



**PHOTOVOLTAIC ELECTRICAL
 POWER SYSTEMS CHECKLIST**

Referenced Codes:

The checklist is only a guide and applies to any component used or installed in a PV system other than a listed, factory-assembled component.

This list should be used in conjunction with Article 690 and other applicable articles of the CEC and includes inspection requirements for both stand-alone PV systems and utility-interactive PV systems. Where Article 690 differs from other articles of the NEC, Article 690 takes precedence. [690.3].

* Code section referenced is 2013 CEC unless noted otherwise.

	Code Requirements	Code section	Re q'd
	1. PV ARRAYS		
1.	Are PV modules listed to UL Standard 1703 [110.3]		
	Mechanical Attachment		
2.	Are modules attached to the mounting structure according to the mfr's instructions?		
3.	Are roof penetrations secure and weather tight?		
	Grounding		
4.	Is each module grounded using the supplied hardware, the grounding point identified on the module and the mfr's instructions? Note: Bolting the module to a 'grounded' structure usually will not meet NEC requirements.		
5.	Are properly sized equipment grounding conductors [EGCs] routed with the circuit conductors?	[690.45]	
6.	Conductor type		

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Code Requirements		Code section	Req'd
7.	If exposed - USE-2, UF (usually inadequate at 60°C), or SE, 90°C, wet-rated and sunlight-resistant.	[690.31(B)]	
8.	If in conduit: RHW-2, THWN-2, or XHHW-2, 90°C, wet-rated conductors	[310.15]	
9.			
10.			
11.			
Conductor insulation			
12.	rated at 90°C [UL-1703] to allow for operation at 70°C+		
13.	If modules are near to the roof deck or in conduit exposed to sunlight -		
14.	add 17 - 20°C to ambient temperature [for derating purposes]		
Temperature derating ampacities			
15.	Conductors - are the temperature-derated ampacity calculations based on 156% of short-circuit current (Isc),		
16.	Overcurrent device - is the derated ampacity greater than 156% Isc rating of overcurrent device?	[690.8 & 9]	
17.	Note: Suggest temperature derating factors of 65°C in installations where the backs of the module receive cooling air (6" or more from the roof deck) and 75° where no cooling air can get to the backs of the modules. Ambient temperatures in excess of 40°C may require different derating factors.		
18.	Portable power cords are allowed only for tracker connections.	[690.31(C), 400.3]	
19.	Are strain reliefs/cable clamps or conduit used for all cables or cords?	[300.4, 400.10]	
20.	Are all components listed for the application and the environment?		

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Code Requirements		Code section	Req'd
OVERCURRENT PROTECTION			
21.	Are overcurrent devices [OCPD] in the dc circuits listed for dc operation?		
22.	If the device is not marked dc, verify dc listing with the mfr. Auto, marine, and telecom devices are not acceptable.		
23.	Are overcurrent devices rated at $1.25 \times 1.25 \Rightarrow 1.56$ times the short-circuit current (Isc) from modules?. Note: Both 125% factors are now in the NEC.	[UL-1703, 690.8, module instructions]	
24.	Supplementary listed devices are allowed in PV source circuits only, but branch-circuit rated devices are preferred. [690.9(C)].		
25.	Does each module or series string of modules have an OCPD protecting the module?. Note: Frequently installer ignore this requirement marked on the back of modules. Listed combiner PV combiner boxes meeting this requirement are available. SMA Sunny Boy and some other 'string' inverters operating at high voltages may not require dc fuses with two strings of modules or less.	[UL-1703, 110.3(B)]	
26.	Are the OCPDs located in a position in the circuit to protect the module conductors from backfed currents from parallel module circuits or from the charge controller or battery?	[690.9(A) FPN].	
27.	Is the smallest conductor used to wire modules protected? Sources of overcurrent are parallel-connected modules, batteries, and ac backfeed through inverters.	[690.9(A)].	
28.	Are user-accessible fuses in "touch-safe" holders or capable of being changed without touching live contacts?	[690.16]	
ELECTRICAL CONNECTIONS			
29.	Are pressure terminals tightened to the recommended torque specification?		
30.	Are crimp-on terminals listed and installed with listed crimping tools by the same mfr?		

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Code Requirements		Code section	Req'd
31.	Are the twist-on wire connectors listed for the environment (i.e. dry, damp, wet, or direct burial) and installed per the mfr's instructions?		
32.	Are the pressure lugs or other terminals listed for the environment? (i.e. inside, outside, wet, direct burial).		
33.	Are the power splicing blocks <i>listed</i> rather than just UL Recognized?		
34.	Are terminals containing more than one conductor listed for multiple conductors?		
35.	Are the connectors or terminals using flexible, <i>fine-stranded</i> conductors listed for use with such conductors (there are different requirements & listing for <i>fine strands</i>).		
CHARGE CONTROLLERS			
36.	Is the charge controller listed to UL Standard 1741?	[110.3]	
37.	Are the exposed energized terminals located as to be not readily accessible?		
38.	Does a diversion controller have an independent backup control method?	[690.72(B)(1)]	
DISCONNECTS			
39.	<ul style="list-style-type: none"> • Are the disconnects listed for dc operation in dc circuits? Automotive, marine, and telecom devices are not acceptable. 		
40.	<ul style="list-style-type: none"> • Is the PV Disconnect readily accessible and located at the first point of penetration of PV conductors? [690.14(C)(1)...this is not required if the conductors are contained within a metal raceway - per 690.14(C)(1) exception]. 		
41.	PV conductors must remain on the outside of the structure until reaching the first readily accessible disconnect unless they are run within a metal raceway	[690.14, 690.31(E)].	

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Code Requirements		Code section	Req'd
42.	Do the disconnects control all current carrying conductors from the PV source?	[690.13]	
43.	Is there a disconnect for equipment? (i.e. inverters, batteries, charge controllers)	[690.15]	
44.	Ensure grounded conductors are <i>not</i> fused or switched; bolted disconnects are OK	[690.13 & FPN].	
45.	Note: Listed PV Centers by Xantrex, Outback, and others for 12-, 24-, and 48-volt systems contain charge controllers, disconnects, and OCPDs for the entire dc system with possible exception of source circuit or module protective fuses.		
INVERTERS (Utility-interactive Systems)			
46.	Is the inverter listed to UL Std 1741 and identified for use in interactive PV power systems? Note: Inverters listed to telecommunications and other standards do not meet NEC requirements.	[690.4(D), 690.60]	
47.	Is there a backup charge controller to regulate the batteries [<i>if applicable</i>] when the grid fails?	[690,72(B)(1)]	
48.	Is the inverter connected to a dedicated branch circuit with a back-fed OCPD?	[690.64]	
49.	Are the disconnects and overcurrent protection listed for dc and ac?	[690.15 & 17]	
50.	Is the total rating of OCPD devices <u>supplying</u> power to ac load center (main breaker + backfed PV breaker) less than the load-center rating (120% of rating allowed in residences)?	[705.12D]	
GROUNDING			

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Code Requirements		Code section	Req'd
51.	Is there only one bonding conductor (grounded conductor to ground) for dc circuit and one bonding conductor for ac circuits (neutral-to-ground) for system grounding? [250] Note: The dc bonds may be located inside inverters or in ground-fault protection devices.		
52.	Are ac and dc grounding electrode conductors connected properly? They may be connected to the same grounding electrode system (ground rod). Separate electrodes, if used, must be bonded together.	[690. 47]	
53.	Are equipment grounding conductors [EGCs] properly sized? (Even on ungrounded, low-voltage systems)?	[690.43]	
54.	Are there disconnects and overcurrent in both of the ungrounded conductors in each circuit on 12-volt, ungrounded systems?	[240.15, 690.13]	
55.	Are there bonding fittings used with metal conduits when dc system voltage is more than 250 volts dc?	[250.97]	
CONDUCTORS (General)			
56.	Are standard building wire cables and wiring methods used? [300.1(A)]		
57.	Are wet-rated conductors used in conduits in exposed locations? [100 - definition of Location, Wet]		
58.	Are the dc color codes correct? There are the same as ac color codes - grounded conductors are white and EGC are green, green/yellow, or bare. [200.6(A)].		