliance		Q4	2027

APPROVED PV HAZARD CONTROL EQUIPMENT AND COMPONENTS

- **PV Modules – UL 1703 / UL 61730 Listed**
 - Fire Rating: Type 1, 2, 29 or 30 Modules
- **EkonoRack Racking Components – UL 2703 Listed**
 - Refer to EkonoRack Installation Manual for list of approved racking components.
- **Approved Electrical Equipment – UL 1741 Listed**
 - Equipment must have PVRSS/PVRSE functions certified to UL 1741.
- **Wire Management – UL 870 Listed**
 - KB Racking® Wire Management – System
 - RayTray v2
- **3rd Party Roof Attachments**
- **3rd Party MLPE Mounts**
- **Listed Conduit (All sizes apply)**
 - Liquid-Tight Flexible Nonmetallic Conduit – UL 1660 Listed
 - Electrical Metallic Tubing – UL 797 Listed
 - Rigid Metal Conduit – UL 6 Listed
 - Intermediate Metal Conduit – UL 1242 Listed
 - Flexible Metal Conduit – UL 1 Listed
 - Liquid Flexible Metal Conduit – UL 360 Listed
 - Schedule 40 or 80 Rigid PVC Conduit – UL 651
 - Listed Tubing, Fitting, and Grounding Components
- **PV Connectors – UL 6703 Listed**
- **PV Wire – UL 4703 Listed**
- **Cable Ties – UL 62275 Listed**
- **Wire Clips – UL 1565 Listed**

Introduction: Understanding UL 3741 and NEC 690.12

2020/2023 NEC 690.12(B)(2) CONTROLLING CONDUCTORS WITHIN THE ARRAY BOUNDARY

The EkonoRack PV Hazard Control System (PVHCS) is a UL 3741 Listed system that complies with NEC 690.12(B)(2)(1), when installed by qualified persons per the installation procedures listed in the EkonoRack installation Manual and the following EkonoRack Addendum. All PVHCS components including inverter connections must be installed within the array boundary per NEC 690.12. Please refer to the following pages of this addendum for various example cases of system designs that comply with 690.12(B)(2).

2020/2023 NEC 690.12 BACKGROUND

NEC 690.12 Rapid Shutdown of PV Systems on Buildings requires that all PV arrays installed on or in buildings shall include rapid shutdown functions to reduce shock hazard for Fire Fighters (FF) in accordance with 690.12(A) through (D):

A. Controlled Conductors

- (1) PV system DC circuits
- (2) Inverter output circuits originating from inverters located within array boundary

B. Controlled Limits

- (1) Outside Array Boundary: $\leq 30V$ within 30 seconds
- (2) Inside Array Boundary:
 - (1) **Listed PV Hazard Control System (UL 3741)**
 - (2) $\leq 80V$ within 30 seconds after rapid shutdown initiation
 - (3) PV array without exposed wiring methods or conductive parts (NEC 2020 only)

C. Initiation Devices

- Initiation device(s) shall initiate the rapid shutdown function of the PV system

D. NEC 2020 – Equipment

- Equipment that performs rapid shutdown functions other than initiation devices, such as listed disconnect switches, circuit breakers, or control switches.

D. NEC 2023 – Building with Rapid Shutdown

- Buildings with PV systems shall have a permanent label located at each service equipment location to which the PV systems are connected or at an approved readily visible location and shall indicate the location of rapid shutdown initiation devices.

NOTE: NEC 690.2 (2020) or Article 100 (2023) defines the array as a mechanically and electrically integrated grouping of modules with support structure, including any attached system components such as inverter(s) or dc-to-dc converter(s) and attached associated wiring. This indicates the EkonoRack Racking and collocated inverters are part of the array.

NOTE: NEC 690.12(B) defines the array boundary as 1ft from array in all directions. This indicates that the array boundary can extend 1ft from the edge of the EkonoRack racking, inverter, or module.

NOTE: The inverter is considered within the array boundary if mechanically attached and within 1 foot of the mounting system or module.

Installation Methods Per UL 3741 and NEC 690.12

CASE STUDIES

The following case studies are provided by KB Racking to illustrate examples of installation configurations that comply with NEC 690.12 (compliance is not limited to these examples).

Contact KB Racking for any compliance and/or array configuration inquiries.

Case 1: UL 3741 Listed System – *page 7*

Case 2: UL 3741 Listed System with Contiguous Sub-Array – *page 8*

Case 3: UL 3741 Listed System with Non-Contiguous Sub-Array – *page 9*

Case 4: UL 3741 Listed System with MLPE Sub-Array – *page 10*

Case 1: UL 3741 Listed System

UL 3741 LISTED SYSTEM

Array(s) comply with NEC 690.12(B)(2)(1)

PV Circuit Voltages

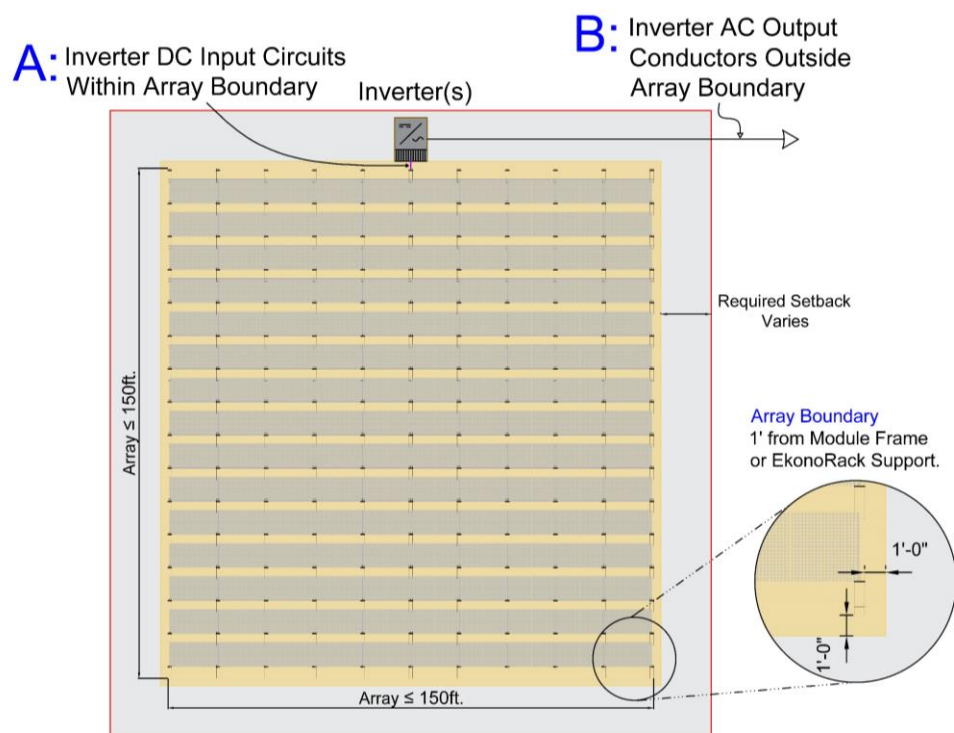
Outside Array Boundary: $\leq 30V$ within 30 seconds

Inside Array Boundary: $\leq 1000V$

Case 1: Array(s) complies with 690.12(B) by utilizing a listed UL 3741 PV Hazard Control System

A. All inverter input circuits (DC) are contained within the PV array boundary and do not require additional measures to reduce string voltages per 690.12(B)(2)(1) after initiation (Inverter DC disconnect, AC breaker or AC disconnect).

B. Inverter output circuits (AC) are outside of the array boundary and meet the 690.12(B)(1) requirement after initiation (AC breaker or AC disconnect).



Case 2: UL 3741 Listed System

UL 3741 LISTED SYSTEM WITH CONTIGUOUS SUB-ARRAY

Sub-Array(s) are within the same Array Boundary and Array(s) comply with NEC 690.12(B)(2)(1)

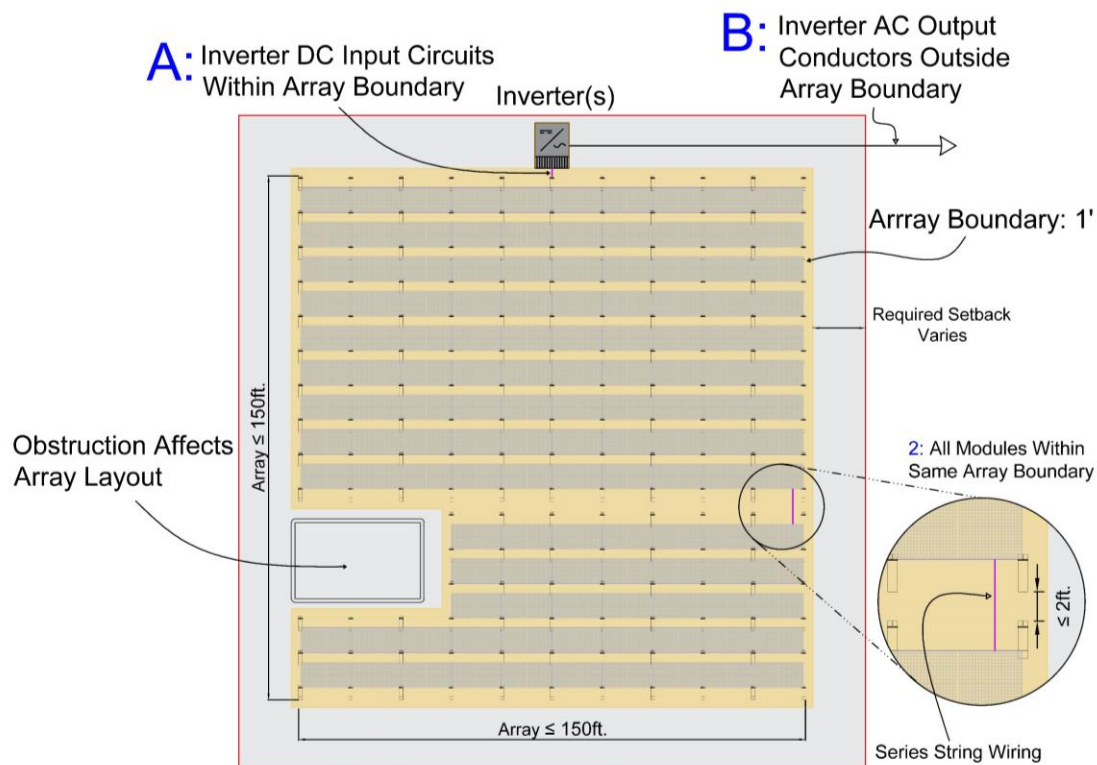
PV Circuit Voltages

Outside Array Boundary: $\leq 30V$ within 30 seconds

Inside Array Boundary: $\leq 1000V$

Case 2: Maintaining NEC Compliance with sub-array(s) within array boundary

Maximum 2 ft. spacing between all array components resulting in a single array boundary.



Case 3: UL 3741 Listed System

UL 3741 LISTED SYSTEM WITH NON-CONTIGUOUS SUB-ARRAY

Multiple Sub-Arrays with conductors outside of Array Boundary are controlled via String Isolation Device(s).

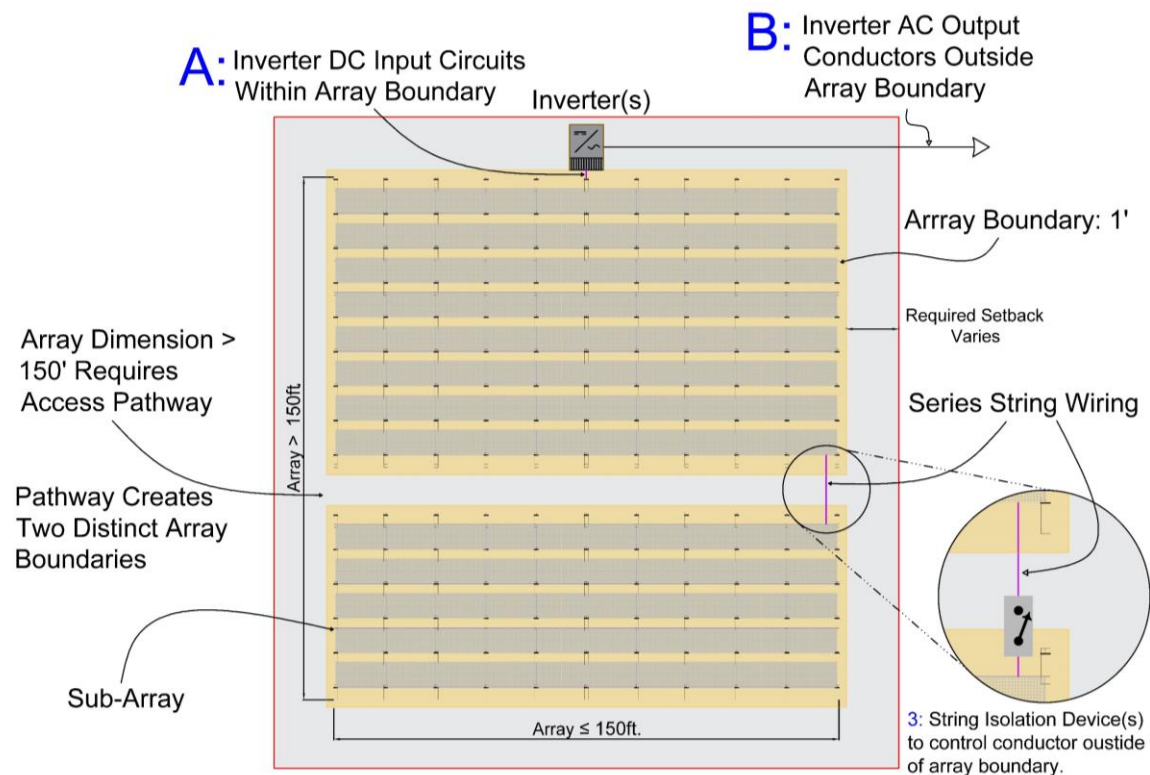
PV Circuit Voltages

Outside Array Boundary: $\leq 30V$ within 30 seconds

Inside Array Boundary: $\leq 1000V$

Case 3: Maintaining NEC Compliance with sub-array(s) outside of array boundary

Complete string must be connected to a single isolation device. If used for a partial string, isolation devices required on both sides of the pathway since voltage will be present on both sides.



Case 4: UL 3741 Listed System

UL 3741 LISTED SYSTEM WITH MLPE SUB-ARRAY

Sub-array(s) using MLPEs to control circuits for 690.12(B)(1) and (B)(2) compliance

PV Circuit Voltages

Outside Array Boundary: $\leq 30V$ within 30 seconds

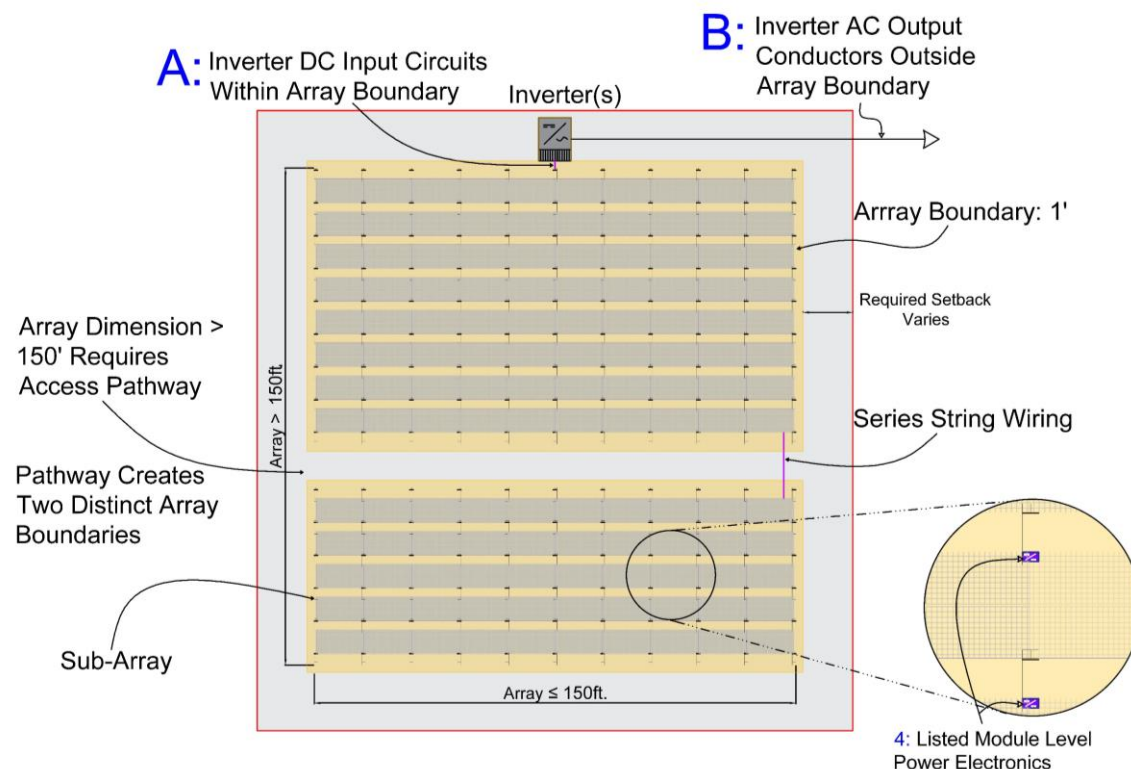
Inside Array Boundary: $\leq 1000V$

Sub Array Boundary: $\leq 80V$ inside within 30 Seconds

Case 4: Maintaining NEC Compliance with sub-array(s) outside of array boundary

Utilize Module-Level Power Electronics on lower sub-array. All modules on the same inverter input must be connected to an MLPE. Upper array utilizes UL 3741 listing without MLPEs for compliance.

NOTE: When using MLPE devices, verify that both the inverter and MLPE devices comply with UL1741 Rapid Shutdown requirements.



Wire Management / Conduit Guidelines

UL 3741 WIRE MANAGEMENT GUIDELINES

The following wire management options are used to avoid potential fire fighter interactions. Wire management & conduit options approved for UL 3741 PV Hazard Control System application are listed on *page 4*.

ROUTING REQUIREMENTS

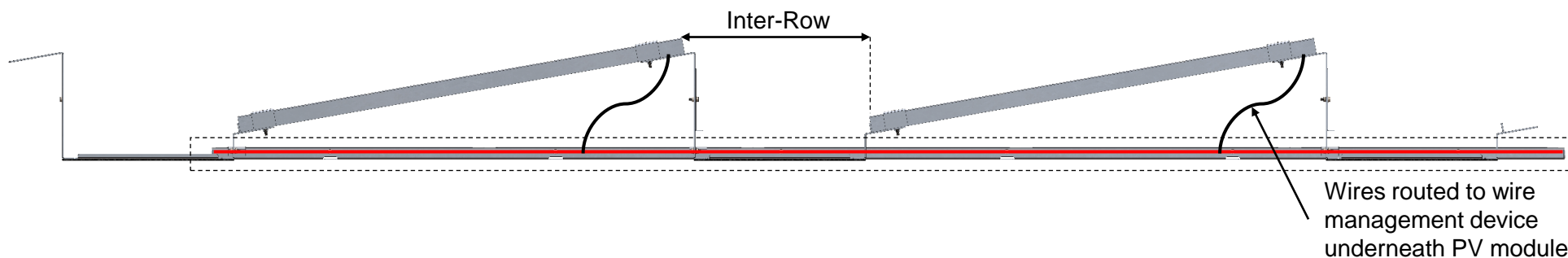
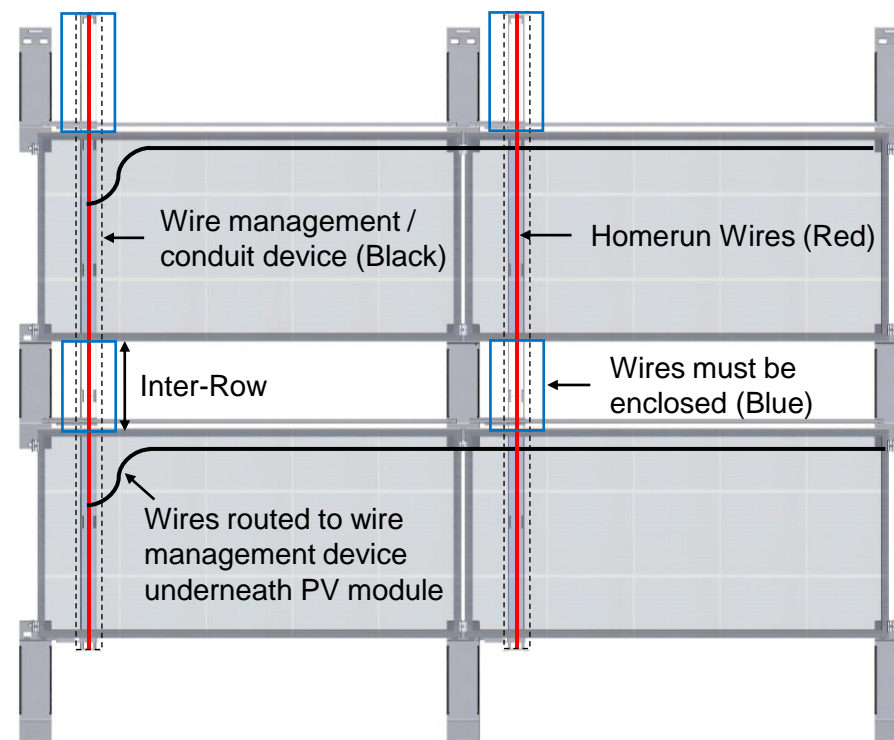
Routing N/S

Routing wires in the N/S direction are required to be enclosed in an approved wire management device along the Inter-Row where wires may be exposed to potential Fire Fighter Interactions.

Routing E/W

Routing wires in the E/W direction are required to be wired underneath enclosed underneath the module to avoid potential Fire Fighter Interactions. Wires underneath the PV module must be routed directly to the wire management device.

NOTE: All wires should not be pinched or sag. Wires cannot be in direct contact with any conductive components. Wire clips and wire management kits are utilized to avoid a wire from being exposed to a potential fire fighter interaction.



Wire Management / Conduit Guidelines

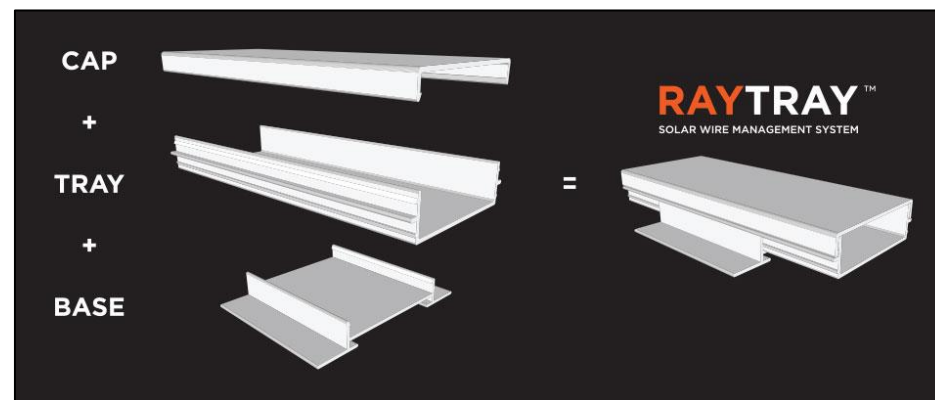
RAYTRAY

Bundles of PV Wires shall be integrated into the RayTray v2. The Assembly includes the cap, tray and base.

The bundles of wire are to be secured into the tray and covered with the cap avoiding exposure to potential fire fighter interactions. Refer to the routing requirements listed on *page 13* when installing the RayTray.

NOTE: It is recommended that the RayTray is installed prior to installing the PV modules.

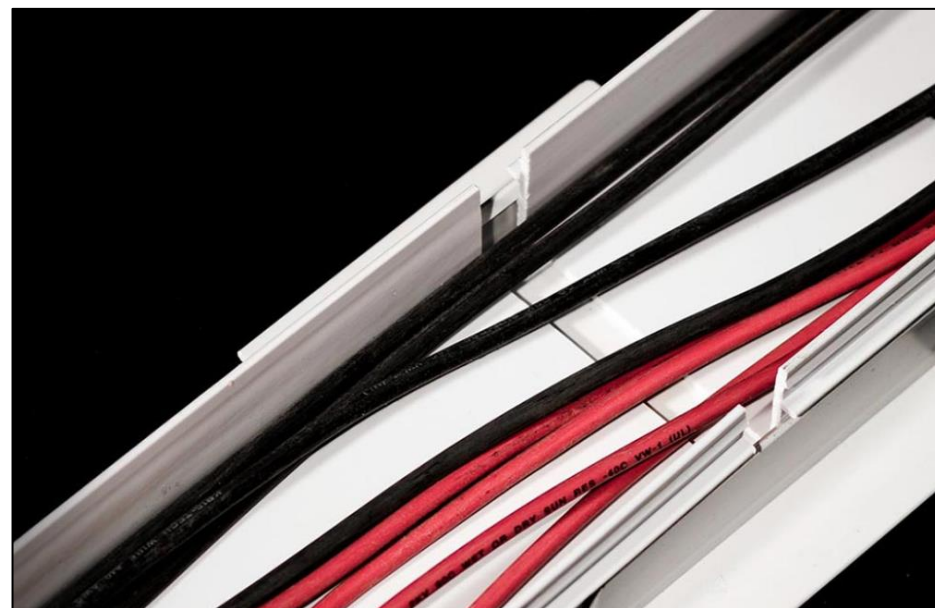
Refer to the RayTray v2 Installation Manual for a complete assembly guide.



RayTray v2 Assembly



Cap Covering Wires



Wires in RayTray

Wire Management / Conduit Guidelines

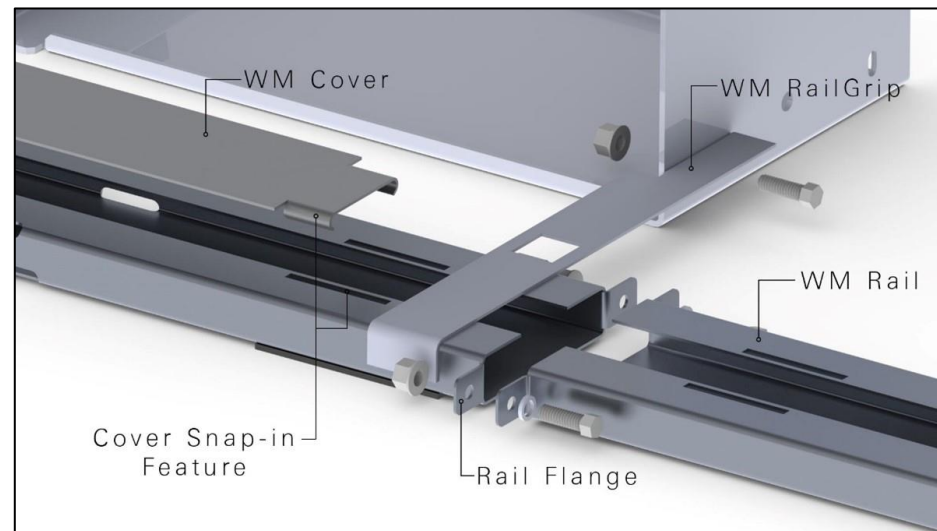
KB RACKING® WIRE MANAGEMENT – SYSTEM

Bundles of PV Wires shall be integrated into the KB Racking® Wire Management – System.

The bundles of wire are to be secured into the rail and covered with the cover avoiding exposure to potential fire fighter interactions. Refer to the routing requirements listed on *page 13* when installing the KB Racking Wire Management System.

NOTE: It is recommended that the KB Racking Wire Management is installed prior to installing the PV modules.

A complete installation guide for assembly Wire Management components can be found in the EkonoRack Installation Manual Appendix A.

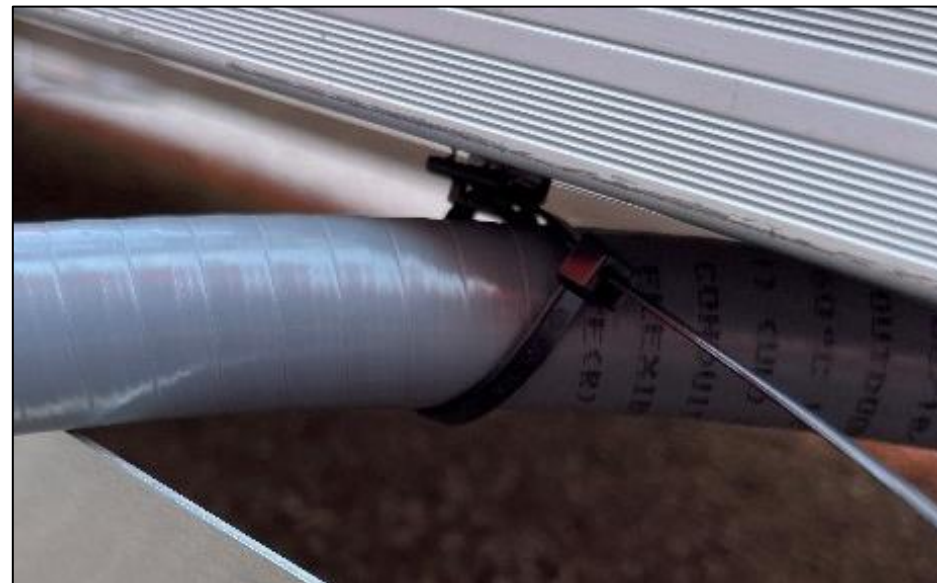


KB Racking® WM Components

CONDUIT

Bundles of PV Wires shall be integrated into the conduit.

The bundles of wire are to be secured into the conduit avoiding exposure to potential fire fighter interactions. Refer to the routing requirements listed on *page 13* when installing Liquid Tight Flexible Non-Metallic Tubing.



Liquid Tight Flexible Non-Metallic Tubing with Wire Clips

Wire Management / Conduit Guidelines

WIRE CLIPS & CABLE TIES

Wire clips are to be secured to the module frame. Wire clips are utilized to keep an air gap between any conductive components of the PV Hazard Control System. Ensure the PV wire does not sag underneath the module avoiding potential fire fighter interactions. Do not overtighten or pinch wires.

NOTE: Wire Clips by themselves cannot be used as a UL 3741 approved wire management system. A listed wire management system or conduit must be used.



Example of Wire Clips