

Standby and Portable Generators

YES Electric • NEC 2026 with NEC 2023 numbers in parentheses

Draft 1 (October 2026). This chapter is under review. Code numbers are NEC 2026. Your local inspector may use an earlier edition, so ask your journeyman which one applies. Boxes marked "Picture coming" will get drawings and photos in a later version.

Course: YES Electric Residential Electrical Course, Phase 1 (Install) **Read first:** R1.2 (How a House Is Wired), R1.5 (Panel Upgrades and Service Changes), R1.6 (Grounding and Bonding). The load calculation in this module is short. R-LOAD teaches it in full. **Code edition:** NEC 2026. Where a section moved, the NEC 2023 number is in parentheses. The local inspector (AHJ) may enforce an earlier edition, so ask your journeyman which one applies before you set up an inspection.

1. Learning Objectives

When you finish this module you will be able to:

1. Install a portable-generator power inlet with a listed interlock kit or a manual transfer switch, and explain why a "dryer cord" backfeed can kill a lineman.
 2. Set and wire an air-cooled standby generator with a 200 A service-rated automatic transfer switch (ATS), including load-shed modules that let a 22 kW generator run a house that calculates bigger than 22 kW.
 3. Size a generator and its transfer equipment with the method that Article 702 requires for the kind of transfer you are installing.
 4. Ground and bond a generator correctly, and tell a separately derived system from a nonseparately derived system.
 5. Post the required signs and leave the customer with a startup sheet.
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2. Background in Plain Language

2.1 What a home generator does

A house normally gets power from one place: the utility. A generator is a second source. The whole job is about two things. First, the generator must never be connected to the utility wires at the same time as the utility. Second, the generator must be big enough for whatever loads will be on it.

The NEC calls a home generator an **optional standby system** (Article 702). "Optional" means the law does not require it. Hospitals and fire pumps use other articles (700 and 701) with stricter rules. A house never falls under 700 or 701, so ignore those articles on residential work.

There are two kinds of home generator jobs:

Job	What the customer has	How power gets to the house	Who switches
Portable hookup	A gas or dual-fuel portable generator on wheels, usually 5,000 to 10,000 watts	A cord from the generator to a power inlet box on the outside wall, then a circuit to an interlocked breaker or a manual transfer switch	The customer, by hand
Standby	A permanently mounted air-cooled generator on a pad, running on natural gas or propane, usually 10 kW to 26 kW	Conductors in conduit from the generator to an automatic transfer switch	The ATS, automatically

2.2 Why backfeeding through a dryer outlet is never allowed

Some homeowners make a cord with a plug on both ends, plug one end into the generator and the other into the dryer receptacle, and turn the generator on. People call it a "suicide cord." Here is what happens:

1. The plug on the house end has live, bare prongs as soon as the generator runs. Anyone who touches them gets 240 V.
2. If the main breaker is still on, the generator pushes power out through the meter, up the service drop, and into the pole transformer. The transformer works in both directions. It takes the 240 V from the generator and steps it up to the utility's line voltage, which is thousands of volts. A lineman working on the "dead" line down the street can be killed.
3. When the utility power comes back, it slams into the running generator out of phase. The generator, the house wiring, or both can be destroyed, and a fire can start.

The code answer is in 702.5(A): transfer or interlock equipment is required, it must be listed, and it must be built so that the sources cannot be connected together "in any operation of the equipment." A cord with two male plugs does not meet that rule. When a customer asks us to "just make a cord," the answer is no, and we offer an inlet and interlock instead.

2.3 Transfer equipment: three choices

Equipment	How it works	Where we use it
Listed interlock kit	A metal slide plate on the panel cover. With the main breaker ON, the plate blocks the generator breaker from turning on. To turn the generator breaker on, you must turn the main OFF and slide the plate.	Portable generators when the panel brand makes a listed kit for that exact panel and main breaker
Manual transfer switch	A small panel with 6 to 10 double-throw switches. Each selected circuit is moved from the main panel to this panel. Each switch picks "LINE" or "GEN."	Portable generators when no interlock kit is listed for the panel, or the customer wants fixed circuits
Automatic transfer switch (ATS)	A motor- or solenoid-driven switch that senses utility loss, signals the generator to start, and moves the load to the generator. It moves back when utility power returns.	Standby generators

The interlock or switch must be listed for the panel it goes in. A Square D interlock kit fits Square D panels with a specific main breaker frame. It does not fit an Eaton panel, and a "universal" plate that is not listed for the panel does not meet 702.5(A).

2.4 Separately derived or not: the neutral question

This is the part people get wrong. Read it twice.

A generator has two hots and a neutral. The question is whether the transfer equipment switches the neutral.

- **Nonseparately derived system (solid neutral).** The transfer switch or interlock switches only the two hots. The generator's neutral stays tied to the utility neutral at the service. The neutral-to-ground bond for the whole system is the main bonding jumper in the service panel. The generator must not have its own neutral-to-ground bond, or neutral current will flow on the ground wires and metal parts. An interlock kit and most residential ATS units, including the Generac 200 A service-rated switch in this module, are two-pole and leave the neutral solid.
- **Separately derived system (switched neutral).** The transfer switch has a third pole that switches the neutral. The generator is now its own system, so it needs its own neutral-to-ground bond (a system bonding jumper) and a grounding electrode connection under 250.30. This is rare on houses.

NEC 2026 says this in 250.30, Informational Note No. 1: an on-site generator "is not a separately derived system if the grounded conductor is solidly interconnected to a service-supplied system grounded conductor." It also says this in 250.35(A) and (B) for permanently installed generators, and in 702.11 for portable ones.

Every generator is marked to tell you whether its neutral is bonded to its frame. NEC 2026 445.11(A)(2) requires that marking, and it requires extra marking if anyone changes the bond in the field. Read the nameplate before you hook up any generator.

The Generac air-cooled installation manual says the same thing in its own words: the neutral-to-ground bond inside the generator "is normally required when the generator is the source in a separately derived system. It is not required when the generator is a backup source in a utility supplied electrical system with a 2-pole transfer switch" (Generac, Installation Guidelines, 60 Hz Air-Cooled Generators 9 kW to 22 kW, Section 6, Main AC Wiring note).

2.5 Sizing: what 702.4 actually says

NEC 2026 702.4(A) has two different sizing rules, and which one you use depends on how loads connect.

1. **Manual or nonautomatic load connection, 702.4(A)(1).** The generator must have "adequate capacity and rating for the supply of all equipment intended to be operated at one time." The user is allowed to pick which loads are on. This is the portable-generator-with-interlock case. The customer decides what to turn on, and our job is to size for the loads they will run together.
2. **Automatic load connection, 702.4(A)(2).** The generator must meet one of two options, figured by Article 120 Parts I through IV (2023: Article 220) or another approved method: - (a) Full load: the generator can supply the full load that is automatically connected. - (b) Energy management system (EMS): the EMS automatically manages the connected load, and it complies with 130.30, or with a power control system (PCS) setting under 130.70, or (for a listed inverter-based system in a one- or two-family dwelling) the multimode inverter rule in 702.4(A)(2)(b)(3).

The standby job in this module uses option (b): load-shed modules managed by the generator system. NEC 2026 130.2 requires energy management equipment to be listed. Check the listing on the load-management modules before you count on them in your sizing.

2.6 What changed in the 2026 code that matters here

Topic	NEC 2026 rule	What it means on the job
Sizing with load management	702.4(A)(2)(b) points to Article 130 (Energy Management Systems)	A load-shed module is an energy management device. The code now has its own article for it.
Generator shutdown	445.19(C): for other than cord-and-plug portable generators at one- and two-family dwellings, an emergency shutdown device must be outside the dwelling, readily accessible, marked "Generator Emergency Shutdown," and meet 445.19(A)(1) and (A)(2). A device on the outside of the generator enclosure is permitted.	The OFF button and breaker on the outside of the unit usually satisfy this when the unit is outside. Check the marking.
Signs	702.7(A)(1) for one- and two-family dwellings: labels at the service location that includes the emergency disconnect required by 225.41 (2023: 230.85), showing where the generator's disconnect or shutdown is	One label at the meter-area disconnect telling the fire department where the generator is and how to stop it
Portable inlet sign	702.7(C): a sign near the inlet saying which kind of system it is wired for, separately derived (bonded neutral) or nonseparately derived (floating neutral)	Our interlock jobs get the "NONSEPARATELY DERIVED (FLOATING NEUTRAL) SYSTEM ONLY" sign

3. Codes and Parts You Will Use

3.1 NEC sections, verified against the NEC 2026 text

Section	What it says, in plain words
702.1	Article 702 covers permanently installed standby systems and systems arranged to connect a portable generator to house wiring.
702.3	Reconditioned transfer switches shall not be installed. Use new.
702.4(A)(1)	Manual load connection: size for everything intended to run at one time. The user picks the loads.
702.4(A)(2)	Automatic load connection: full load, or an energy management system per 130.30, 130.70, or the inverter rule. Calculate by Article 120 Parts I-IV or another approved method.
702.5(A)	Transfer or interlock equipment is required, must be listed, and must prevent the sources from connecting together in any operation. The exception (no transfer equipment) is for qualified-person supervised sites only. It does not apply to a homeowner.
702.5(B)	A transfer switch that mounts between the meter and the meter socket must be a listed meter-mounted transfer switch and must be approved.
702.5(C)	Field marking of transfer switch short-circuit rating is required in other than dwelling units. Houses are exempt from this marking, but the rating still has to be high enough (see 110.10).
702.6	Signals for malfunction and carrying load "where practicable." Portable sources are exempt. The standby controller's display and app do this.
702.7(A)(1)	One- and two-family dwellings: labels at the service location with the 225.41 emergency disconnect, showing where the generator disconnect or shutdown is.
702.7(B)	If removing a grounding or bonding connection in the normal-source equipment would cut the grounding electrode conductor connection to the generator's grounded conductor, post the warning: "WARNING: SHOCK HAZARD EXISTS IF GROUNDING ELECTRODE CONDUCTOR OR BONDING JUMPER CONNECTION IN THIS EQUIPMENT IS REMOVED WHILE ALTERNATE SOURCE(S) IS ENERGIZED."
702.7(C)	Power inlet for a portable generator: warning sign near the inlet stating "FOR CONNECTION OF A SEPARATELY DERIVED (BONDED NEUTRAL) SYSTEM ONLY" or "FOR CONNECTION OF A NONSEPARATELY DERIVED (FLOATING NEUTRAL) SYSTEM ONLY."
702.10	Standby wiring may share raceways, cables, boxes, and cabinets with other general wiring.
702.11(A), (B)	Portable generator grounding: separately derived systems follow 250.30; nonseparately derived systems bond the equipment grounding conductor to the system grounding electrode.
702.12(A)	Outdoor generator over 15 kW or permanently installed, with a 445.18(A) disconnect: that disconnect can serve as the building disconnect if it is readily accessible and within sight of the building.
702.12(B)	

Section	What it says, in plain words
	Portable generator 15 kW or less connected by a flanged inlet or other cord-and-plug connection: no separate disconnect required. The inlet must be located outside the building.
702.12(C)	Power inlets rated 100 A or more must be listed for the use. If the inlet is not rated as a disconnect, it needs an interlocked disconnect.
445.2	Stationary generators shall be listed.
445.11(A)(2)	Generator must be marked to show whether the neutral is bonded to the frame. Field changes require extra marking.
445.13(A)	Conductors from the generator terminals to the first overcurrent device, when the generator has no overcurrent protection: at least 115 percent of nameplate current.
445.18(A)	Generators other than cord-and-plug portables need a lockable disconnect that opens all ungrounded conductors. It may be inside the generator behind a cover, with a field label showing where.
445.19(C)	Emergency shutdown device for one- and two-family dwellings, marked "Generator Emergency Shutdown."
445.20	Portable generators 15 kW or smaller: GFCI protection on 125 V, 15 and 20 A receptacles on the generator.
250.30	Grounding rules for separately derived systems. Informational Note No. 1 explains that a generator with a solidly connected neutral is not separately derived.
250.34(A)	A portable generator's frame does not need a ground rod when it feeds only cord-connected equipment through its own receptacles and the EGC terminals are bonded to the frame. This is camping and job-site use, not house hookup.
250.35	Permanently installed generator: run an effective ground-fault current path (an EGC or supply-side bonding jumper) with the supply conductors to the first disconnect. (A) separately derived: follow 250.30. (B) nonseparately derived: bonding jumpers per 250.102(C) when the overcurrent device is not part of the generator.
250.142(B)	On the load side of the service disconnect, the neutral may not be connected to metal parts of equipment. This is why the old main panel becomes a subpanel with separated neutrals and grounds when a service-rated ATS goes in ahead of it.
408.36(D)	A plug-in breaker that is backfed and terminates field-installed supply conductors must be secured by an additional fastener. The generator breaker in an interlock job is this breaker.
225.41 (2023: 230.85)	One- and two-family dwellings need an outdoor emergency disconnect. A service-rated ATS with its breaker outside on the house usually is that disconnect.
230.70(A)(1), 230.70(E)	One- and two-family service disconnects go in a readily accessible outdoor location, on or within sight of the house, unless a 225.41 emergency disconnect is installed. When service equipment is replaced, 230.70(A) through (C) apply. An outdoor service-rated ATS meets this.
230.67	

Section	What it says, in plain words
	SPD (Type 1 or 2) required at the service. If the ATS becomes the new service equipment, the SPD rule applies. See R1.9.
110.26	Working space: 3 ft deep (0–150 V to ground), 30 in wide, 6½ ft high, in front of the ATS and panel.
300.7, Table 300.7(A) (2023: 300.5)	Burial depth. PVC conduit in a yard: 18 in of cover. Under a one- or two-family driveway: 18 in.
110.14(D)	Torque every lug to the value on the equipment label, with a torque tool.

3.2 Manufacturer data used in this module

Item	Value	Source
Generac 22 kW air-cooled (G007042/ G007043) rated output	22,000 W on LP, 19,500 W on natural gas	Generac 20/22/24 kW Guardian spec sheet, p. 4: https://www.generac.com/globalassets/products/residential/standby-generators/spec-sheets/20kw-22kw-24kw_guardian-series_aircooled-gasengine_specsheet.pdf
Rated max continuous current at 240 V	91.7 A (LP), 81.3 A (NG)	Same, p. 4
Generator main line circuit breaker	100 A	Same, p. 4
Derating	About 3.5 percent per 1,000 ft above sea level, and about 1 percent per 10 °F above 60 °F	Same, p. 4 footnote
Fuel at full load, 22 kW	327 ft ³ /hr NG, 142 ft ³ /hr LP	Same, p. 4
Gas pressure at the generator inlet	3.5–7 in water column NG, 10–12 in water column LP	Same, p. 4
200 A service-rated ATS	2 poles, 200 A, 120/240 V 1Ø, NEMA 3R, short-circuit rating "circuit breaker protected 22,000," lugs 250 kcmil to #6, manages up to 4 AC loads with no extra hardware, up to 8 more 240 V loads with Smart Management Modules	Same, p. 5
Clearances		

Item	Value	Source
	Rear 18 in minimum; front and ends 3 ft (shrubs, bushes, trees count); no operable window, door, or wall opening within 5 ft of any point of the generator; overhead 5 ft; fence panels no closer than 3 ft in front	Generac, Installation Guidelines, 60 Hz Air-Cooled Generators 9 kW to 22 kW, Section 3, Figure 3-1 and text: https://floridabuilding.org/Upload/Petitions/Pet_ID_174_Response_generac%202022%20install%20manual.pdf
Base	Level within 0.5 in all around. Set the composite pad on level solid ground, 4 in of compacted pea gravel, or concrete. If you build a gravel base: about 5 in deep and about 6 in longer and wider than the generator footprint.	Same, Sections 3 and 4
Control wiring	N1 and N2 (240 V utility sensing), T1 (fused 120 V for battery charger), 0 (DC common), 194 (12 V DC +), 23 (transfer signal). Size by length: 18 AWG to 115 ft, 16 AWG to 185 ft, 14 AWG to 295 ft, 12 AWG to 460 ft. Copper only. All conductors rated at least 300 V.	Same, Section 6, Tables 6-2 and 6-3
Generator lug torque	Power, large neutral, and large	Same, Section 6, Table 6-4

Item	Value	Source
	ground lugs: 120 in-lb. Neutral bar: 35 in-lb (4–6 AWG), 25 in-lb (8 AWG), 20 in-lb (10–14 AWG). Lugs rated 75 °C, copper or aluminum.	
Battery	12 V, Group 26R 540 CCA minimum, or Group 35 AGM 650 CCA minimum. Connect positive first. Battery post torque 70 in-lb.	Same, Section 6
Load-shed module (Generac SMM, 50 A)	240 V coil, 50 A resistive / 40 A inductive, 180 A locked rotor, 3 hp. Sheds on low generator frequency. Priority 1 recovers after 5 minutes; each priority after waits 15 more seconds (Priority 8 = 6 min 45 s). Field terminals 25 in-lb. 8 AWG copper for 50 A (40 A max in Type NM cable).	Generac Owner's/Installation Manual for SMM, Tables 2-1 and 3-1: https://www.generac.com/globalassets/residential/dealers--installers/generac-installer-programs/solar--battery-installer-support/10000030493-rev-e-50a-smart-management-module-install--owners-manual.pdf
Square D interlock kits	Interlock the QOM2 main breaker (100–225 A) with a 2-pole backfed generator breaker, 15–125 A, located in branch positions 2–4. HOMCGK2C (Homeline 150–225 A, indoor),	Schneider Electric, Generator Interlock Kit, Document RP19200310, Aug. 2016: https://images.thdstatic.com/catalog/pdfimages/60/605938f6-6ced-4d52-a5a3-c25e7e9202aa.pdf

Item	Value	Source
	HOMRBGK2C (Homeline 150–225 A, outdoor), QOCGK2C (QO 150–225 A indoor).	

Always read the instructions that come in the box for the exact model you are installing. NEC 110.3(B) makes the listing instructions part of the code requirement.

4. Step-by-Step Procedures

Procedure A: Portable generator with inlet and listed interlock kit

This is the job we do most. It takes one tech about 4 to 6 hours on a house with the panel on an outside wall or in a garage.

Material for a typical 30 A job (Square D Homeline 200 A main-breaker panel example):

Qty	Item	Why
1	Listed interlock kit for the exact panel and main breaker (example: HOMCGK2C for an indoor Homeline 150–225 A QOM2-frame main)	702.5(A) listed interlock
1	30 A 2-pole breaker, same brand and type as the panel	Generator breaker, backfed
1	Breaker hold-down (retainer) listed for the panel	408.36(D) backfed breaker fastener. Many kits include a retaining bracket.
1	30 A, 125/250 V, NEMA L14-30 flanged power inlet box, outdoor rated	Where the generator cord plugs in
As needed	10-3 with ground NM-B (indoors, dry), or 3 #10 THWN-2 plus #10 green in conduit (outdoors, wet)	30 A circuit, two hots, neutral, ground
1	Generator cord, 10/4 SOOW, L14-30P to L14-30R, 20–30 ft	Customer may already own one
1	Warning sign per 702.7(C)	Inlet sign
1	Label at the panel showing generator breaker and interlock	Directory and customer instruction

Steps:

1. **Read the panel label and the generator nameplate first.** Find the panel brand, catalog number, main breaker frame, and the slots the interlock kit is listed for. On the

Square D kits the generator breaker goes in branch positions 2–4, right under the main. If those slots are full, you will move circuits down to make room. Read the generator's neutral marking (445.11(A)(2)): bonded or floating.

Why: the interlock only works with the breaker in the exact position the kit is designed for. A breaker in the wrong slot can be turned on with the main on.

1. **Pick the inlet location.** It must be outside (702.12(B)). Mount it where the customer can park the generator at least as far from doors, windows, and vents as the generator manual requires, with the exhaust pointed away from the house. Mount the inlet at a height that keeps it out of splash and snow. 18 in to 24 in above grade is common.

SAFETY: Portable generators make carbon monoxide. Put the inlet where the generator will sit outside and away from openings. A generator running in a garage, even with the door open, can kill everyone in the house. Tell the customer this in plain words and write it on the startup sheet.

1. **Turn off and verify dead.** Call the customer to warn them the power is going off. Turn off the main breaker. Test with your non-contact tester, then your meter, on the line side of a branch breaker you know: L1 to N, L2 to N, L1 to L2. Remember the line side of the main breaker and the service conductors are still live. Only the utility can make those dead. Do not reach into the top of the panel near the main lugs.

SAFETY: The service conductors and main lugs stay energized with the main off. Treat the top 6 in of the panel as live. Wear the PPE your journeyman assigns for panel work (see R1.1 and commercial 2.1).

1. **Make room for the generator breaker.** If positions 2–4 are taken, move those circuits to empty slots lower in the panel. Extend the wires if they don't reach with listed splicing devices in the panel gutter only if the panel instructions allow; otherwise, re-pull. Update the directory as you go.
2. **Mount the inlet box and run the circuit.** Drill through the rim joist or wall, seal the hole, and run the 10 AWG circuit to the panel. Indoors in dry space, 10-3 with ground NM-B, stapled within 12 in of the box and every 4½ ft (see R1.3 for the support rules). Outdoors or in a wet location, use conduit and THWN-2 wire. Keep the run as short as you can.

Why 10 AWG: the inlet and breaker are 30 A. 10 AWG copper is rated 30 A in the 60 °C column of Table 310.16, which is the column you must use for NM cable.

1. **Wire the inlet.** L14-30 terminals: X and Y are the two hots (black and red), W is the neutral (white), G is the ground (green or bare). Torque the terminals to the value on the inlet.
2. **Install the 2-pole 30 A breaker in the interlock position.** Land black and red on the breaker. Land the white on the neutral bar and the bare on the ground bar. In a service panel the bars are bonded together. In a subpanel they are separate, and the interlock is

not legal in a subpanel unless the kit and the panel listing say so. Install the hold-down so the breaker cannot be pulled off the bus by hand (408.36(D)).

Why the hold-down: when the generator is running, this breaker's line terminals are live from the generator side. If the breaker were pulled off the bus, it would hang loose and live.

1. **Install the interlock plate.** Use the kit's drilling template on the panel cover. Drill the holes the kit calls for. Install the shoulder screws and the plate exactly as the instructions show. Install the kit's retaining bracket if it has one, so the plate cannot be removed without taking off the cover.
2. **Prove the interlock.** With the cover on: - Main ON: try to turn the generator breaker ON. It must be blocked. - Main OFF, slide the plate, generator breaker ON: try to turn the main ON. It must be blocked. If either one moves, stop and fix the install. Do not leave the house with an interlock that fails.
3. **Post the signs and labels.**
 - Near the inlet: the 702.7(C) sign. For a floating-neutral hookup through an interlock (the neutral is not switched), use "WARNING: FOR CONNECTION OF A NONSEPARATELY DERIVED (FLOATING NEUTRAL) SYSTEM ONLY."
 - On the panel directory: "GENERATOR — 30 A — interlocked with main."
 - On the panel cover: the kit's interlock labels.
4. **Test with the customer's generator.** Main OFF. Slide the plate. Start the generator outdoors with no load. Plug in the cord. Turn on the generator's 30 A output breaker. Turn on the panel's generator breaker. Measure at a branch breaker: L1–N about 120 V, L2–N about 120 V, L1–L2 about 240 V. Turn on one load circuit at a time. Then shut down in reverse.
5. **Teach the customer the sequence** (write it on the startup sheet and tape a copy inside the panel door):

To go on generator	To go back to utility
1. Start generator outside, nothing plugged in.	1. Turn OFF the generator breaker in the panel.
2. Plug cord into generator, then into the inlet.	2. Slide the interlock plate.
3. Turn OFF the main breaker.	3. Turn ON the main breaker.
4. Slide the plate. Turn ON the generator breaker.	4. Turn off the generator output, unplug, then stop the generator.
5. Turn branch breakers on one at a time, biggest motor first. Stay under the generator's running watts.	

The neutral and the bonded-neutral generator. With an interlock, the generator neutral connects straight to the house neutral bar, which is bonded to ground at the service. If the

generator's neutral is also bonded to its frame, there are two neutral-ground bonds and neutral current splits onto the cord's ground wire. Many portable generators sold for job-site use come with a bonded neutral. Read the generator manual. Some manufacturers describe how to remove the bond for home standby use and require a marking when you do (445.11(A)(2)). If the manual does not allow it, the customer needs a generator with a floating neutral, or a transfer switch that switches the neutral. Do not cut a bond strap inside a generator on your own judgment.

Procedure B: Portable generator with a manual transfer switch

Use this when no listed interlock exists for the panel, or the panel is full and won't take the generator breaker in the required slot.

1. Pick the circuits with the customer: refrigerator, freezer, furnace or air handler, a few lights, a kitchen receptacle circuit, internet. Most residential manual transfer switches have 6 to 10 circuits and are rated 30 A or 50 A in.
2. Mount the transfer switch beside the panel. Most come with a flexible whip that enters a knockout in the side of the panel.
3. Turn off the main and verify dead as in Procedure A, step 3.
4. For each selected circuit: disconnect the branch wire from its breaker. Connect the breaker to the transfer switch's "line" lead for that circuit (the lead goes back to the breaker). Connect the branch wire to the transfer switch's "load" lead (splice in the panel gutter with listed connectors). Match colors as the instructions say.
5. A 240 V circuit (well pump) takes two adjacent transfer positions that are tied together. Read the instructions.
6. Land the transfer switch neutral and ground in the panel.
7. Run the circuit from the transfer switch's generator input to the outdoor inlet as in Procedure A.
8. Post the 702.7(C) sign at the inlet. Label each transfer switch position with the circuit name.
9. Test: every switch on LINE, house works normally. Main still on, generator running, flip one switch to GEN, confirm that circuit is on the generator and nothing else is.

Because each double-throw switch can only connect a circuit to one source at a time, the utility and generator can never meet. That is what makes it legal under 702.5(A).

Procedure C: Air-cooled standby generator with 200 A service-rated ATS

This is a two-person job over one to two days, plus a licensed gas fitter or plumber for the gas line if YES does not do gas. It needs an electrical permit, often a gas permit, and an inspection before the utility will release a meter pull.

Day-before checklist:

Item	Detail
Permits	Electrical permit. Gas permit. Ask your journeyman who pulls the gas permit.
Utility	Schedule the meter pull or disconnect if the ATS goes in ahead of the panel. See R-SERVICE for the order of calls.
811 locate	Call 811 before you dig the trench. Allow the locate time your state requires.
Gas	Confirm the gas meter can supply the generator plus every gas appliance. The 22 kW unit uses 327 ft ³ /hr on natural gas at full load. The utility may need to upsize the meter.
Pad location	Confirm clearances on site (Step 1 below).
Material	Generator, ATS, load-shed modules, conduit and fittings, wire, battery, gravel or pad, signs.

Steps:

1. **Site the generator.** Measure from the generator's footprint, not its center: - Rear to wall: 18 in minimum. - Front and both ends: 3 ft clear, including shrubs, bushes, and trees. - Any operable window, door, or opening (dryer vent, crawl space vent, soffit vent, fresh-air intake): no closer than 5 ft from any point of the generator. - Overhead: 5 ft clear. Never under a wood deck or a low roof overhang unless 5 ft is kept. - Fence panels in front: no closer than 3 ft. - Out of downspout, irrigation, and sump discharge spray. On high ground so water won't stand around it. - As close as practical to the gas meter and the ATS. These come from the Generac air-cooled installation guidelines, Section 3. They are based on NFPA 37 and the manufacturer's fire testing. Other brands have their own numbers, so read the manual for the unit you are setting. The local AHJ or HOA may add a property-line setback.

SAFETY: The 5 ft opening rule exists because exhaust contains carbon monoxide. A generator 3 ft from a bedroom window is a CO hazard even though everything else is right.

1. **Prepare the base.** Level within 0.5 in all around. Most air-cooled units ship on a composite pad that can sit on level solid ground, on 4 in of compacted pea gravel, or on concrete. If the AHJ wants a concrete pad, follow the local rule. Compact the base so it will not settle or wash out.
2. **Set the generator.** Use a cart or a crew of four. Do not lift by the louvers. Remove shipping hardware the manual lists.
3. **Mount the ATS.** A service-rated ATS goes between the meter and the existing panel. Mount it next to the meter on the outside wall. Keep the 110.26 working space: 3 ft deep, 30 in wide, 6½ ft high, clear to the ground.

Putting the service-rated ATS outside next to the meter also handles two disconnect rules at once. NEC 2026 230.70(A)(1) puts the service disconnect for a one- or two-family dwelling in a readily accessible outdoor location, on or within sight of the house, unless a 225.41 emergency

disconnect is installed, and 230.70(E) applies that rule when service equipment is replaced. Alabama Power has required an external disconnect on the load side of new residential meter bases since January 1, 2022 (Alabama Power, Builder's Guide, "External Disconnect"). The ATS service breaker is that outdoor disconnect. If the existing main panel was the service disconnect and was indoors, it becomes a subpanel and the outdoor ATS takes over the job. See R1.5 and R-SERVICE.

Alabama Power's Rules and Regulations for Electric Service (effective October 4, 2022), Rule 4.10, also says a customer generator must be inspected by the local inspecting authority before it is connected to the premises wiring, that it may not run in parallel with an Alabama Power circuit without written authorization, and that a cord-and-plug portable generator built only for plugging in appliances "shall not be connected directly to the premises wiring." Plan the inspection before the first run under load.

SAFETY: The meter base and service conductors are live until the utility pulls the meter or cuts the service. You do not touch the service conductors until that happens. See R-SERVICE.

1. **Plan the conduit runs.** You need: - Generator to ATS: power conductors (2 hots, neutral, ground) and control wires. NEC 2026 300.5(C)(1) (2023: 300.3(C)(1)) allows the 120/240 V power and the low-voltage control wires in the same conduit when every conductor is insulated for the highest voltage present. Generac's manual repeats this and requires all conductors rated at least 300 V. Use 600 V THWN-2 for the control wires. - ATS to the existing panel: the new 4-wire feeder (2 hots, neutral, ground). The old panel is now a subpanel. - ATS to each load-shed module and from the module to its load. Bury PVC with 18 in of cover in the yard (Table 300.7(A), column 3). Use a sweep up into the generator's knockout. Close the unused knockout with a NEMA 3R plug.
2. **Size the generator-to-ATS conductors.** See Worked Example 2, step 6. For the 22 kW unit with its 100 A breaker: 3 #2 Cu THWN-2 (two hots and neutral) plus 1 #8 Cu ground, and 6 control wires, in 1¼ in PVC.
3. **Pull wire and land the generator end.** Inside the generator wiring compartment:
 4. Ground wire to the ground lug: 120 in-lb.
 5. Neutral to the neutral lug: 120 in-lb.
 6. E1 and E2 (hots) to the power lugs: 120 in-lb.
 7. Check the factory neutral and ground connections at 25 in-lb.
 8. Do not install the neutral-to-ground jumper. The 200 A ATS is 2-pole, so the generator is nonseparately derived. The only neutral-ground bond is in the ATS (the new service equipment).
 9. Sense wires N1 and N2 to the sense terminal block. Control wires T1, 0, 194, 23 to the control terminal block. Strip only enough so bare wire, and no insulation, sits in each spring terminal.

10. **Convert the existing panel to a subpanel.** Once the utility has pulled the meter and you have verified the panel dead:
 11. Remove the main bonding screw or strap in the old panel.
 12. Separate neutrals and grounds. All white neutrals stay on the neutral bar. All bare and green grounds go to a ground bar bonded to the can. Add a ground bar kit if the panel doesn't have one.
 13. Move the grounding electrode conductor from the old panel to the ATS, which is now the service equipment. Rods and the water pipe bond land there.
 14. Run the 4-wire feeder from the ATS load side to the old panel's main lugs or main breaker. This is required by 250.142(B). A neutral bonded to metal on the load side of the service puts neutral current on every ground wire and metal pipe in the house. See R1.6.
15. **Land the ATS.** Service conductors from the meter to the ATS service breaker. Generator conductors to the ATS "E" terminals. Feeder to the panel from the ATS load terminals. Neutral to the ATS neutral, ground to the ATS ground bar, main bonding jumper installed in the ATS per its instructions, grounding electrode conductor landed. Torque every lug to the value printed on the ATS label (110.14(D)). Mark each lug with a paint pen after torquing.
16. **Install the SPD.** The ATS is now service equipment, so 230.67 requires a Type 1 or Type 2 SPD in or right next to it, rated at least 10 kA nominal discharge current. See R1.9.
17. **Wire the load-shed modules.** For each managed 240 V load (range, dryer, water heater):
 1. Mount the module near the panel or near the load. The Generac SMM enclosure is NEMA 3R, indoor or outdoor.
 2. Run the branch circuit from its breaker to the module's LINE terminals and from the module's LOAD terminals on to the appliance.
 3. Use 75 °C copper sized for the breaker. The SMM manual calls for 8 AWG on a 50 A load, and limits Type NM to 40 A on that size.
 4. Torque the module field terminals to 25 in-lb.
 5. Set a different priority dial on each module. Priority 1 is the first load to come back after a shed. For central air conditioners, the ATS controller manages up to four AC loads through the thermostat wire without extra hardware. If the thermostat has no 24 V wire available, the SMM manual says use an SMM to break power at the HVAC unit itself.
18. **Battery.** Generator OFF. Utility to the ATS off. Remove the 7.5 A control fuse. Connect red (positive) first, then black (negative). 70 in-lb on each post. Dielectric grease on the posts. Install the red post cover.

SAFETY: With the generator in AUTO and utility off, it will start the moment the battery is connected. Keep it in OFF and keep the fuse out until you are ready.

19. **Gas.** The gas fitter runs and pressure-tests the line, sized for the generator's full-load flow plus the house's other gas loads. The Generac guide sizes pipe by kW and length and adds 2.5 ft per bend, tee, or angle. The generator inlet size does not set the pipe size.
20. **Inspection, then utility reconnect.** Do not have the meter reinstalled until the inspector releases the service. See R-SERVICE.
21. **Commission the generator.** Follow the "Electrical Checks," "Generator Tests Under Load," and "Checking Automatic Operation" sections of the Generac manual. The checks are summarized below.

Check	Expected reading	If wrong
Utility at ATS N1-N2	240 V	Check service wiring to N1/N2
Utility N1-neutral, N2-neutral	120 V each	Check neutral
Generator running, breaker on, at ATS E1-E2	238–242 V, 59.5–60.5 Hz	Check generator breaker, output, and wiring
E1-neutral, E2-neutral	119–121 V each	Check neutral
Cranking and running gas pressure	Record both. Must stay within 3.5–7 in w.c. (NG) or 10–12 in w.c. (LP) at the generator inlet, steady needle.	Undersized or restricted pipe, small regulator
Under load, 20–30 min	About 240 V, about 60 Hz, steady	Falling volts and hertz: overload or fuel problem
Automatic test	Utility off: engine starts after about 5 s delay plus warm-up, ATS transfers. Utility back: re-transfers after about 15 s, engine cools down and stops about 1 min later.	Check control wiring 23 and 194, N1/N2 sensing

1. **Set the controller.** Activate the unit (the Generac controller will not run in AUTO until activated), set date and time, fuel type, and the exercise timer. Set AUTO. Close all panels.
2. **Post the signs.** See Section 4.1 below.
3. **Fill out the startup sheet and walk the customer through it.** See Section 4.2.

4.1 Signs and labels for a standby install

Where	What it says	Rule
At the outdoor emergency disconnect (the ATS service breaker, usually)	Location of the generator and its disconnect or emergency shutdown, for example "STANDBY GENERATOR LOCATED AT REAR LEFT CORNER OF HOUSE. GENERATOR DISCONNECT AND EMERGENCY SHUTDOWN ON UNIT."	702.7(A)(1), 225.41(B)
On the ATS service breaker	"SERVICE DISCONNECT"	230.70(B)
On the generator	"Generator Emergency Shutdown" at the shutdown device, and a label showing where the generator disconnect is if it is inside a cover	445.19(C), 445.18(A)
At the old panel, now a subpanel	Directory updated. Note "Fed from ATS."	408.4
On each load-shed module	Load name and priority number (decal supplied)	Manufacturer
Where removing a bond would cut the generator's grounding path	702.7(B) shock hazard warning	702.7(B)

4.2 The customer startup sheet

Leave one copy taped inside the ATS door and give one to the customer. It lists:

1. Generator model, serial number, kW on their fuel.
 2. Which loads are managed and their priority order.
 3. What the generator does in an outage: starts in about 5–10 seconds, power returns to the house, managed loads come back over 5 to 7 minutes.
 4. Exercise day and time. The unit runs for about 5 minutes on that schedule and does not carry the house during the exercise.
 5. How to shut it down for service: turn off the main utility disconnect, turn the generator breaker OFF, press OFF on the controller, remove the 7.5 A fuse. Reverse to restore.
 6. Keep 3 ft clear in front and on the ends. Keep 5 ft from windows and doors. Do not stack firewood or plant shrubs against it.
 7. Maintenance interval from the owner's manual, and YES's phone number.
-

5. Worked Examples

Worked Example 1: Portable generator for an outage load list (702.4(A)(1))

The house: 1,800 sq ft, Birmingham, gas furnace with an electric blower, gas water heater, electric range. The customer wants to keep food cold, run the furnace in winter, keep lights and internet on, and run the microwave.

Step 1. List the loads from their nameplates. Running watts = volts × nameplate amps. Starting watts for a motor load is higher for a second or two. Use the nameplate locked-rotor amps (LRA) if one is printed. If not, the assumption in this example is 3 times running, which is a planning number, not a code number.

Load	Volts	Nameplate amps	Running W	Starting W (assumed 3× for motors)	Leg
Refrigerator	120	6.0	720	2,160	A
Chest freezer	120	4.0	480	1,440	A
LED lights, 10 rooms	120	—	400	400	A
Gas furnace blower	120	7.0	840	2,520	B
Microwave	120	12.5	1,500	1,500	B
Internet, TV, phone chargers	120	2.5	300	300	B
Total running			4,240		

Step 2. Add the biggest motor start on top of all the running load. Only one motor starts at a time in practice. The furnace blower has the largest starting jump: $2,520 - 840 = 1,680$ W extra.

Peak = $4,240 + 1,680 = 5,920$ W.

Step 3. Check each leg. A 120/240 V generator splits its 120 V loads between two legs. A 30 A inlet allows 30 A per leg.

- Leg A running: $720 + 480 + 400 = 1,600$ W ÷ 120 V = **13.3 A**
- Leg B running: $840 + 1,500 + 300 = 2,640$ W ÷ 120 V = **22.0 A**

Both legs are under 30 A. If one leg had been over, you would move a circuit to the other leg by moving it to a breaker on the other bus.

Step 4. Pick the generator. It must deliver at least 4,240 running watts and 5,920 surge watts, and have a 30 A 125/250 V receptacle. A generator rated around 6,000 running watts or more with an L14-30 outlet covers this list. On the receptacle side, 445.20 requires GFCI protection on the generator's 125 V, 15 and 20 A receptacles if it is 15 kW or smaller.

Step 5. Pick the inlet, breaker, wire, and cord.

Part	Choice	Reason
Inlet	30 A, 125/250 V, L14-30, outdoor, outside the house	702.12(B) inlet outside; matches generator receptacle
Panel breaker	30 A 2-pole, interlocked, with hold-down	702.5(A), 408.36(D)
Wire	10-3 with ground NM-B indoors (10 AWG = 30 A in the 60 °C column)	Table 310.16 and 240.4(D)
Cord	10/4 SOOW, L14-30P to L14-30R	Four wires: two hots, neutral, ground

Step 6. Tell the customer what they cannot run. The electric range (one 8 in burner alone is around 2,000 W at 240 V) and an electric dryer will overload this generator. The 30 A inlet tops out at $30\text{ A} \times 240\text{ V} = 7,200\text{ W}$ no matter how big the generator is. If they want the central air, they need a bigger generator and a 50 A inlet, or a standby unit.

Worked Example 2: Whole-house standby with load management (702.4(A)(2))

The house: 2,400 sq ft, 200 A service, natural gas available, gas furnace with an electric blower, 4-ton central AC, electric range, electric dryer, electric water heater. The customer wants the whole house on the generator and an automatic switch. We quote a Generac 22 kW air-cooled unit on natural gas with a 200 A service-rated ATS and three 50 A load-shed modules.

Step 1. Gather nameplates. These are example values. On a real job, write down what is on each label.

Load	Nameplate
Range	12.0 kW
Dryer	5.0 kW
Water heater	4.5 kW
Dishwasher	1,200 VA
Disposal	$7.2\text{ A at }120\text{ V} = 864\text{ VA}$
Over-range microwave	1,500 VA
Furnace blower	$7.0\text{ A at }120\text{ V} = 840\text{ VA}$
AC condenser (4-ton)	Compressor RLA 18.6 A + fan FLA 1.2 A = 19.8 A at 240 V = 4,752 VA

Step 2. Run the full calculation by the NEC 2026 optional dwelling method, 120.82 (2023: 220.82). 702.4(A)(2) says to use Article 120 Parts I-IV. R-LOAD walks this method line by line. Here are the numbers.

120.82(B) general loads:

Line	Item	VA
(1)	General lighting and receptacles, $2,400 \text{ ft}^2 \times 2 \text{ VA/ft}^2$	4,800
(2)	Two small-appliance circuits + one laundry circuit, $3 \times 1,500 \text{ VA}$	4,500
(3)	Range 12,000 + dryer 5,000 + water heater 4,500 + dishwasher 1,200 + disposal 864 + microwave 1,500	25,064
(4)	Furnace blower motor	840
	Total general load	35,204

Apply 120.82(B): 100 percent of the first 8 kVA plus 40 percent of the rest.

- First 8,000 VA at 100% = 8,000 VA
- Remainder $35,204 - 8,000 = 27,204 \text{ VA} \times 0.40 = 10,881.6 \text{ VA}$
- General load after demand = 18,881.6 VA

120.82(C) heating and air conditioning, the largest of the selections. Here only (1) applies: 100% of the AC nameplate = 4,752 VA. The gas furnace is not electric heat.

Full calculated load = $18,881.6 + 4,752 = 23,633.6 \text{ VA}$. At 240 V: $23,633.6 \div 240 = 98.5 \text{ A}$.

Step 3. Compare to the generator for option (a), full load. The 22 kW unit on natural gas is rated 19,500 W (81.3 A). 98.5 A is more than 81.3 A, so option (a) fails. Even on propane (22,000 W, 91.7 A), it fails. To use full-load sizing, this house would need a generator rated at least 23.6 kW on its fuel, before derating for altitude and heat.

Step 4. Use option (b), an energy management system. We put the range, dryer, and water heater on load-shed modules, and the ATS manages the AC through its thermostat control. Now figure the load that is never shed.

Unmanaged general loads: $4,800 + 4,500 + (1,200 + 864 + 1,500) + 840 = 13,704 \text{ VA}$.

- First 8,000 at 100% = 8,000
- Remainder $5,704 \times 0.40 = 2,281.6$
- Subtotal = 10,281.6 VA

The AC is managed, but it is the load the customer most wants running in a Birmingham summer, so we count it as always on: + 4,752 VA.

Unmanaged load with AC = $15,033.6 \text{ VA} \div 240 = 62.6 \text{ A}$.

Generator capacity on natural gas = 81.3 A. Room left for managed loads = $81.3 - 62.6 = 18.7 \text{ A}$ (about 4,490 W).

Managed load	Amps at 240 V	Fits in 18.7 A alone?
Water heater, 4,500 W	18.75 A	Just over. The module will bring it on, and if the frequency sags the module sheds it again.
Dryer, 5,000 W	20.8 A	No, unless the AC is cycled off
Range, 12,000 W	50 A nameplate (actual draw depends on burners on)	No, only with other loads off

This is how load management works in practice. The generator carries the 62.6 A that is always on. The modules let the big loads come on in priority order, and when the generator's frequency drops because it is overloaded, the modules drop those loads. The SMM manual says loads are shed when frequency drops below a preset value for a preset time, and a module that sees a second overload during recovery stays off for up to 30 minutes.

Step 5. Set priorities with the customer. Example:

Priority	Load	Recovery after a shed
1	AC (through ATS)	5 min
2	Water heater (SMM)	5 min 15 s
3	Range (SMM)	5 min 30 s
4	Dryer (SMM)	5 min 45 s

The 5-minute delay before the AC returns also lets the compressor's pressures equalize so it starts easier. The SMM manual gives that reason for the 5-minute delay on first power-up.

Step 6. Size the generator-to-ATS conductors.

- Generator rated current on LP is 91.7 A, and its main line circuit breaker is 100 A.
- 445.13(A) requires 115% of nameplate current when there is no overcurrent protection at the generator: $91.7 \times 1.15 = 105.5$ A. This unit has a 100 A breaker, but sizing to 105.5 A covers both readings and costs one wire size.
- Table 310.16, 75 °C copper column: #3 = 100 A, #2 = 115 A. Pick **#2 Cu THWN-2** for E1, E2, and neutral. The generator lugs and the ATS lugs are rated 75 °C, so the 75 °C column is allowed (110.14(C)).
- Equipment grounding conductor for a 100 A overcurrent device, Table 250.122: **#8 Cu**.
- Control: 6 wires (N1, N2, T1, 0, 194, 23). Run is 40 ft, so 18 AWG by the Generac table. Use 600 V-rated insulation.

Conduit fill (Chapter 9, Table 5 areas for THWN-2; TFFN area used for the 18 AWG control conductors):

Conductor	Count	Area each (in ²)	Total (in ²)
#2 THWN-2	3	0.1158	0.3474
#8 THWN-2	1	0.0366	0.0366
18 AWG	6	0.0055	0.0330
Total			0.4170

Schedule 40 PVC, 40% fill (Chapter 9, Table 4): 1 in = 0.333 in² (too small), 1¼ in = 0.581 in² (fits). **Use 1¼ in Schedule 40 PVC.** Bury it with 18 in of cover.

Step 7. Check the ATS. 200 A, service rated, 2-pole (solid neutral, so the generator is nonseparately derived and has no neutral-ground bond). Short-circuit rating marked "circuit breaker protected 22,000." Compare that to the available fault current from the utility (ask the utility or read the value on the existing service label). If the available fault current is higher than 22,000 A, this ATS cannot be used at that service (110.10).

Step 8. Check gas. Full load on natural gas is 327 ft³/hr, which the spec sheet says equals 327,000 BTU/hr (ft³/hr × 1,000). Add the furnace, water heater, and any other gas appliance nameplates. The gas meter must handle the total, and the pipe must be sized for the generator's full load.

What to write on the job sheet: "22 kW Generac, NG, 19.5 kW / 81.3 A. Calculated load 98.5 A full, 62.6 A unmanaged with AC. Managed under 702.4(A)(2)(b): range, dryer, water heater on SMMs, AC on ATS. Gen to ATS: 3 #2 + 1 #8 Cu THWN-2 + 6 #18 control in 1¼ in PVC, 18 in cover."

Worked Example 3: Interlock breaker size for a 50 A inlet

A customer has a 12,000 W running portable generator with a 50 A, 125/250 V receptacle.

- Generator current at 240 V: $12,000 \div 240 = 50$ A.
- Inlet: 50 A, 125/250 V, matching the generator's receptacle.
- Panel breaker: 50 A 2-pole, interlocked, with hold-down. The Square D kits accept a backfed breaker from 15 A through 125 A.
- Wire: 6 AWG copper NM-B is 55 A in the 60 °C column. 8 AWG NM is 40 A at 60 °C, which is too small for 50 A. Use **6-3 with ground NM-B** indoors, or #6 THWN-2 in conduit with a #10 Cu ground (Table 250.122, 60 A row covers a 50 A breaker).
- 702.12(B) still applies: the generator is 15 kW or less, so no separate disconnect is needed at the inlet, and the inlet must be outside.

6. Common Mistakes

Mistake	What happens	Fix
"Universal" interlock plate not listed for the panel	Fails 702.5(A); the plate may let both breakers on	Use the listed kit for that panel and main breaker frame
Generator breaker in the wrong slot	Interlock does not block it	Put it in the positions the kit names
No hold-down on the backfed breaker	Breaker can be pulled off the bus while live from the generator	Install the retainer (408.36(D))
Inlet inside the garage	Customer runs the generator in the garage; CO poisoning	Inlet outside (702.12(B)); talk about CO
Bonded-neutral portable on an interlock	Neutral current on the cord ground and house grounds; GFCI trips	Follow the generator manual for floating-neutral use, or a neutral-switching transfer switch
Leaving the bonding screw in the old panel after adding a service-rated ATS	Neutral current on grounds, metal pipes, and appliance frames	Remove the bond; separate neutrals and grounds (250.142(B))
Installing the neutral-ground jumper in an air-cooled generator on a 2-pole ATS	Same parallel neutral path	Leave it out unless the system is separately derived
Generator 3 ft from a window	Exhaust enters the house	5 ft from any operable opening
Shrubs planted against the generator after install	Overheating, high-temperature shutdown	Tell the customer: 3 ft clear front and ends
Sizing a standby by "square feet" instead of the load calc	Generator overloads in the first hot outage	Do the Article 120 calc and pick (a) or (b)
Control-wire insulation rating not checked, or bell wire used	Fails 300.5(C)(1) (2023: 300.3(C)(1)) when in the power conduit	600 V insulation on control wires sharing the conduit
Gas pipe sized to the generator inlet fitting	Generator stalls under load; fluctuating gas pressure	Size from the manufacturer's pipe table and full-load flow
No signs	Fire department can't find or stop the generator	702.7, 445.19(C)
Reconditioned or used transfer switch	Not allowed	702.3: new only

7. Field Exercise

Do this on the training panel and mock pad with a journeyman watching. It takes one full day.

Part 1: Interlock and inlet.

1. On the training panel, read the panel label and choose the listed interlock kit for it. Write down the catalog number and the slots it requires.
2. Clear the required slots by moving circuits if needed, and update the directory.
3. Install the 30 A two-pole backfeed breaker in the required slot with its hold-down.
4. Run 10-3 with ground NM-B to an outdoor L14-30 inlet box mounted on the training wall's "exterior" side. Land and torque both ends.
5. Install the interlock plate per the kit instructions.
6. Prove the interlock with the cover on: main ON blocks the generator breaker; generator breaker ON blocks the main. Your journeyman watches both tests.
7. Post the 702.7(C) floating-neutral sign at the inlet and the panel labels.

Part 2: Standby set on the mock pad.

1. On the mock pad, measure and mark: 18 in to the wall, 3 ft front and ends, 5 ft to the mock window, 5 ft to the mock gas meter (or the distance your journeyman gives for the gas meter from the gas utility rules), 5 ft overhead. Have the journeyman check each tape measurement.
2. Level the pad within 0.5 in and set the unit.
3. Run the conduit for power and control wiring from the generator to the 200 A service-rated transfer switch mounted on the training wall. Use 1½ in PVC with a sweep into the generator knockout.
4. Pull 3 #2 THWN-2, 1 #8 THWN-2, and 6 control conductors. Land the generator conductors at both ends and torque to the label values (120 in-lb at the generator lugs). Land N1, N2, T1, 0, 194, and 23.
5. Convert the training panel to a subpanel: remove the bonding screw, separate neutrals and grounds, run the 4-wire feeder from the ATS.
6. Fill out the startup checklist (Section 4.2) as if for a real customer.

Part 3: The neutral-ground question.

1. Read the nameplate on the training generator and copy the neutral bonding marking word for word.
 2. Write two sentences: Is this generator, connected to this 2-pole ATS, separately derived or nonseparately derived? Where is the one neutral-to-ground bond in this system?
 3. Have your journeyman sign off on the answer.
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8. NEC 2026 Cross-References

- Art. 702 (Optional Standby Systems): 702.1, 702.3, 702.4(A)(1), 702.4(A)(2)(a) and (b), 702.5(A)–(D), 702.6, 702.7(A)(1), 702.7(B), 702.7(C), 702.10, 702.11, 702.12(A)–(C).
- Art. 445 (Generators): 445.2, 445.10, 445.11(A)(2), 445.13, 445.18(A), 445.19(C), 445.20.
- Art. 130 (Energy Management Systems): 130.2, 130.30, 130.70.
- Art. 120 Parts I–IV (2023: Art. 220), especially 120.82 (2023: 220.82). See R-LOAD.
- 250.30, 250.34(A), 250.35(A) and (B), 250.142(B), Table 250.122.
- 225.41 (2023: 230.85) outdoor emergency disconnect; 230.70(A)(1) and 230.70(E) outdoor service disconnect.
- 230.67 surge protection at the service. See R1.9.
- 230.70(B) service disconnect marking.
- 408.36(D) backfed plug-in breakers.
- 110.10 short-circuit ratings, 110.14(C) and (D) terminals and torque, 110.26 working space.
- 300.5(C)(1) (2023: 300.3(C)(1)) mixed voltages in one raceway.
- 300.7 and Table 300.7(A) (2023: 300.5, Table 300.5) burial depth.
- Table 310.16 ampacity. Chapter 9, Tables 4 and 5, conduit fill.

Articles 700 (Emergency) and 701 (Legally Required Standby) do not apply to houses.

9. Pictures for This Module

- **[Picture coming]** Portable generator setup, side view of a house: generator on the driveway at least the manual's distance from a window and a door, exhaust pointing away from the house; 10/4 cord to an L14-30 inlet box on the siding about 24 in above grade with the 702.7(C) floating-neutral warning sign beside it; 10-3 cable through the wall to the panel; panel cover close-up with the interlock plate blocking the 30 A two-pole breaker in slots 2–4 while the main is ON; a red X over a male-to-male "dryer cord" in the corner.
- **[Picture coming]** Standby generator one-line: utility transformer → meter → 200 A service-rated ATS (service breaker, two-pole transfer, neutral bar with main bonding jumper, ground bar, grounding electrode conductor to two rods and water pipe) → 4-wire feeder → existing panel shown as a subpanel with separate neutral and ground bars and no bonding screw. Generator → ATS with E1, E2, neutral, ground, and a separate dashed line for control wires N1, N2, T1, 0, 194, 23. Load-shed modules drawn on the range, dryer, and water heater circuits, and a thermostat line from the ATS to the AC.
- **[Picture coming]** Top-down clearance diagram around a standby unit: 18 in to the house wall at the rear, 3 ft at the front and each end with a shrub drawn outside the line, 5 ft radius from every point of the unit to a window and a door, 5 ft overhead shown in a side view with a deck above crossed out, the gas meter and the ATS on the same wall, and a property line with a "check AHJ/HOA setback" label.

- **[Picture coming]** Neutral-to-ground bond, two drawings side by side. Left, "nonseparately derived (solid neutral)": two-pole ATS, neutral passes straight through, one bond at the service, generator neutral not bonded to frame. Right, "separately derived (switched neutral)": three-pole ATS, neutral switched, bond in the generator, grounding electrode at the generator. Arrows show normal neutral current path in each.
 - **[Picture coming]** Load-shed recovery timeline after an outage: generator starts at about 10 s, house loads on, then AC at 5:00, water heater at 5:15, range at 5:30, dryer at 5:45; a second line shows a frequency dip, the dryer shed, and a 30-minute lockout bar.
 - **[Field photo coming]** A finished YES standby install: generator on its pad with clearances visible, ATS beside the meter with the 702.7(A)(1) label and "SERVICE DISCONNECT" label, SPD mounted, load-shed module with priority decal, and the startup sheet taped inside the ATS door.
 - **[Field photo coming]** A finished interlock job: panel cover with the interlock plate, hold-down visible on the 30 A breaker, updated directory, and the outdoor inlet with its warning sign.
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10. End-of-Chapter Checklist

Portable inlet and interlock

- ☐ Interlock kit is listed for this panel and main breaker frame.
- ☐ Generator breaker is in the slots the kit requires, with a hold-down.
- ☐ Interlock proven both ways with the cover on.
- ☐ Inlet is outside. Wire and breaker match the inlet rating.
- ☐ 702.7(C) sign at the inlet matches how the system is wired.
- ☐ Generator neutral marking read; bonded-neutral issue resolved per the generator manual.
- ☐ Customer taught the switching order and the CO warning, with written steps left in the panel door.

Standby generator

- ☐ Load calc done by Article 120; sizing method (a) full load or (b) EMS chosen and written down.
- ☐ Clearances measured: 18 in rear, 3 ft front and ends, 5 ft to openings, 5 ft overhead.
- ☐ Base level within 0.5 in.
- ☐ Conduit buried with 18 in of cover; control wires rated for the highest voltage in the conduit.
- ☐ Generator-to-ATS conductors sized; EGC per Table 250.122.
- ☐ No neutral-ground bond in the generator on a 2-pole ATS.
- ☐ Old panel converted to a subpanel: bond removed, neutrals and grounds separated, 4-wire feeder.
- ☐ Grounding electrode conductor moved to the ATS.

- [] SPD installed at the new service equipment.
 - [] Every lug torqued to the label value and marked.
 - [] Load-shed modules wired, each on a different priority.
 - [] Battery connected positive first, 70 in-lb.
 - [] Voltage, frequency, and gas pressure recorded at startup; automatic transfer and re-transfer tested.
 - [] Unit activated, clock and exerciser set, left in AUTO.
 - [] Signs posted: 702.7(A)(1), service disconnect, generator emergency shutdown, module decals.
 - [] Startup sheet completed and reviewed with the customer.
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11. Sources

- NEC 2026: Art. 702 (702.1–702.12), Art. 445 (445.2–445.20), Art. 130 (130.2, 130.30, 130.70), 120.82, 250.30, 250.34, 250.35, 250.142, Table 250.122, 225.41, 230.67, 408.36(D), 110.26, Table 300.7(A), Table 310.16, Chapter 9 Tables 4 and 5.
 - Generac, Installation Guidelines, 60 Hz Air-Cooled Generators 9 kW to 22 kW, Sections 3 (site selection), 4 (placement), 5 (gas), 6 (electrical connections), 7 (start-up and testing). https://floridabuilding.org/Upload/Petitions/Pet_ID_174_Response_generac%2022%20install%20manual.pdf
 - Generac, 20/22/24 kW Guardian Series Residential Standby Generators spec sheet, pp. 4–5. https://www.generac.com/globalassets/products/residential/standby-generators/spec-sheets/20kw-22kw-24kw_guardian-series_aircooled-gasengine_specsheet.pdf
 - Generac, Owner's/Installation Manual for SMM (50 A Smart Management Module), document 10000030493 Rev E, Tables 2-1 and 3-1. <https://www.generac.com/globalassets/residential/dealers--installers/generac-installer-programs/solar--battery-installer-support/10000030493-rev-e-50a-smart-management-module-install--owners-manual.pdf>
 - Schneider Electric, Generator Interlock Kit (Square D QO and Homeline), Document RP19200310, August 2016. <https://images.thdstatic.com/catalog/pdfImages/60/605938f6-6ced-4d52-a5a3-c25e7e9202aa.pdf>
 - Alabama Power, Builder's Guide to Working with Alabama Power, "External Disconnect" (required on the load side of new residential meter bases, enforced from January 1, 2022), and Rules and Regulations for Electric Service, effective October 4, 2022, Rule 4.10 (Customer Generators). Text copies were supplied by the course quarterback; source URLs were not recorded in this module.
 - Arc Workforce, Residential Electrical Field Guide, Part 7, "Pre-Storm / Hurricane Prep," generator hookup line (verify portable generators connect through a transfer switch, not a dryer-outlet backfeed).
 - Commercial course Module 1.6 for motor starting basics and 1.7 for grounding and bonding depth.
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Videos to watch

These videos are made by other electricians and companies, not YES Electric. Watch each one after you read the section it goes with. Where a video does something differently from this module, the caution line says so. Follow this module and your journeyman, not the video. Click a title to open it on YouTube.

Section	Video
Procedure A: Portable generator with inlet and listed interlock kit	The RIGHT Way To Connect A Generator To Your House Interlock Kit & Inlet Box Install Sparky Izzy • 15:26 A Texas master electrician installs a listed interlock kit and breaker retainer on a Square D QO panel, moves breakers to free the top slot, mounts a NEMA 3R 50 A inlet, runs 3/4 in EMT with #6 conductors and a #10 ground, and tests the transfer with a generator. Caution: This is a 50 A inlet; the module's typical job is 30 A with 10 AWG (see Worked Example 3 for 50 A). He re-energizes the panel partway through for the customer. He does not discuss the generator's bonded-neutral marking; read 445.11 marking and the module's bonded-neutral note. There is a sponsored Jobber segment in the middle.
Procedure A steps 7 through 9: breaker hold-down, interlock plate, proving it	Square D 'QO' 150A-225A Interlock Kit Installation for use with a portable generator. Electrician Ron • 5:46 A New Jersey electrician installs the 2-pole 30 A generator breaker with the mechanical hold-down (citing 408.36(D)), drills the cover from the kit's metal template, mounts the interlock, and shows that the main and generator breaker cannot both be on.
Procedure B: Portable generator with a manual transfer switch	How to Install a Manual Transfer Switch for a Portable Generator Ask This Old House This Old House • 8:36 Scott Caron mounts a 10-circuit manual transfer switch beside the panel, explains how each selected breaker feeds the switch on the red lead and the circuit returns on the black lead, runs 10-3 to an outdoor inlet, and tests line and generator positions. Caution: He made the customer's 55 ft generator cord from bulk cable and cord ends; YES uses a factory-made listed cord. The 5 ft from windows and doors he quotes is a common rule; follow the generator manual for portables. Put the 702.7(C) sign at the inlet, which the video does not show.
§2.3, §2.4 and Procedure C: How a standby system works, critical-loads option, and the neutral question	What Should You Know Before Installing a Generator? Whole Home or Critical Loads? Electrician U • 25:53 Dustin Stelzer explains ATS power and low-voltage control wiring, siting clearances, fuel, whole-home vs critical-loads, and shows a real install where neutrals and grounds were bonded in a transfer switch with an unswitched neutral and why that had to be fixed (250.30). Caution: Generac-sponsored. He first calls it a separately derived system and then corrects himself; the conclusion (unswitched neutral = not separately derived, keep N and G separate downstream of the service) matches module §2.4. The job shown is a 100 A critical-loads setup, not the module's 200 A service-rated ATS.

Procedure C: Inside a 200 A Generac automatic transfer switch	Why Electricians Miss This Critical Transfer Switch Detail Generac Doctor • 3:56 A generator tech opens a 200 A Generac service-rated ATS and points out the control board, the N1/N2 utility-sensing wires, T1 battery-charger feed, the 194/23 transfer wires, the fuses, utility line lugs, load lugs, and the bonding strap that stays in only when the ATS is the service equipment. Caution: Clickbait title; the content is a plain walkthrough. Terminal names are Generac's; other brands differ.
Procedure C steps 1 to 3 and testing: Setting a standby unit and simulating an outage	How to Install an Automatic Standby Generator Ask This Old House This Old House • 4:14 Scott Caron bolts a 20 kW standby unit to its pad 5 ft from doors and windows, explains the gas flex connection, battery and trickle charger, and the transfer switch beside the meter, then opens the disconnect to show the generator start within seconds. Caution: Ten years old; the gas connection is a plumber's work. The ATS here is already in place, so it does not show the wiring.