PHOTOVOLTAIC WIRE (UL)

Photovoltaic wire, also known as PV wire, is a single-conductor wire used to connect the panels of a photovoltaic electric energy system. PV systems, or solar panels, are electric-power production systems that capture sunlight in order to produce electricity through an energy conversion process. Electricity is produced at the panel and wiring is needed to convey the electrical energy back to a collection point or piece of equipment. Photovoltaic wire is a specific kind of wire created for PV applications.

WHAT IS PV WIRE?

In the United States, PV wire is a single-conductor product that meets the requirements of UL 4703 Standard for Photovoltaic Wire. The current construction requirements outlined by UL 4703 are as follows:

- Conductor size: 18 AWG through 2000 kcmil
- Conductor material: copper, copper-clad aluminum, aluminum
- Insulation: XLPE, EPR
- Voltage: 600 V, 1 kV, 2 kV
- Sunlight resistant
- Temperature rating: 90°C wet, 105°C dry, 125°C dry, and 150°C dry
- Optional direct burial rating
- Optional multi-ratings: USE-2, RHW-2
- Construction: Single conductor, non-armored

PV wire sizes for panels are commonly constructed of copper conductors in 12 AWG, 10 AWG and 8 AWG sizes. Feeders sizes are commonly 1/0 AWG and larger, contain aluminum conductors and are rated 2 kV. PV wire 1 kV and 2 kV constructions often contain the same insulation thickness. 2 kV PV wires are a standard construction for systems that require cables rated over 600 V.

CODE WIRING REQUIREMENTS

The NEC (National Electrical Code) developed Article 690 Solar Photovoltaic (PV) Systems for guidance on electrical energy systems, array circuits, inverters and charge controllers for PV systems. The NEC is commonly used in the United States for various installations (local codes may apply).

The 2017 NEC Article 690 Part IV Wiring Methods permits various wiring methods in photovoltaic systems. For single conductors, UL Listed USE-2 (Underground Service Entrance) and PV wire types are permitted in exposed outdoor locations in PV source circuits within the PV array. PV wire is further permitted to be installed in trays for outdoor PV source circuits and PV output circuits without needing to be rated for tray use. Restrictions do apply if the PV source and output circuits are operating over 30 volts in accessible locations. In these cases, Type MC or suitable conductors installed in raceways are required.

The NEC does not recognize Canadian type designations such as RWU90, RPV, or RPVU cables for solar applications that do not contain a suitable dual UL listing. For installations in Canada, the 2012 CEC Section 64-210 provides information on the permitted wiring types for photovoltaic applications.

PV WIRE ADVANTAGES

PV modules operate at high temperatures and are exposed to a variety of environmental conditions. The NEC limits various PV array applications to USE-2 or PV wire. These cables need to meet the required sunlight resistance and temperature ratings for the environment.

PV wires are manufactured for use in photovoltaic applications, while USE-2 cable types are typically manufactured for underground service entrance applications. Both cable types commonly contain XLPE insulation and can be sunlight resistant and/or rated for direct burial.

PV wire is set apart from USE-2 wire in terms of insulation thickness, voltage ratings and operating temperatures. PV wire contains thicker insulations suitable for protection against various harsh environments. USE-2 is rated up to 600 V, while PV wire is available in three voltage ratings.
ratings: 600 V, 1 kV, and 2 kV. USE-2 cable types’ maximum cable operating temperature is 90ºC, while PV wire can be rated to higher temperatures.

PV wire is one of the few single-conductor wire types that can be rated over 600 V and be direct buried per the NEC without needing to be shielded.

**WIRE MANAGEMENT**

PV modules are frequently pre-installed with single-conductor wires and quick-connect plugs for easy field installation. However, managing the wire installation can be difficult in harsh or tight environments or where rodents may be a problem. Installers need to ensure wires are secured and held in place to decrease wear and tear on the cable’s outer layer.

Installers commonly use wire clips that can hold wires to the module frames. Another solution used in the field is sunlight-resistant zip ties to secure the wires. Since PV is approved for use in trays, where rodents are a problem or where cables cannot practically be directly buried, wire trays can be attached to the bottom of a solar array above ground. Local or industry code may require further support and securing methods.