

CITY & COUNTY OF DENVER COMMUNITY PLANNING & DEVELOPMENT BUILDING PERMIT POLICY		
Subject: RESIDENTIAL SOLAR PHOTOVOLTAIC (PV) ENERGY SYSTEMS PERMITS		
Approved: Eric Browning, P.E., - Building Official		Drafted by: Pafford
Number: DRC R324 – 2023 NEC	Previous Edition: March 1, 2023 Reissued: August 14, 2023	Page 1 of 5

REFERENCE

2022 Denver Building Code (DBC) Section 1 Administration Section 131, 2022 Denver Residential Code (DRC) Section R324, 2023 National Electrical Code (NEC) Articles 690 & 705, 2022 Denver Mechanical Code (DMC) Chapter 14, Denver Revised Municipal Code (DRMC) Chapter 30

PROCEDURE

The procedure to obtain a permit (or permits, where applicable) for a residential solar photovoltaic (PV) system is outlined below. This applies only to one and two family homes, and to DRC townhomes.

1. Ensure that the Zoning and Landmark conditions listed below have been addressed if they apply.
 - a. **When zoning permits are required before obtaining electrical permits:** If the panels will be installed at an angle unequal to the slope of the roof and do not meet the definition of “solar panel, flush mounted” per Denver Zoning Code Section 13.3, or if a generator or energy storage system is a part of the project and will be located on the exterior of the structure, a zoning permit must be obtained for the PV system(s) before applying for an electrical permit. Contact Residential Zoning at residentialpermits@denvergov.org or 720-865-2710 for questions.
 - b. **When Landmark Preservation approval is required before obtaining electrical permits:** If the structure or site on which the PV system or related equipment (energy storage, generator, etc.) will be mounted is a designated structure for preservation or is in a district designated for preservation under the provisions of the Denver Revised Municipal Code (DRMC) Chapter 30, approval must be obtained from Landmark Preservation before applying for electrical permits. Contact Landmark Preservation at landmark@denvergov.org or 720-865-2719 for questions.
2. After obtaining Landmark approvals and Zoning permits, submit plans and calculations through the ePermits portal at www.denvergov.org/epermits for the appropriate electrical (and potentially construction) permits.
3. Engineered plans bearing a professional engineer’s seal and signature are not required for one and two family homes, and for DRC townhomes PV installations unless the proposed PV system equals or exceeds a maximum solar output of 10 kilowatts or includes provisions for a generator or battery backup/energy storage system, or solar shingles. Plans must still be submitted for review, but the professional engineer’s seal and signature will not be required on the electrical plans.

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POLICY

Solar Hot Water Systems – Submittal Requirements

A Quick Permit (Plumbing) can be issued for one and two family homes, and to DRC townhomes. The documentation listed below must be uploaded to the plumbing permit in the ePermits portal at the time of the plumbing permit issuance. The ePermits portal can be accessed at www.denvergov.org/epermits.

1. A piping diagram of the solar hot water system
2. The name of the testing agency and approval number for the solar hot water system

If the homeowner is the applicant for the permit, the permit process must follow the procedures outlined in DBC Section 131.4.

Residential Solar Photovoltaic Systems – Electrical Submittal Requirements

The documentation listed below is required when submitting plans in e-permits for review.

1. DRC Roof Access and Pathways
 - a. A site plan showing the location of all buildings on the property.
 - b. A summary of the applicable codes.
 - c. A roof layout of solar PV panel locations demonstrating compliance with DRC 324.6.
2. Manufacturer's specification sheets and listing information for PV equipment, inverters, and other special equipment, including the system manufacturer, model name and number.
3. One-Line Diagram: Indicate all conductor sizes and insulation types, conduit sizes, fuse and circuit breaker ratings, inverter ratings, ground fault protection device (GFPD), AC and DC disconnect ratings. Specify the PV module's nameplate short circuit current (Isc) and open circuit voltage (Voc). If disconnects, breakers, fuses, GFPD, etc. are part of a larger piece of equipment, show them as such by indicating how they are connected to the other devices and indicating their ratings. The inverter must be shown as either a source connection to a service per one of the three methods in 705.11(A), or as a load-side source connection permitted to be connected to the load side of the service disconnecting means at any distribution equipment on the premises, with the feeders or distribution equipment meeting the relevant sections of 705.12(A) and 705.12(B). The grounding electrode system must be shown on the one-line diagram (NEC 690.47).
4. Calculations: Submit conductor ampacity calculations based upon 156% multiplied by the short circuit current (Isc) (NEC 690.8), or where the PV system rating is greater than 100 kilowatts, submit a documented and stamped PV system design using an industry standard method and provided by a licensed professional electrical engineer to indicate the maximum current value. The current value obtained by using the method indicated in NEC 690.8 cannot be less than 70% of the value calculated using NEC 690.8(A)(1)(1). Also include the temperature derating correction factor per NEC Table 690.31(A)(3)(2). For all roof-mounted flexible wiring, use a worst-case ambient temperature of 61-65°C (141-149°F).

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5. The maximum PV system voltage is equal to the open circuit voltage multiplied by the number of modules in the series, multiplied by the NEC lowest expected ambient temperature derating correction factor from Table 690.7(A) for the -21°C to -25°C (-5°F to -13°F) range.
6. Provide calculations indicating that the equipment grounding conductor is sized correctly (NEC 690.43 and 690.45).

Modifications to permitted Residential Solar Photovoltaic Systems

A review and permit are not required for the following modifications to permitted Residential Solar Photovoltaic Systems:

1. Substitutions of inverter manufacture/model where there is no change in wattage rating from the permitted plans.
2. Substitutions of solar module manufacturer/model where there is no change in wattage rating from the permitted plans.
3. Other PV system equipment substitutions other than that which directly affect the electrical distribution.
4. Modifications to the solar module roof layout or orientation unless the module quantity changes from the permitted plans.
5. Addition of a disconnect switch where not required by the NEC.
6. Change in module mounting hardware that does not result in alternations to the roof other than for blocking or sistering of rafters, joists, or truss top chords.
7. Increase in conductor size beyond what is required by the NEC (oversized/upsized conductor).

Permitting using SolarApp+ - Submittal Requirements

The Denver-specific SolarApp+ documentation can be submitted for eligible solar photovoltaic projects to allow the electrical permit to be issued as a Quick Permit. To determine if a project is eligible for permitting using SolarApp+, please review the following guidance: [Solar PV](#). The documentation listed below must be uploaded to the electrical permit in the ePermits portal at the time of the electrical permit issuance. The ePermits portal can be accessed at www.denvergov.org/epermits.

1. SolarApp+ Inspections Checklist and all other SolarApp+ documentation output
2. Manufacturer's specification sheets of equipment (inverters, solar panels, etc)

Structural Enhancements – Submittal Requirements

1. Calculations performed by a Colorado registered professional engineer must be submitted for review to substantiate that the structure can support the design loads specified in DCBC Chapter 16. Details and calculations for the panel connections to the roof must be included.
 - a. If structural alterations are required for a single-family home, duplex, or DRC townhouse project, sealed and electronically signed drawings must be logged in for a structural review. A separate permit will be issued for this work to an appropriately licensed contractor.

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- b. Colorado registered professional engineering design is required when panels are not flush mounted (parallel to the plane of the roof).
 - c. The letter from a licensed structural engineer will not be required if approved SolarApp+ documentation is submitted for the project in e-permits.
2. Residential Structural Integrity Letter Alternative [to Item 1, above]:
- a. Residential single-family, two-family, or one unit of an DRC townhome may be provided with a sealed and electronically signed letter from a Colorado licensed (structural) engineer, indicating that the existing structure has been reviewed and can adequately support all PV systems and meets all current applicable code requirements for gravity and wind loads. If additional structural enhancements are required, detailed structural drawings and/or structural enhancements outlined in a report must be signed and sealed by a structural engineer and submitted with the permit.
 - b. The addition of blocking and the “sistering” of roof rafters, joists, or truss top chords can be installed by the licensed (electrical) PV contractor without the need for a separate general construction permit. For residential single-family, two-family, or one unit of an DRC townhome projects, the structural improvements complying with item 2(B) will be noted on the solar panel (electrical) permit. An inspection of this work will not be required.
 - c. Any structural modifications or reinforcement other than blocking or the “sistering” of rafters, joists, or truss top chords shall require a Denver licensed general contractor to obtain a separate permit in addition to the (electrical) PV permit.

Solar Photovoltaic Systems – Inspections

1. A qualified person must be present at the time of a PV electrical inspection. A qualified person is as follows:
 - a. For one and two family homes, and to DRC townhomes with an electrical service of 200 amps or less, the qualified person can be either a:
 - i. Licensed master electrician,
 - ii. Licensed journeyman electrician,
 - iii. Residential wireman, or
 - iv. NABCEP-certified (North American Board of Certified Energy Practitioners) solar installer capable of testing the rapid shut down system. If a certified solar installer is present, then the dead front of the electrical panel shall be removed by the electrical inspector.
 - b. For single family homes, duplexes, and IRC townhomes with an electrical service over 200 amps, the qualified person can be either a:
 - i. Licensed master electrician or
 - ii. Licensed journeyman electrician.
2. Except as allowed by item 2(b) above, when structural enhancements are required, a rough framing inspection must be requested.

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3. At time of inspection, the contractor must submit written documentation stating that “All grounding and bonding regarding the array has been performed as per NEC Article 690.41 through 690.47, and furthermore, all equipment installed on the roof complies with all NEC guidelines.”
4. A ladder must be provided by the customer for commercial PV electrical inspections where any component of the system is mounted on the roof.
5. The rapid shut down system must be tested at the final electrical inspection with the inspector present.
 - a. If the rapid shut down system is located on the AC side of the system, then this test must be conducted by a licensed electrician.
 - b. If the rapid shut down system is located on the DC side of the system, then a NABCEP certificate holder can conduct this test, in addition to any licensed electrician. The solar installer must provide proof of their NABCEP certificate, which may be done by providing the inspector a photo of the certificate, a copy of the certificate, or by showing the inspector their name on the NABCEP website with a driver’s license to verify.

Permits for Reroofing a Structure Containing Solar PV Panels

When applying for a roofing permit to replace or repair a roof on an existing building that includes solar PV panels, a Quick Permit (Electrical) can be issued through the Epermits portal for the removal and reinstallation of the panels, provided there were no changes to the previously approved solar PV system. The scope of work must state if the existing PV on the roof will be removed and reinstalled per the previously reviewed and permitted PV project plans and details. A roofing permit will be required for the roofing replacement or roofing repair.

At time of the electrical inspection, the contractor must submit written documentation stating that “All grounding and bonding regarding the array has been performed as per NEC Article 690.41 through 690.47, and furthermore, all equipment installed on the roof complies with all NEC guidelines.”

For the electrical inspector to final the electrical permit, the PV installer must provide a letter to the inspector at the time of the final electrical inspection that states that no modifications to the permitted PV system were made, and the PV system was only removed and will be reinstalled following the completion of the roofing replacement or roofing repair. The letter must be on the company letterhead of the PV company that removed and will reinstall the system.

If any changes are proposed to the PV system other than the relocation of the solar panels, then plans must be submitted, and a new electrical permit must be issued. The electrical permit will be finalized after the roof permit.

FEES

Solar systems have reduced building permit fees. A \$50 flat building permit fee will be applied to both single-family residential and commercial PV system installations. Where other non-solar work is required under the project, the \$50 flat fee will only apply to the solar PV system portion of the project. The permit fee for the non-PV work shall be based on the actual valuation of that work.