

COA – Residential Solar PV System Inspection Checklist

This document includes solar-specific code requirements, but there may be other structural or electrical requirements that apply as well. Building Code compliance is the obligation of design professionals and/or contractors. Plan Review and Inspection Guidelines are intended to be used by designer professionals and contractors to assure that construction plans and construction projects, at a minimum, address the same code priorities that the City of Allentown Building Department will be looking at during plan review and inspection. The Guidelines are not all inclusive.

Plans

- ☐ All plans are signed and sealed by design professional (Pennsylvania only)
- ☐ Site plan with address
- ☐ Fire lane requirements
- ☐ Freestanding structures are accessory structures and must meet zoning requirements, including area and yard requirements and maximum number of accessory structures permitted on a property.

Racking

- ☐ Roof penetrations are flashed to prevent moisture from entering the roof. (IRC Chapter 9, Section R903, R324.4.3)
- ☐ Racking and PV system support structures installed and torqued per manufacturer's instructions and approved plans.

Wiring Methods

Conductors:

All PV system conductors are sized and identified per the approved plans.

- ☐ Bonding fittings are used for ferrous metal conduits enclosing grounding electrode conductors. (NEC 250.64(E))
- ☐ Bonding fittings are used on concentric/eccentric knockouts with metal conduits for circuits over 250 volts to ground. (NEC 250.97) (see also exceptions 1 through 4)
- ☐ For underground conductor installations, the burial depth is appropriate. (NEC 300.5(D)(3) and Table 300.5, 300.50 and Table 300.50)
- ☐ For conductors installed where ambient temperatures exceed 30°C conductor ampacities should be corrected for higher temperatures. (2017 NEC Table 690.31(A))
- ☐ PV source and output circuits must be separated from non-PV system circuit conductors and inverter output circuit conductors. (NEC 690.31(B))
- ☐ DC positive and negative conductors should not be identified with white or grey except for solidly grounded PV system conductors. (690.31(B)(1))

- ☐ Single conductor cables are secured within 12 inches of each box, cabinet, conduit body or other termination. (NEC 690.31(C))
- ☐ PV system conductors shall be grouped and identified. (2017 NEC 690.31)
- ☐ Single conductor cables are secured by staples, cable ties, straps, hangers or similar fittings at intervals that do not exceed 4.5 feet. (NEC 690.31(C))
- ☐ Exposed single conductor wiring is a 90°C, wet rated and sunlight resistant type USE-2 or listed PV wire. (NEC 690.31(C)) If the wiring is in a conduit, it is 90°C, wet-rated type RHW-2, THWN-2, or XHHW-2. (NEC 310.15)
- ☐ DC conductors inside a building are in a metal raceway or MC metal-clad cable that complies with 250.118(10), or metal enclosures. (NEC 690.31(G))
- ☐ Flexible metal conduit smaller than 3/4" or Type MC cable smaller than 1", where used, closely follows the surface of the building finish or of the running boards. (2017 NEC 690.31(G)(2) and IFC 605.11.2)
- ☐ Properly sized equipment grounding conductor is routed with the circuit conductors. (NEC 690.45, 250.134(B) and 300.3(B))
- ☐ Separate grounding electrodes, if used, are bonded together. (NEC 690.47, 250.50 and 250.58)

Conduit, Raceways, Cable Assembly

All conduit, raceways, and cables sized and installed per the approved plans.

- ☐ Terminals containing more than one conductor are listed for multiple conductors. (NEC 110.14(A) and 110.3(B))
- ☐ DC wiring in buildings is installed in metallic conduit or raceways. (IFC 605.11.2 and NEC 690.31(G))
- ☐ The markings on the conduits, raceways and cable assemblies are every 10 feet, within one foot of all turns or bends and within one foot above and below all penetrations of roof/ceiling assemblies, walls and barriers. (NEC 690.31(G)(4) IFC 605.11.1.4)
- ☐ Rooftop DC Conduits are located as close as possible to the ridge or hip or valley and from the hip or valley as directly as possible to an outside wall to reduce trip hazards and maximize ventilation opportunities. (IFC 605.11.2)
- ☐ Conduit runs between sub arrays and to DC combiner boxes are installed in a manner that minimizes total amount of conduit on the roof by taking the shortest path from the array to the DC combiner box. (IFC 605.11.2)
- ☐ DC Combiner Boxes are located so that conduit runs are minimized in the pathways between arrays. (IFC 605.11.2)
- ☐ Expansion fittings must be installed where necessary to compensate for thermal expansion, deflection, and contraction. (300.7(B))

Connectors

- ☐ Connectors and terminals used for fine strand conductors are listed for use with such conductors. (NEC 110.3(B) & 110.14(A))
- ☐ Crimp on terminals are listed and installed using a listed tool specified for use in crimping those specific crimps. (NEC 110.3(B) and 110.14)
- ☐ Pressure terminals are listed for the environment and tightened to manufacturer recommended torque specifications. (NEC 110.3(B), 110.11, and 110.14(D))
- ☐ Connectors are listed for the voltage of the system and have appropriate temperature and ampere ratings. (NEC 110.3(B) and 110.14)
- ☐ Twist on wire connectors are listed for the environment (i.e. wet, damp, direct burial, etc.) and installed per manufacturer's instructions. (NEC 110.3(B), 110.11, 110.14 and 300.5(B))
- ☐ Power distribution blocks are listed and rated for DC if used with DC PV circuits. (2017 NEC 314.28(E) and 376.56 690.4)

Modules

- ☐ Module manufacturer, make, model, and number of modules match the approved plans. (IBC 107.4 - Amended Construction Documents) Modules are properly marked and labeled. (NEC 110.3, 690.4(B) and 690.51 or 690.52)
- ☐ Modules are attached to the mounting structure according to the manufacturer's instructions and the approved plans. (NEC 110.3(B), 2009 and 2012 IBC 107.4)
- ☐ Module connectors are tight and secure. (NEC 110.3(B) and 110.12)
- ☐ PV modules are in good condition (i.e., no broken glass or cells, no discoloration, frames not damaged, etc.). (NEC 110.12(B))
- ☐ Grounding - modules are bonded in accordance with manufacturer's installation instructions using the supplied hardware or listed equipment specified in the instructions and identified for the environment (NEC 110.3(B)) and 690.43(A))
- ☐ If the racking system is used to bond the modules, the module/rack assembly is listed to bonding attribute of UL 2703.
- ☐ Where PV circuits are embedded in built-up, laminate, or membrane roofing materials in roof areas not covered by PV modules and associated equipment, the location of circuits shall be clearly marked. (NEC 690.31(G)(1))

Equipment Accessible at Ground Level

- ☐ Equipment locations, models, and specifications match the approved plans.

- ☐ Connection from PV system to grounding electrode system made per the approved plans. (NEC 690.47)
- ☐ Overcurrent devices in the PV DC circuits are listed for use in PV system and ratings match the approved plans. (NEC 110.3(A),(B), 690.9(B))
- ☐ Disconnects used in PV systems must be rated for the maximum short circuit current and voltage. A DC PV system disconnecting means shall be marked for use in PV systems or be suitable for backfeed operation. (NEC 110.3 and 690.13(E) and (F))
- ☐ Isolating devices or disconnects are installed for the PV equipment, either integrated into the equipment or within 10' of the equipment. (NEC 690.15)
- ☐ All interior and exterior DC conduit, enclosures, raceways, cable assemblies, junction boxes, combiner boxes, and disconnects on buildings are marked. "The markings say "WARNING: PHOTOVOLTAIC POWER SOURCE" and have 3/8 inch (9.5 mm) minimum-sized white letters on a red background. The signs are made of reflective weather resistant material. (IFC 605.11.1.1, 605.11.1.2 and NEC 690.31(G)(3))
- ☐ Connectors that are readily accessible and operating at over 30 volts DC or 15 volts AC require a tool for opening. (NEC 690.33(C))
- ☐ PV source and output circuits in readily accessible locations and operating over 30V must be guarded or in a raceway.

Inverter

- ☐ Inverter is properly secured with manufacturers required clearances (NEC 110.3(B), 110.13))
- ☐ AC and DC terminations are properly torqued (NEC 110.14(D))
- ☐ Verify inverter or other listed equipment provides DC ground-fault protection for the DC PV array (NEC 690.41(B)).
- ☐ Verify inverter or other listed equipment provides DC arc-fault protection where PV systems operate over 80V (NEC 690.11).
- ☐ Required labels per Signage Requirements Table installed.
- ☐ UL 1741

Point of Utility Interconnection

- ☐ Point of connection is either on the supply side of the service disconnecting means or at a dedicated breaker or disconnect on the load side of the service disconnecting means. (2017 NEC 705.12(A) and (B)(1)).
- ☐ For load side connections, total rating of the overcurrent devices supplying a panelboard plus 125% of the inverter output current does not exceed 120% of the rating of the panelboard busbars. (NEC 705.12(B)(2)(3)(a))

☐ For load side connections, PV interconnect breaker is located at the opposite end of the bus from the feeder connection, unless the bus assembly has ampacity rating equal to or greater than the sum of 125% of the inverter output current and the rating of the overcurrent device protecting the panelboard. (NEC 705.12(B)(3))

☐ For supply-side connections, the sum of the ratings of all OCPDs connected to the power source must not exceed the rating of the service (NEC 705.12(A)). Overcurrent protection for supply-side connected power source conductors must be provided within 3m (10') of the point of interconnection to the service (NEC 705.31)

☐ PV system disconnecting means labeled "PV SYSTEM DISCONNECT" and readily accessible (NEC 690.13(A) and (B)). Disconnect may be an externally operable general-use switch or circuit breaker, or other approved means.

Required labels per Signage Requirements Table installed.

Rapid Shutdown

☐ Rapid shutdown initiation device installed and located per approved plans. For one and two family dwellings device must be outside at a readily accessible location. (690.12(C))

☐ Installed rapid shutdown equipment, other than the initiation device, must be listed for the application (690.12(D)). Rapid shutdown equipment must control PV system conductors to within the limits of 690.12(B)

☐ Required labels per Signage Requirements Table installed.

Energy Storage System

☐ Batteries

☐ Flexible battery cables do not leave the battery enclosure. (NEC 400.12)

☐ Flexible, fine strand cables are only be used with terminals, lugs, devices, and connectors that are listed and marked for such use. (NEC 110.3(B) and 110.14)

☐ Area is well ventilated and the batteries are not installed in living areas. (NEC 408.10 and 706.10(A))

☐ Live parts of battery systems are guarded to prevent accidental contact by persons or objects. (NEC 706.10(B))

☐ Working space and illumination are provided around the battery installation.(706.10 (C),(D) and (E)

☐ Proper diagrams or placards are provided at the building electric service equipment and other power source locations. (NEC 706.11)

Signs & Labels

☐ Labels are phenolic where exposed to sunlight. Labels required on conduit are permanent, weather resistant and suitable for the environment. Labels have a red background with white lettering. The following labels are required as applicable:

Table: Signage Requirements for PV Systems

<u>Code Selection</u>	<u>Location of Label</u>	<u>Text</u>
NEC 690.13(B)	On the PV system disconnect as identified in Figure 690.1(B)	<u>PV System Disconnect</u>
NEC 690.13(B)	Disconnects with power on line and load terminals when in the open position	<u>Warning Electric Shock Hazard Terminals on the Line and Load Sides May Be Energized in the Open Position</u>
NEC 690.53	On the DC disconnects	<u>Maximum voltage informational Note to (1): See 690.7 for voltage.</u> <u>Maximum circuit current information Note to (2): See 690.8(A) for calculation of maximum circuit current</u> <u>Maximum rated output current of the charge controller or dc-to-dc converter (if installed)</u>
NEC 690.54	At interactive points of interconnection, usually the main service	<u>Rated AC Output Current Amps Normal Operating AC Voltage Volts</u>
NEC 690.56(B) 705.1	At the electrical service and at the PV inverter if not at the same location.	<u>A directory providing the location of the service disconnecting means and the photovoltaic system disconnecting means</u>
NEC 690.56(C)	At the service disconnecting means	<u>Rapid Shutdown Labels for Type</u>
NEC 705.12(B)(2)(3)(b)	Inverter output OCPD	<u>Warning: Power Source Output Connection - Do Not Relocate This Overcurrent Device</u>
NEC 690.55	Battery enclosure	<u>Maximum Operating Voltage, Equalization Voltage Polarity of Grounded Conductors</u>
IFC 605.11.1.4	On conduit, raceways, and enclosures mark every 10 feet, at turns, above/below penetrations	<u>Warning: Photovoltaic Power Source</u>

NEC 705.12(B)(3) Equipment containing overcurrent devices in circuits supplying power to a busbar or conductor supplied from multiple sources shall be marked to indicate the presence of all sources Dual power source. Second source is a solar PV system.