FREE HOMEOWNER GUIDE

What wire size does my EV charger need over a long run?

Why voltage drop matters for EV chargers

Voltage drop is one of the most overlooked parts of an EV charger installation, and it is exactly the kind of detail that separates a charger that works flawlessly from one that underperforms. As current travels down a wire, a little voltage is lost to the resistance of the conductor itself. The longer the run and the higher the current, the more voltage is lost by the time it reaches the charger.

For a charger that pulls 40 to 60 amps for hours at a time, often over a long run from the panel to a detached garage or the far side of the house, too much voltage drop means slower charging, wasted energy as heat, and in extreme cases charger faults. Sizing the conductors for the distance is how you avoid all three.

The 3 percent rule

The National Electrical Code recommends keeping voltage drop under 3 percent on a branch circuit feeding an EV charger. Under that threshold, the charger sees essentially full voltage and runs at its rated speed. The further the charger is from the panel, the larger the wire has to be to stay under 3 percent, which is why a run that would be fine at 40 feet may need to be upsized at 120 feet.

Voltage drop is driven by four things: the current the charger draws, the one-way distance of the run, the conductor material (copper has less resistance than aluminum for the same size), and the wire's cross-sectional area. An electrician runs this calculation for your specific distance rather than guessing; the tables below are a starting point, not a substitute for the math.

Typical copper wire sizes for 240V chargers

As a general reference for copper conductors at 240 volts, keeping voltage drop under 3 percent, here is roughly how wire size and maximum distance line up with common charger amperages. Aluminum conductors are also used, especially on longer or larger feeders, but they need to be upsized relative to copper for the same current and distance.

- [ ] 32-amp charger, 40-amp breaker: #8 AWG copper, good to roughly 150 feet
- [ ] 40-amp charger, 50-amp breaker: #6 AWG copper, good to roughly 175 feet
- [ ] 48-amp charger, 60-amp breaker: #6 AWG copper, good to roughly 125 feet
- [ ] 60-amp charger, 75-amp breaker: #4 AWG copper, good to roughly 150 feet
- [ ] Always verify against current NEC tables and local Oregon amendments, and re-check if the run is longer or the load increases

Breaker sizing: the 125 percent rule

EV charging is a continuous load, since the charger can run at full current for three hours or more, so the code requires the circuit's breaker and wire to be sized at 125 percent of the charger's draw. In practice that means a 40-amp charger needs a 50-amp breaker (40 × 1.25 = 50), a 48-amp charger needs a 60-amp breaker, and a 32-amp charger needs a 40-amp breaker.

This is not padding for its own sake; it keeps the conductors from running hot during long charging sessions. It also means the wire has to be rated for that larger breaker, which is one more reason charger amperage, breaker size, and wire size all have to be chosen together. A charger must always be on a dedicated circuit, with GFCI protection where the code requires it.

When the run is long, plan the wire first

Detached garages, shops, and back-of-lot ADUs are where voltage drop bites hardest, because the run from the main panel can easily exceed 100 feet. On those jobs, the wire size and the route are worth settling before anything is trenched or drilled, because upsizing conductors after the fact is expensive. Sometimes the cleaner answer is a subpanel at the structure, with the charger fed from there over a short run.

If you are still deciding between chargers, or whether your service can handle one at all, start with our guides on Level 1 vs Level 2 charging and whether you need a panel upgrade first. We run the voltage-drop and load calculations on every EV charger installation so the wire is right the first time. Have a licensed electrician size it rather than working from a generic online chart.

Frequently asked questions

How far can I run an EV charger circuit from the panel?

It depends on the charger's amperage and the wire size. As a rough guide for copper at 240 volts under a 3 percent voltage drop, a 32-amp charger on #8 wire is good to about 150 feet, and a 48-amp charger on #6 wire to about 125 feet. Longer runs need larger wire. An electrician should calculate it for your exact distance.

What is voltage drop and why does it matter for charging?

Voltage drop is the small loss of voltage that happens as current travels down a wire. On a long run to an EV charger it can mean slower charging, wasted energy as heat, and even charger faults. The NEC recommends keeping it under 3 percent, which is achieved by sizing the wire to the distance and current.

Why does a 40-amp charger need a 50-amp breaker?

EV charging is a continuous load, so the code requires the breaker and wire to be sized at 125 percent of the charger's draw. For a 40-amp charger that is 40 × 1.25 = 50 amps. This keeps the conductors from overheating during long charging sessions, and it means the wire must be rated for the larger breaker.

Should I use copper or aluminum wire for my charger?

Both are used. Copper carries more current for a given size and is common on shorter branch circuits. Aluminum is often used on longer or larger feeders and costs less, but it must be upsized compared to copper for the same load and distance. Which is right depends on the run, so have a licensed electrician specify it.

Sources

1. Electric Vehicle Charging Safety, Electrical Safety Foundation International (ESFI). https://www.esfi.org/electric-vehicle-charging-safety/
2. Electrical Code Program: Codes and standards, Oregon Building Codes Division. https://www.oregon.gov/bcd/codes-stand/Pages/electrical.aspx

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> Call Smiley Electric at (503) 484-7556 (Mon–Sat, 7am–5pm) or visit smileyelectric.net/contact. For sparks, smoke, a burning smell or a hot panel, turn off the power if it is safe and call right away.

Reviewed by Joshua Smiley, owner & master electrician, Smiley Electric. Last reviewed November 13, 2026. Online version: smileyelectric.net/help/ev-charger-wire-size-and-voltage-drop/. General information, not a substitute for an on-site inspection.

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