



PHOTOVOLTAIC

JM INSTALLATION AND REFERENCE GUIDE



CONTENT	PAGE
UNDERSTANDING PV ROOFS	3
PV ARRAY CONSIDERATIONS	4
ADDING SOLAR TO EXISTING ROOFS	5
ADDING SOLAR TO NEW ROOFS	6
LAYOUT OF PV SYSTEMS	7
GUARANTEE IMPLICATIONS	9

This manual is provided as a courtesy. This complimentary assistance is not to be used or relied upon by anyone as a substitute for professional engineering design and documentation required by building code, contract or applicable law. By accepting these comments, you agree they do not constitute any representations of, endorsements of or an assumption by Johns Manville of any responsibility/liability for the adequacy of the design of any building/roofing system, code compliance, material or any other material not supplied by Johns Manville.

UNDERSTANDING PV ROOFS

The decision to install a photovoltaic (PV) array on your building is complex and requires understanding several critical issues. Determining the size and scope, retaining a design professional and photovoltaic contractor and understanding the costs and benefits take time and focus.

WHEN MAKING PLANS FOR YOUR BUILDING, IT'S IMPORTANT TO RECOGNIZE THE EFFECTS OF PHOTOVOLTAIC ARRAYS BEYOND JUST THEIR IMPACT ON ELECTRICAL SYSTEMS. CONSIDER THESE QUESTIONS:

What are the current mandates and code requirements?

Has the building been designed to absorb the additional weight of the array?

How effective is the current drainage system or the layout for a new roof? A large PV array may impact how quickly the roof drains.

What is the overall condition of the rooftop environment? Are the building walls, parapets, skylights and RTUs in good condition?

The presence of a PV system likely will make other projects more complex and costly. Ideally, if the roof and other components are in sufficient condition, major service or replacement will not typically be required over the lifecycle of the PV array.

A multitude of PV arrays is available for commercial applications. Some provide much easier interfaces with the roofing system. Given the critical nature of the roofing asset, it is important to consider how PV system components and overall design will affect the roofing system. The PV system should be designed to resist or accommodate movement due to weather changes, seismic activity, thermal expansion and/or structural load. One of the most critical design aspects is how the PV system is attached to the building structure.



PV ARRAY CONSIDERATIONS

Review and consider the following when installing a particular PV array:

- » Don't apply thin-film PV directly to the waterproofing membrane. Laminate thin-film blankets to a compatible sacrificial layer of like membrane; then apply the sacrificial sheet to the waterproofing membrane using an approved method.
- » Don't use non-penetrating attachment methods that rely solely on a heat-welded seam to anchor photovoltaic panels to a thermoplastic membrane. Roof systems are not designed to be the primary anchor point of any rooftop structure.
- » If penetration of the membrane is required to secure a racking system to the building structure, circular steel tubing will provide the best possible flashing option and

facilitate the use of prefabricated accessories.

- » Regardless of the type of penetration used, it is important to confirm it can be flashed in accordance with JM-approved details. A properly designed PV array will see maximum sunlight. Gaskets or washers that serve as a primary waterproofing component should be minimal or concealed as much as possible from sunlight, as they will require maintenance/replacement over time.
- » Don't use caulk or sealants as the primary method to waterproof the attachment to the roofing system. Don't rely on details that require consistent inspection and maintenance for primary waterproofing.
- » JM will not accept individual steel rods or dowels as flashing tie-ins to the roofing system. These types of penetrations do not

provide sufficient surface area to create a watertight seal.

- » Ballasted PV arrays often use concrete pavers or blocks to create wind uplift resistance. Use high-density concrete that has been tested to not break down under the stress of sunlight and freeze/thaw.

Check ballasted systems to determine that the point load at each roof interface is appropriate for the type of roof system. This is especially important on bituminous systems.

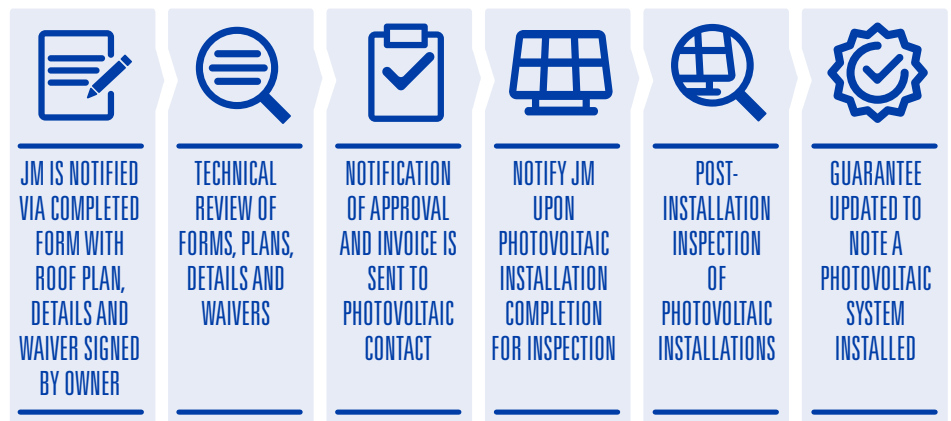
- » A PV system must consider thermal movement. Use racking clips and attachments that accommodate thermal expansion without transferring movement to the underlying roof system, as damage can occur, particularly on bituminous systems.

An alternative is to separate large arrays into smaller sub-arrays.

- » Mechanically attached racking systems may require the use of flexible flashing details to allow for movement of the array.
- » Depending on conduit material and length, you might need to use thermal expansion fittings.

KNOW THE JM PHOTOVOLTAIC SYSTEMS PROCESS >>>

This high level process goes through a series of steps to document the addition of solar components, ensuring the PV array and its installation does not violate or affect the terms of the guarantee.



ADDING SOLAR TO EXISTING ROOFS

WHEN ADDING PV TO AN EXISTING BUILDING, THE ROOF IS THE MOST IMPACTED. IT IS IMPORTANT TO CONSIDER THE MANY WAYS A PV SYSTEM CAN AFFECT THE ROOF.

If a roof replacement is not planned as part of your photovoltaic project, understanding the current condition of the roof becomes much more critical.

On an existing roof, it may be prudent to upgrade components or some details: add liquid flashing at all penetrations, mitigate areas prone to ponding water or introduce additional walkpads to protect the roof surface during solar maintenance.

WHAT IS THE ANTICIPATED REMAINING SERVICE LIFE?

It is critical to align the roof system's lifecycle with the anticipated PV life, which is often 20 to 25 years.

IS THE ROOF UNDER GUARANTEE?

Most manufacturers have specific requirements when adding photovoltaic. Regardless of the guarantee status, a professional evaluation of the roof by a licensed engineer or photovoltaic consultant can be invaluable when considering a PV installation. Whether done by a roofing consultant or trusted professional contractor, a thorough inspection of the roof system and related components is a vital step.

ONCE THE ROOF'S BEEN FULLY EXAMINED, ASK:

- » Is simple maintenance enough, or is a more comprehensive restoration of the roof system necessary?
- » Is it more cost-effective to recover the existing system, or is a complete replacement more appropriate?



Proper design and installation of PV systems are critical. Above is an EPDM ballasted roof that has compromised wind uplift performance due to reduced ballast to accommodate structural limitations and a ballasted PV array that failed due to insufficient wind uplift resistance.

ADDING SOLAR TO NEW ROOFS

**SPECIFY A MORE
ROBUST, RELIABLE
SYSTEM THAT
REQUIRES LESS
MAINTENANCE
WHENEVER
YOU REPLACE A
ROOF SYSTEM
THAT'S PART OF
THE OVERALL PV
INSTALLATION.**



JM RECOMMENDS THE FOLLOWING:

- » For ballasted PV arrays, specify an adhered high-density cover board (minimum 100 psi compressive strength) and a fully adhered membrane. This configuration will distribute loading and minimize long-term point-loading impacts on the waterproofing membrane.
- » On single ply systems, higher mil thickness membranes have additional resistance to scrapes, gouges and foot traffic, as well as a longer service life.
 - 80 mil thermoplastics (TPO and PVC) and 90 mil EPDM.
- » The roof system should have walkpads at all access and service points, as well as any corridors where foot traffic will be concentrated.
- » Design the drainage system with minimum ¼" slope, with particular attention to cricket width, which should not exceed a 3:1 ratio.
- » The slope of the roof should not exceed 1:12" (one inch per foot) for single ply systems and ¼:12" (one-quarter inch per foot) for bituminous membrane systems.
- » Install crickets on any projection or curb perpendicular to the drainage flow that is wider than 24".
- » Consider using 25- and 30-year details, which typically are more robust and require less maintenance over time.

- » Given the cost to remove and store a well-used PV array, it's worth considering a roof design that's eligible for a longer guarantee term of 25 or 30 years.
- » Please consult with a design professional for your project-specific needs.

**WITH MORE
THAN 164 YEARS
OF INDUSTRY
EXPERIENCE,
JOHNS MANVILLE
HAS RESOURCES
TO ASSIST YOU
WITH YOUR
ROOFING PROJECT.
FROM TOOLS TO
EXPERTISE TO
THE PRODUCTS
THEMSELVES, YOU
HAVE EVERYTHING
NEEDED TO
SUCCESSFULLY
COMPLETE YOUR
PROJECT.**

LAYOUT OF PV SYSTEMS

THE ROOF MUST BE ADEQUATELY PROTECTED FROM TRADE-RELATED ROOF TRAFFIC AND DAMAGE DURING INSTALLATION:

» Protect areas of the roof that are used for PV maintenance and access in accordance with JM published details using either walkpads or pavers. Best practice is to protect the membrane in high-traffic areas.

PV layouts should provide reasonable access to all RTUs, drains and other projections to allow for service.

» On ballasted PV array installations, install a compatible protection sheet at PV mounting contact points to protect the primary waterproofing membrane from premature wear and degradation. Recommended protection sheet materials include JM DynaTred walkway pads or DynaLastic polyester reinforced modified bitumen cap sheets for bituminous systems and JM walkpad material or a minimum 60 mil single ply membrane of the same type as the primary waterproofing membrane for single ply systems. The color of the protection sheet should match the primary membrane.

» Projections through the roof system should not be located within 2' of valleys or drainage collection points adjacent to drains, scuppers or gutters.

» Depending on the specific system chosen and the roof slope, consider modifying PV racking heights to counter varying thicknesses of tapered insulation.

» Ballasted systems must not impede the flow of drainage. A minimum height of 1-2" above the roof surface is recommended. All systems should allow water to drain completely within 48 hours of a precipitation event.

» Rack-supported PV arrays should provide proper clearance to the roof membrane for maintenance or repairs.

» Keep the number of roof penetrations to a minimum.

» Cables passing through the roof assembly shall not travel horizontally within a roof system, such as directly under the roof membrane or in a notched-out section of the insulation.

» Penetrations for electrical conduit into the building should be properly flashed to the roof system. Run electrical conduit passing through a roof assembly inside a sheet-metal enclosure with a roof curb; you can use a gooseneck vent where a cable needs to pass through a roof assembly.

» Penetration pockets (pitch pockets or pitch pans) are acceptable as a last alternative for flashing PV system electrical connections that pass through a roof assembly.

» Ensure the protection layer extends a minimum of 2" beyond the point of contact in all directions.

» Ballasted PV assemblies are NOT recommended on gravel-surfaced bituminous membrane assemblies. As an alternative to ballasting, JM recommends they be mounted to the building structure. The mounting apparatus can then be flashed (waterproofed) in accordance with JM-approved details. If there is no alternative, a piece of 1.5" minimum thickness extruded polystyrene (40 or 60



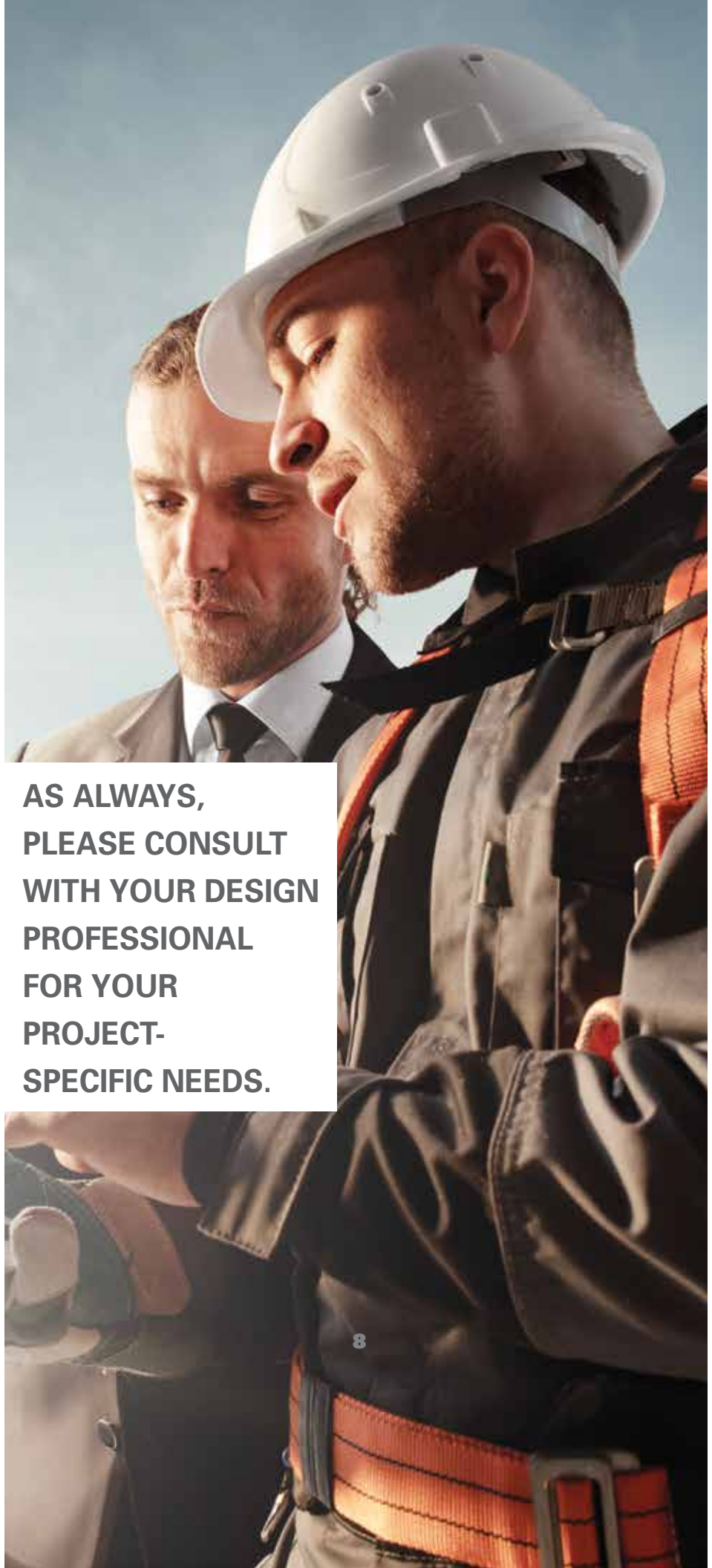
psi compressive strength) can be placed directly on the loose, unswept gravel surface in accordance with this guide. The XPS is then covered with a protection sheet to shield it from UV. JM will also accept a semi-rigid 1" minimum thickness EPDM rubber pad installed in the same manner.

» Ballasted PV assemblies are NOT acceptable for installation on stone aggregate ballasted single ply membrane assemblies; this installation will void the JM roofing system guarantee.

» Closely examine all waterproofing membrane T-joints in areas where the PV array will conceal access. Use non-reinforced T-joint patches of the same membrane material as the primary waterproofing membrane for single ply systems. Apply JM PermaFlash or JM PMMA at bituminous cap sheet T-joints.

» On single ply membranes, thoroughly examine and strip-in all seams with a membrane-appropriate cover strip in areas where the PV array will conceal access. NOTE: If the roof system has not received an approved final inspection from a JM Field Technical Representative prior to the installation of the PV array, you must strip-in any seams that will be covered by the PV array.

» JM recommends the weight at the point of contact on single ply roofs over standard polyisocyanurate insulation and bituminous systems not exceed 25 pounds per square foot. Single ply systems that include a cover board should not exceed 50 pounds per square foot.



**AS ALWAYS,
PLEASE CONSULT
WITH YOUR DESIGN
PROFESSIONAL
FOR YOUR
PROJECT-
SPECIFIC NEEDS.**

GUARANTEE IMPLICATIONS

**PV SYSTEMS WILL
CONCENTRATE
SERVICE TRAFFIC
TO SMALLER
AREAS AND WILL
REQUIRE PERIODIC
MAINTENANCE.
JM HAS VARIOUS
PUNCTURE RIDERS
(DEPENDING ON THE
SYSTEM) WITH OUR
NDL (NO DOLLAR
LIMIT) GUARANTEES.**

**THESE CAN OFFER
THE BUILDING
OWNER ADDITIONAL
PROTECTION
FROM ACCIDENTAL
DAMAGE.**



JM Guarantees offer valuable protection to you, the building owner. Guarantees impart obligations on the part of both manufacturer and building owner.

You should review the terms and conditions of your specific guarantee to understand your responsibilities. JM requires that all proposed alterations be communicated to JM for approval prior to project start. For any type of alteration, including PV, understand the following:



- » Any change to the roofing system must be approved by JM and utilize JM products installed in accordance with our details and specifications.
- » All alterations or changes to the roofing system must be performed by a JM Approved Peak Advantage Roofing Contractor.
- » While JM may permit a certain product to be installed on the roof system, only JM branded products are covered by the guarantee.
- » When reviewing proposed alterations, JM evaluates the proposed layout, products and details to ensure that there is not a significant issue with the proposed changes. This “approval” is not to be confused with an endorsement or warranty of the products being used. The JM Guarantee does not cover the alterations or additions – and any issues arising out of such are the sole responsibility of the building owner to address.

- » When a PV system is being installed, review and understand your responsibilities as outlined in JM’s Peak Advantage® Guarantee Photovoltaic Overburden Waiver, which includes but is not limited to the following:

The JM Guarantee does not cover any leaks, changes in appearance, damage or loss of performance in the roofing system resulting from the installation, operation or presence of a PV system on the roofing system.

JM is not responsible for any claims related to the JM Guarantee that are attributable, either in whole or in part, to the installation, operation and/or presence of a PV system.

Should the removal of any part of the PV system be required to complete repairs, whether covered by the JM Guarantee or not, these costs shall be the owner’s responsibility and are not covered.

JM does not guarantee or approve the suitability, installation or performance of any PV system or component.

Guarantee Maintenance

- » Once your PV system has been successfully installed, remember that, like the roofing system itself, photovoltaic arrays will require periodic inspection and maintenance.
- » Inspect the PV system at least twice a year, ideally in the spring and fall. Here are some factors to consider during an inspection:
 - Have all the slip sheets remained in place? Is the PV array abrading the roof surface at any location?
 - Are all the electrical connections secure?
 - Are the penetration pockets filled with pourable sealer and still watertight?
 - Are all the caulks and sealants adhered and free of cracking or deterioration?
 - Is any debris building up under the photovoltaic system and preventing proper drainage?

PEAK ADVANTAGE *Johns Manville*

Johns Manville offers one of the most comprehensive guarantees in the roofing industry. That's the advantage you can expect from a longtime, dependable leader with the financial backing of Berkshire Hathaway.

 **Johns Manville**
A Berkshire Hathaway Company


717 17th St.
Denver, CO 80202
(800) 922-5922
www.jm.com/roofing

 @JohnsManvilleRoofing

 JohnsManvilleRoofingSystems

 Above it all

 @JMRoofingSystem

 Johns Manville Commercial
Roofing Systems

RS-9346 7-22 (NEW)