

RESTREPO STANDARD

Stubbed. Sealed. Signed.

Pre-Slab Conduit & Subpanel Standard

Charge · Lift · Slab · Subpanel

The slab is poured once. Stub the conduit before the concrete sets.

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PREFACE

The slab is poured once. Every conduit stub-up, every trench drain opening, every ground rod location, and every lift anchor zone must be established before the concrete truck arrives. Once the slab is cured and the polyaspartic topcoat is applied, core-drilling is a maintenance patch at best and a warranty void at worst. This standard codifies the pre-slab conduit discipline for the Restrepo Innovations Garage and EV Workshop: nine domain sections, a 25-item QC gate, and 25 cited sources. The slab is poured once. Stub the conduit before the concrete sets.

This standard does not replace manufacturer instructions, code authorities, or professional licensing. NEC 2023 Articles 220, 230, 250, 300, 408, 422, 511, 625, IRC R302.5.1, R309.3, R506, ANSI/ALI ALCTV-2017, ASTM F2170, ICRI 310.2R, NJ UCC NJAC 5:23, and manufacturer installation guides govern. Verify all specifications against current product data sheets prior to procurement. See Citations for primary source URLs. Residential-only scope throughout.

The slab is poured once.

Stub the conduit before the concrete sets.

01 SUBPANEL PLAN & NAMING

200A subpanel with main breaker, circuit naming convention, NEC 220.83/220.87 load calculation, NEC 408.36 OCPD, and NEC 250.32(B) 4-wire feeder grounding with isolated neutral bar. Every circuit is labeled at the panel and at the stub-out cap.

200A Garage Subpanel — Baseline Recommendation

A 200A subpanel with main breaker is the correct baseline for a three-car luxury garage with EV charging, vehicle lift, compressor, and workshop circuits. Square D QO130M200P (30-space, main breaker, UL File E8460, Plug-on Neutral platform) or Eaton CH200L200P (30-space, main breaker, UL File E8741, factory-insulated neutral bar). Either panel accepts dedicated AFCI and GFCI breakers. Size the feeder at 2/0 AWG copper or 4/0 AWG aluminum THWN-2 per NEC 215, with #4 AWG copper EGC per NEC 250.122 Table (200A protection).

Circuit Naming Convention

Each circuit is labeled at the panel and at the load: EV-01 / EV-02 / EV-03 (EVSE bays 1, 2, 3), LIFT-01 (BendPak lift bay), COMP-01 (compressor), DUST-01 (dust collector), HVAC-01 (mini-split), RECEPT-W (workshop 120V general), RECEPT-D (door/entry area). Labels use engraved or laminated tags secured to the panel cover and to each circuit stub-out cap above slab. Naming convention carried through to the sleeve schedule, as-builts, and panel directory.

NEC 220.83 / 220.87 Load Calculation

NEC 220.83 (standard clipboard method) sums all loads including EVSE at 100% of nameplate per NEC 220.57. Three 48A EVSE circuits at 240V: $3 \times (48A \times 240V \times 1.25) = 43.2 \text{ kVA}$. Add lift (4.8 kVA), compressor (6.0 kVA), dust collector (3.5 kVA), HVAC (2.9 kVA), lighting and receptacles (3.0 kVA): subtotal approximately 63 kVA. NEC 220.87 (actual demand monitoring) consistently produces lower required amperage when 12 months of PSE&G smart meter data is used. With a Tesla Dynamic Power Management EMS per NEC 625.42(A), the feeder calculation may be held at 150-200A if EVSE loads are controlled.

NEC 408.36 OCPD

NEC 408.36 requires every panelboard to be protected by an overcurrent device rated not greater than the panelboard rating. The 200A two-pole feeder breaker at the main house panel satisfies this for the 200A garage subpanel. Bergen County NJ inspectors typically require a disconnecting means within the garage accessible without returning to the house; specify a main-breaker subpanel or a separate 200A fusible safety switch at the subpanel location to comply with NJ UCC NJAC 5:23-3.15 field practice.

NEC 250.32(B) Feeder Grounding — 4-Wire Feeder

The garage subpanel requires a 4-wire feeder: two hot conductors, one neutral, and one dedicated equipment grounding conductor (EGC). At the garage subpanel, the green bonding screw must be removed: the neutral bar floats, and the EGC bar bonds to the panel enclosure and connects back to the house main panel EGC. This prevents neutral return current from flowing on the equipment grounding path. An isolated neutral bar (supplied as standard on QO130M200PG and CH200L200P) is required. A supplementary ground rod at the exterior of the garage is required for a detached structure per NEC 250.32(B); for an attached garage, consult AHJ.

SPEC · SUBPANEL CLOSEOUT LOCK

No subpanel energization proceeds before: (1) isolated neutral confirmed (green bonding screw removed), (2) 4-wire feeder conductors confirmed, (3) all circuits labeled at panel and at stub-out caps, (4) Type 2 SPD installed and indicator lit, (5) working clearance (NEC 110.26) measured and documented. Deviations require written direction from the Restrepo principal.

SUBPANEL NOTES

- Spare breaker positions: minimum 4 open spaces at panel closeout for future circuits. A 30-space panel with approximately 18 occupied circuits satisfies this requirement.
- Panel working clearance per NEC 110.26: 36 inches in front of panel; 30 inches wide (or panel width, whichever is greater); 78 inches high from finished floor. No storage in this zone.
- Type 2 SPD at garage subpanel per NEC 230.67: Square D Homeline HEPD80 (80 kA) or Eaton CHSPCMF mounted at panel. See Section 08 for surge and grounding full detail.
- BX/MC cable on feeder or EVSE home-runs requires written direction from the Restrepo principal. Default conduit material is Schedule 80 PVC for all stub-ups through slab and EMT above slab.
- Spare hardware: minimum 5% spare breakers, fittings, conduit bodies, and pull-box covers delivered at closeout, labeled with project ID per Restrepo closeout standard.

02 CONDUIT TYPE & BURIAL DEPTH

NEC Table 300.5 governs minimum cover by wiring method and location. Schedule 80 PVC for all slab penetrations. EMT above slab. Long-radius sweeps at all below-grade direction changes. Expansion fittings on PVC runs exceeding 25 feet.

WIRING METHOD	MIN COVER	CODE REF	NOTES
PVC Sched 80 (under slab, stub-ups)	Flush to slab bottom	NEC 300.5 / 300.5(D)	Schedule 80 PVC for all conduits that penetrate the slab. Seal penetrations per NEC 300.5(D) to prevent moisture/gas migration.
PVC Sched 40 (trench, exterior grade)	18 inches	NEC 300.5 Table	Standard residential burial for circuits above 30V in unprotected ground.
Sched 40/80 PVC under driveway/vehicle lane	24 inches	NEC Table 300.5	All conduit crossing a vehicle lane requires 24-inch minimum cover regardless of conduit type.
EMT (exposed, above slab)	N/A (exposed)	NEC 358	EMT from slab stub-up to panel and to equipment. No EMT below slab or in earth.
RMC / IMC (exposed risers, exterior)	6 inches if buried	NEC 300.5 Table	Rigid metallic conduit at exterior above-grade risers and where AHJ requires metal conduit.
Residential branch ≤ 120V/20A GFCI	12 inches	NEC Table 300.5 Col 4	Residential branch circuits at 120V/20A with GFCI protection: 12-inch minimum cover in raceway.

CONDUIT DISCIPLINE

- NEC Table 300.5 column selection: Column 1 (direct burial cable) 24 inches; Column 2 (rigid metal conduit) 6 inches; Column 3 (intermediate metal conduit) 6 inches; Column 4 (nonmetallic conduit approved for direct burial, residential branch 120V/20A GFCI) 12 inches; Column 5 (residential EVSE and equipment circuits) consult local AHJ.
- Long-radius sweeps at all direction changes underground: minimum 18-inch radius for 1-inch conduit; minimum 24-inch radius for 2-inch conduit. No standard 90-degree elbows below grade.
- Expansion fittings on PVC Schedule 40/80 runs exceeding 25 linear feet to accommodate thermal expansion (PVC expands approximately 3/8 inch per 10-degree F change per 100 feet of run).
- Sleeves stubbed minimum 18 inches above finished slab surface, capped with removable PVC plug, and labeled with circuit ID at stub-out cap before concrete pour.
- BX/MC cable below slab or in landscape burial requires written direction. Default is PVC Schedule 40 or 80 for all Vol 21 runs below grade.
- Spare hardware: minimum 5% spare PVC fittings, couplings, pull-box covers, and conduit caps delivered at closeout, serialized and labeled per project closeout standard.

03 EV CHARGER STUB-OUTS

Tesla Wall Connector Gen 3 (48A/60A, 11.5 kW, NEMA 3R, J3400/NACS), ChargePoint Home Flex CPH50 (50A, 12 kW, NEMA 14-50 or hardwire), Wallbox Pulsar Plus (40A or 48A, Type 4). NEC 625.42 80% continuous load rule. 1-inch minimum conduit, #6 AWG Cu THWN-2, rough-in box at 48 inches.

Tesla Wall Connector Gen 3 — Stub-Out Requirement

Tesla Wall Connector Gen 3 (part basis 1457768-00-E): 48A continuous output, 60A two-pole dedicated breaker, 240V, 11.5 kW, 24 ft cable, NEMA 3R enclosure, SAE J3400 (NACS) connector, operating range -40 F to 122 F. Wire: #6 AWG copper THWN-2 in 1-inch minimum Schedule 80 PVC stub-up per NEC 625.42. Rough-in box height: 48 inches centered to charger handle mounting point. NEC 625.42 80% continuous load rule: 48A output requires 60A breaker ($48A / 0.80 = 60A$). Group Power Management: up to six Gen 3 units may share a single circuit with dynamic load sharing.

ChargePoint Home Flex CPH50 — Stub-Out Requirement

ChargePoint Home Flex CPH50-NACS-L23: 50A maximum output, 12 kW at 240V, adjustable 16A-50A via app, 23 ft cable, NEMA 3R, UL 2594/UL 2231, ENERGY STAR certified. NEMA 14-50 plug-in (40A) or hardwire (50A). For 50A hardwire: dedicated 60A two-pole breaker, #6 AWG copper THWN-2 in 1-inch minimum conduit per NEC 625.42. ChargePoint built-in 20 mA CCID satisfies NEC 625.47 personnel protection; do not add external GFCI breaker (may conflict with CCID). NJBPU \$250 rebate eligible.

Wallbox Pulsar Plus — Stub-Out Requirement

Wallbox Pulsar Plus 48A hardwire: 48A maximum, 11.5 kW at 240V, 25 ft SAE J1772 cable, Type 4 (IP55) enclosure, UL 2594/UL 2231, ENERGY STAR certified. Wire terminal rated 105 C, accepts 6 AWG maximum. Conduit rear aperture 1.25 inch diameter. Recommended mounting height 50-67 inches (130-170 cm). Dedicated 60A two-pole breaker per NEC 625.42 for 48A output. #6 AWG copper THWN-2 in 1-inch minimum Schedule 80 PVC stub-up. Pulsar Plus does not support NACS natively; specify Tesla-to-J1772 adapter (Tesla part 1800778-00-A) for Tesla vehicles.

NEC 625.42 — 80% Continuous Load Rule

NEC 625.42 classifies all EV charging as a continuous load. Service, feeder, and branch circuit are sized at 125% of maximum EVSE output amperage: 48A output = 60A breaker minimum; 40A output = 50A breaker minimum. NEC 625.40 requires each EVSE greater than 16A or 120V to be supplied by an individual branch circuit. Exception: multiple EVSE on one circuit permitted only when an EMS per NEC 625.42(A) or adjustable-setting restriction per NEC 625.42(B) is deployed. For a luxury three-car garage, the preferred configuration is three individual 60A circuits, one per bay.

NEC 625.17 Cord Length and Conduit Sizing

NEC 625.17 permits EVSE cords up to 25 ft for portable units. For hardwired EVSE, no cord length limit applies. Conduit sizing: 1-inch minimum for #6 THWN-2 conductors (two hots and one EGC in a 3-wire 240V circuit; no neutral required for EVSE). Per NEC Chapter 9 Table 4, a 1-inch Schedule 80 PVC conduit accommodates three #6 THWN-2 conductors at or below 40% conduit fill for non-EVSE circuits. EVSE circuits require only two current-carrying conductors plus EGC.

SPEC · EVSE STUB-UP LOCK

All three EVSE stub-ups (EV-01, EV-02, EV-03) must be set, capped with pull string, and photographed before concrete pour. Any change to EVSE position after slab cure requires core-drilling and is subject to written direction from the Restrepo principal.

EVSE NOTES

- All three EVSE stub-ups are set in the slab before the pour: 1-inch Schedule 80 PVC with pull string, capped flush with finished slab, labeled EV-01, EV-02, EV-03 on the sleeve schedule.
- Rough-in box height: 48 inches from finished floor to center of the charger handle mounting point. Field-verify with manufacturer installation template before stub-up location is finalized.
- NEC 210.8(A)(2): All 120V 15A and 20A general-use receptacles in the garage require GFCI protection. Dedicated 240V EVSE circuits are not subject to 210.8 GFCI (covered by NEC 625.47 CCID).
- NJBPU Charge Up New Jersey: \$250 residential rebate for each listed Level 2 EVSE. Tesla Wall Connector Gen 3, ChargePoint CPH50, and Wallbox Pulsar Plus are all eligible. Apply within 14 days of installation.
- BX/MC cable on EVSE circuits requires written direction. Default is EMT above slab with Schedule 80 PVC stub-up through the slab.

04 LIFT BAY CONDUIT & DISCONNECT

BendPak HD-9XW / HD-9ST / HD-7P / P-9000LT: 220V / 1-phase / 30A dedicated circuit. ANSI/ALI ALCTV-2017 slab and installation requirements. NEC 422.31 disconnect within sight. Floor stub or ceiling drop per lift type. 3/4-inch minimum conduit. NEC 511 excluded for residential surface-mount lifts.

BendPak HD-9XW / HD-9ST / HD-7P — Power Requirements

BendPak HD-9XW (SKU 5175863): 9,000 lb four-post lift; 220 VAC / 60 Hz / 1-phase power unit motor; 82-inch max rise; ETL approved; ANSI/ALI ALCTV-2011 certified (current standard: ALCTV-2017). BendPak HD-9ST (SKU 5175860): same electrical specs, standard width. BendPak HD-7P: 7,000 lb four-post storage lift; 220 VAC / 1-phase. BendPak P-9000LT: 9,000 lb low-rise pit-style surface-mount; 208-240 VAC, 1-phase, 1.5 HP, 11A operating; 25A minimum fuse for 230V 1-phase circuit. Required circuit for HD-9XW / HD-9ST / HD-7P: 30A dedicated two-pole 240V circuit.

ANSI/ALI ALCTV-2017 — Slab and Installation Requirements

All vehicle lift installations governed by ANSI/ALI ALCTV-2017 (Automotive Lift Institute standard). ALI Gold Label marks compliance. Concrete requirements per ALI and BendPak: minimum 4-inch slab thickness, 3,000 PSI compressive strength at 28 days, slab age minimum 28 days before installation, no expansion joints within column anchor footprint. Vapor barrier 10-mil polyethylene under slab per IRC R506.2.3. Anchor bolts installed with BendPak-specified hardware. Lift pad dimensions: minimum 12 ft x 24 ft for HD-9XW footprint; larger with approach ramps.

NEC 422.31 Disconnect Within Sight

NEC 422.31 requires a lockable disconnecting means within sight of the motor (visible and not more than 50 ft from the motor) for each fixed motor-driven appliance. For BendPak HD-9XW: specify a fusible safety switch (Eaton DH321FGK, 30A, 240V, NEMA 1) mounted adjacent to the power unit, or within sight at the lift column. The disconnect must be lockable in the open position. The 30A panel breaker is not sufficient by itself; a dedicated disconnect at the lift bay is required.

Conduit Routing and Stub-Up Location

Ceiling drop or floor stub depending on lift type. For 4-post lifts (HD-9XW, HD-9ST): floor stub from below at the power unit location is preferred; set 1-inch Schedule 80 PVC stub-up at the power unit column base location before the slab is poured. For P-9000LT pit-style: floor stub at one end of the pit; coordinate with the hydraulic power unit location shown in the BendPak installation drawings. Conduit size: 3/4-inch minimum for #10 AWG 30A circuit; 1-inch recommended to allow future circuit upgrade. Label stub LIFT-01 on sleeve schedule.

NEC 511 Exclusion Note

NEC Article 511 applies to commercial garages with Class I flammable vapor hazards. An attached residential garage is NOT a classified location under NEC 511 for 4-post and pit-style surface-mount lifts (BendPak HD-9XW, HD-9ST, P-9000LT). True in-ground lifts (in-ground hydraulic cylinder) may constitute a Class I Division 1 hazard zone per NEC 511.3 and are excluded from this project scope. This margin note is informational; NEC 511 does not apply to the Vol 21 garage project.

INSPECT · LIFT CIRCUIT COMMISSIONING

Verify: (1) 30A dedicated two-pole 240V circuit breaker at panel labeled LIFT-01, (2) lockable disconnect mounted within sight of power unit and locked in open position until lift is fully installed and anchored, (3) equipotential bonding jumper from each lift column to EGC bus, (4) ALI-certified concrete slab (4 inches, 3,000 PSI at 28 days, 28-day cure) before lift anchor installation.

LIFT BAY NOTES

- Set the lift power stub-up before the slab pour. Core-drilling through cured concrete disrupts rebar and creates a penetration that is impossible to seal invisibly after polyaspartic topcoat.
- Air supply requirement for BendPak HD-9XW: minimum 30 PSI / 3 CFM for pneumatic safety lock release. Compressed air stub-up at lift bay: specify a 1/2-inch air line with ball valve, served from the shop compressor. Coordinate with Section 05.
- Emergency stop at lift bay: mushroom-head E-stop button wired in series with lift power circuit per ANSI/ALI ALCTV-2017; accessible from operator position and from the lift structure.
- Ceiling clearance check: BendPak HD-9XW requires minimum 10 ft 6 in clear ceiling height with vehicle on lift at full rise (82 inches). Confirm architectural ceiling height before ordering.
- LiftMaster 8500W jackshaft garage door opener (DC brushless motor, 115V, 15A outlet) is the preferred opener for garages with 4-post lifts: wall-mount jackshaft drive frees the full ceiling for lift rise. MyQ Wi-Fi built-in.

05 COMPRESSED AIR & DUST COLLECTION BRANCH

Quincy QGS rotary screw 5HP/7.5HP (30A or 40A dedicated 240V), Ingersoll Rand SS5L5 (30A dedicated), Oneida V-System 3000 3HP (20A dedicated 240V), Laguna P|Flux 3 (30A dedicated). Separate circuits, lockable disconnects, vibration loops.

Quincy QGS Rotary Screw Compressor — 5HP and 7.5HP

Quincy QGS-5 (model 4152051926): 5 HP, 230V / single-phase, 16.6 CFM at 90 PSI, 60-gallon horizontal tank, 150 PSI maximum, 100% continuous duty cycle, 64 dB, integrated refrigerated air dryer. QGS-7.5 (model 4152051929): 7.5 HP, 230V / 1-phase, 21.2 CFM at 90 PSI, 60-gallon, 150 PSI, 64 dB. Circuit for QGS-5: 30A dedicated 240V single-phase; #10 AWG copper minimum. Circuit for QGS-7.5: 40A dedicated 240V single-phase; #8 AWG copper. Magnetic starter or soft-start recommended to limit inrush. 100% duty cycle eliminates the pump-rest cycle required by reciprocating compressors; suitable for sustained workshop use.

Ingersoll Rand SS5L5 — Secondary Option

Ingersoll Rand SS5L5: 5 HP, 230V / 1-phase / 60 Hz, 18.1 CFM at 90 PSI, 60-gallon vertical, 135 PSI maximum, 78 dB, 21.5A operating amps, cast iron pump, approximately 50% duty cycle. Required circuit: 30A dedicated 240V single-phase; #10 AWG copper. NEC 422.10 branch circuit sizing for motor appliances: conductor at 125% of motor FLA = $21.5A \times 1.25 = 26.9A$; use #10 AWG (30A circuit minimum). Lockable disconnect within sight per NEC 422.31. SS5L5 is adequate for occasional-use workshops; QGS rotary screw preferred for luxury three-car workshop.

Oneida V-System 3000 — Dust Collection

Oneida V-System 3000 (SKU XXVM003): 3 HP, 220-240V / 1-phase, 13A, NEMA 6-20 (250V / 20A outlet), 1,349 actual CFM at 2.3 inches WC, 74 dBA, 15-inch non-sparking impeller, HEPA-grade ePTFE media filter, 35-gallon drum, cETLus certified, NFPA compliance ready. Recommended circuit: 20A dedicated 240V. Maximum 2 blast gates open simultaneously. Static dissipative polyethylene cyclone body. Bond metallic ductwork to EGC per NEC 250.116.

Laguna P|Flux 3 and JET DC-1100VX-CK Alternatives

Laguna P|Flux 3: 3 HP, 220V / 1-phase, 22A at 8-inch inlet, 2,718 CFM free fan, 11.2-inch WC, HEPA cartridge, 46-gallon drum, RF remote. NEC 430 branch circuit: $22A \times 1.25 = 27.5A$; round up to 30A breaker, #10 AWG wire. Separate from compressor circuit. JET DC-1100VX-CK: 1.5 HP, 115V or 230V, 11A at 115V / 5.5A at 230V, 1,100 CFM, 10.5-inch WC; prewired 115V, rewirable to 230V; suitable for single-tool light-duty workshop; not recommended as primary dust collection for a three-machine shop.

Branch Circuit Separation and Vibration Loop

Dust collection circuit is separate from the compressor circuit per NEC 422 and good workshop practice (simultaneous compressor startup and dust collector startup would exceed 20% demand factor margin on a shared branch). Vibration isolation: flex whip (LFNC liquidtight, maximum 36 inches) at final connection to compressor and dust collector for vibration isolation; not used for underground runs. Schedule 40 or 80 PVC terminates at above-grade transition fitting below the flex whip connection.

NOTE · COMPRESSOR AND DUST COLLECTOR SEPARATION

Compressor and dust collector circuits are dedicated and separate from each other. Simultaneous full-load startup of both units exceeds 20% demand margin on a shared branch. Flex whip (LFNC, maximum 36 inches) at final connection to each unit for vibration isolation. Bond metallic spiral ductwork to EGC at the dust collector motor per NEC 250.116.

AIR & DUST NOTES

- Compressor stub-up in slab: 1-inch Schedule 80 PVC at compressor location before pour. Label COMP-01. Dust collector stub-up: 1-inch Schedule 80 PVC. Label DUST-01.
- Coalescing filter downstream of compressor tank for all pneumatic tool and paint work: removes oil aerosols to 0.01 ppm. Electronic auto-drain valve with timer on tank (prevents water accumulation in tank bottom).
- NEC 422.31 lockable disconnect: specify a fusible safety switch at each piece of equipment visible from the motor. Compressor disconnect: 30A 240V minimum for QGS-5; 40A for QGS-7.5.
- Metallic spiral dust collection ductwork: bond to EGC at the motor per NEC 250.116. Wood dust is combustible; HEPA filtration minimizes fine dust in breathing zone. NFPA 664 wood dust bonding and grounding applies.
- BX/MC cable on equipment branch circuits requires written direction. Default is EMT above slab with Schedule 80 PVC stub-up through the slab.

06 WORKSHOP HVAC & MAKE-UP AIR

Mitsubishi MSZ-FH 24K BTU mini-split (operates to 14 F, 240V 20A) or Daikin Aurora (operates to -13 F). Condensate routing. Make-up air for combustion appliances. IRC R302.5.1 garage opening protection. Vehicle exhaust ventilation.

Mitsubishi MSZ-FH 24K BTU Mini-Split

Mitsubishi MSZ-FH24NA / MUZ-FH24NA: 24,000 BTU/H, 208-230V / 1-phase / 60 Hz, operates to 14 F outdoor ambient in heating mode. Rated heating at 47 F outdoor: approximately 13,700 BTU/H (COP approximately 4.0). Rated heating at 17 F outdoor: approximately 11,000 BTU/H. SEER 22+; HSPF 12+. Refrigerant R410A (transitioning to R454B on WX series). Circuit: dedicated 240V, 20A circuit (verify MCA and MOP per installation manual for the specific model ordered). Condensate drain routed to floor drain or exterior penetration; coordinate with plumbing permit.

Daikin Aurora Alternative

Daikin FTXB24WVJU / RXB24AXVJU (Aurora series): 24,000 BTU, operates to -13 F (-25 C) outdoor ambient. Superior cold-weather heating performance vs. MSZ-FH for worst NJ winter nights (Franklin Lakes design temperature 13 F). Circuit: dedicated 240V, 15-20A (confirm per installation manual). Aurora series blue-fin corrosion protection is advantageous in garages with corrosive fumes from cleaning products, battery exhaust, and hydraulic fluid vapors.

IRC R302.5.1 Garage Opening Protection

IRC R302.5.1: Doors and openings between the garage and the dwelling must be equipped with solid wood or solid or honeycomb steel doors not less than 1-3/8 inches thick, or 20-minute fire-rated door assemblies. Self-closing device required. The HVAC make-up air supply or return air duct penetrating the garage-to-house fire separation wall must be protected with a listed fire damper or the duct must be constructed of 26-gauge steel with no openings in the garage-side section per IRC R302.5.

Make-Up Air for Combustion Appliances

For a fully electric garage (no gas heater, no gas appliances), dedicated outdoor make-up air is not required by code. If a gas heater is added in the future, IRC M1503 requires dedicated outdoor make-up air to prevent combustion appliance depressurization. Vehicle exhaust ventilation: minimum 1.5 air changes per hour; install through-wall exhaust fan (Broan-Nutone QTXE110S, 110 CFM, 120V) on a 15A dedicated circuit. Coordinate exhaust fan location with garage door opening to promote cross-ventilation when doors are open.

FIELD · MINI-SPLIT COMMISSIONING

Mini-split dedicated 240V circuit confirmed at correct MCA/MOP per installation manual before energizing. Condensate drain routed to floor drain or exterior; confirmed draining without backup at commissioning under full cooling load. Refrigerant line penetration sealed with closed-cell backer rod and polyurethane sealant at wall or slab penetration.

HVAC NOTES

- Mini-split outdoor unit siting: coordinate with landscape, pool equipment, and Vol 20 outdoor living mechanical per cross-reference in Vol 21. Maintain minimum 12-inch clearance from adjacent walls per manufacturer.
- Mini-split circuit stub-up through slab: dedicated 240V circuit from garage subpanel. Stub 3/4-inch Schedule 80 PVC for the refrigerant line penetration through the slab or wall. Line set is not routed through conduit, but any electrical connection is in conduit.
- NJ Climate Zone 4A: the MSZ-FH24NA maintains approximately 79% rated heating capacity at 17 F outdoor; adequate for a three-car insulated garage (R-20 walls, R-49 roof per NJ IECC 2021). Maintain garage at minimum 50 F year-round for EVSE, hydraulic lift fluid, and polyaspartic floor integrity.
- Condensate disposal: routed to floor drain, wall penetration, or approved disposal point. Do not allow condensate to drip on polyaspartic floor coating; moisture pooling under the unit will cause coating delamination over time.

07 SLAB MOISTURE & TRENCH DRAIN

ASTM F2170 in-situ RH probe testing before coating. IRC R506 concrete floors. IRC R309.3 floor slope 1/4-inch per foot to drain. NDS Mini Channel trench drain. Roklin PolyFlex DS crack sealer. Penntek PT 300 polyaspartic topcoat (93% solids, 6,000 PSI, single-day cure). ICRI 310.2R CSP 3-4 surface profile.

ASTM F2170 In-Situ Relative Humidity Testing

ASTM F2170 is the industry-standard method for concrete moisture measurement prior to floor coating application.

Procedure: drill holes at 40% of slab thickness (1.6 inches for 4-inch slab), insert humidity probe sleeves, cap and seal, allow 24 hours of equilibration, then measure with calibrated hygrometer probe. Required probes: 3 per first 1,000 sq ft, plus 1 per additional 1,000 sq ft, and one probe within 3 ft of each exterior wall. Acceptable threshold: below 95% RH for Penntek polyaspartic systems. In NJ Climate Zone 4A, test no sooner than 28 days after pour, with HVAC operating at service conditions (65-85 F, 40-60% RH). Do not test on cold slab before heat is on.

IRC R506 Concrete Floors — Slab Requirements

IRC R506.1: minimum 3.5-inch concrete slab for residential garages; industry best practice is 4 inches for vehicle and lift loads. IRC R506.2.3: vapor retarder not less than 6-mil polyethylene between base course and concrete slab; for NJ Zone 4A luxury garage, specify 10-mil virgin polyethylene with 12-inch laps sealed with Tyvek tape. IRC R506.2.4: minimum 4-inch base of compacted gravel or crushed stone beneath slab. Thickened edge at perimeter: minimum 8 inches at door threshold for frost protection (Bergen County frost depth 36-42 inches).

IRC R309.3 Garage Floor Slope

IRC R309.3 (via R309 general requirement): garage floor surfaces shall be sloped to facilitate the movement of liquids to a drain or toward the main vehicle entry doorway. Standard slope: 1/8 inch per foot (1% grade) minimum; 1/4 inch per foot preferred for faster drainage. For a 24-ft deep three-car garage: 24 ft x 0.125 in/ft = 3 inches total drop from back wall to door threshold. Trench drain alternative: slope to a center or side trench drain for better liquid containment. Slab flatness target: FF 35-50 for a smooth polyaspartic topcoat finish.

NDS Mini Channel Trench Drain

NDS Mini Channel Drain (3-inch wide, UV-protected HDPE): part numbers 500 (gray, 6-ft section), 500S (sand). Channel ID: 2-13/16 inches wide, 3-1/8 inches deep. Flow rate: up to 62.8 GPM at 1% slope. Outlets: 2-inch end outlet or 4-inch bottom outlet. For luxury garage: specify brass or cast-iron grate. Trench drain must be set in formwork before concrete pour with top elevation matching finished floor surface after coating. Alternative: slot drain 4-inch stainless steel strip drain.

Roklin PolyFlex DS Crack Sealer and Penntek PT 300

Roklin Systems PolyFlex DS: rapid-setting polyurea crack filler; sets in minutes; color-matched to substrate; suitable for cracks up to 1/4-inch width. Process: clean, dry, fill, feather-sand flush, re-grind before base coat. Penntek PT 300 Polyaspartic topcoat: 93% solids aliphatic polyaspartic polyurea, 6,000 PSI tensile strength (ASTM D412), 9,400 PSI compressive strength (ASTM D695), 112% elongation, zero VOC, UV stable (FadeLock, no yellowing), hot-tire pickup resistant, single-day cure (foot traffic 4-6 hours, full vehicle traffic 24 hours). ICRI 310.2R CSP 3-4 surface profile required: diamond grinding to CSP 3-4 with 600+ lb walk-behind grinder.

DONOT · CORE-DRILLING AFTER TOPCOAT

Core-drilling through cured polyaspartic topcoat is a maintenance patch, not an invisible repair. All conduit stub-ups, trench drain openings, lift anchor zone markings, and ground rod locations must be set before the concrete pour. No post-coat penetrations without written direction from the Restrepo principal.

SLAB & COATING NOTES

- Control joints: saw-cut within 24 hours of pour at depth = 1/4 slab thickness (1 inch for 4-inch slab), maximum spacing 8 ft for a 4-inch slab. No control joints within lift column anchor footprint.
- Expansion joints at perimeter and structural transitions: closed-cell polyethylene backer rod with polyurethane sealant. Fill control joints with polyurea crack filler before coating for invisible finish.
- Conduit stub-up timing relative to slab: all stub-ups set, capped, and photographed before concrete is placed. Photo grid archived with project record. No core-drilling after slab cure without principal direction.
- Polyaspartic application season in NJ: spring or early summer preferred (low soil moisture, ambient temperature 50-90 F). Penntek X-treme Heat formulation permits winter application. Slab must be above dew point and surface temperature above 35 F.

- Vapor barrier continuity: 10-mil poly lapped 12 inches at seams, sealed with Tyvek tape, turned up 6 inches at perimeter walls. Punctures at stub-up locations sealed with compatible butyl tape before pour.

08 SURGE & GROUNDING

NEC 230.67 Type 1 SPD at service entrance (mandatory 2020+); Type 2 at garage subpanel. NEC 250.32(B) 4-wire feeder, separate EGC, isolated neutral bar. Bonding jumper sizing per NEC 250.66. Equipotential bonding around lift columns. Ground rod at exterior foundation for detached structure.

NEC 230.67 — Type 1 SPD at Service Entrance (Mandatory 2020+)

NEC 230.67 (2020 and 2023 NEC) requires a Surge Protective Device (SPD) at all new service entrances and service replacements in dwelling units. For the garage subpanel: install a Type 2 SPD rated minimum 40 kA SCCR at the garage subpanel in addition to the main house SPD. Square D HEPD80 (80 kA Type 2) for QO panels; Eaton CHSPCMF for CH panels. Exception per NEC 230.67: the SPD may be at the next downstream distribution panel rather than the service equipment. Verify AHJ adoption of 2020/2023 NEC for Bergen County NJ.

NEC 250.32(B) — Feeder to Detached Structure, Separate EGC, Isolated Neutral

NEC 250.32(B): the feeder to any subpanel (attached or detached garage) must be a 4-wire feeder. Two ungrounded conductors, one grounded (neutral) conductor, and one equipment grounding conductor (EGC) that is separate from the neutral. At the garage subpanel, the EGC connects to the panel enclosure and to the grounding electrode system. The neutral bar is isolated (floating) — green bonding screw removed. Bonding jumper sizing per NEC 250.66 based on the size of the service entrance conductors. For detached garage: supplementary ground rod at exterior foundation per NEC 250.32(B).

Equipotential Bonding Around Lift Columns

For vehicle lift installations, bonding the lift columns to the equipment grounding conductor equalizes potential and prevents shock from stray voltage. Run a #6 AWG copper bonding jumper from each lift column to the EGC at the disconnect box or to the garage subpanel EGC bus. This is consistent with NEC 250.116 (bonding metallic equipment) and ANSI/ALI ALCTV-2017 grounding provisions. The bonding jumper is visible and accessible; not buried or concealed in the slab.

Ground Rod — Supplementary Electrode for Subpanel

For an attached garage subpanel, the 4-wire feeder EGC connects back to the house grounding electrode system; no separate ground rod at the garage is required by NEC 250.32(B) for an attached structure. For a detached structure, NEC 250.32 requires a grounding electrode system at the detached building: minimum one 8-ft ground rod driven at the exterior foundation, connected to the EGC at the subpanel. Location: outside slab perimeter, minimum 2 ft from foundation, driven vertically. Document ground rod location on as-built sleeve plan.

INSPECT · SPD & GROUNDING COMMISSIONING

Verify: (1) Type 2 SPD indicator light active at garage subpanel after energization; (2) SPD make, model, kA rating, and indicator status documented in project record; (3) equipotential bonding jumper from each lift column to EGC bus confirmed accessible; (4) isolated neutral bar confirmed (floating); no neutral-to-ground bond at subpanel.

SURGE & GROUNDING NOTES

- NEC 230.67 Type 1 or Type 2 SPD at main service is mandatory as of 2020 NEC adoption in NJ. Confirm local AHJ has adopted 2020 or 2023 NEC via NJ UCC amendment schedule.
- NEC 250.66 bonding jumper sizing for 200A service: where the service entrance conductors are 2/0 AWG copper or 4/0 AWG aluminum, the bonding jumper is minimum #4 AWG copper per NEC Table 250.66.
- EVSE grounding: all listed EVSE include an equipment grounding conductor as part of the supply circuit. The EVSE housing is grounded through the EGC in the supply conduit. No separate bonding jumper to EVSE enclosure is required.
- Spare hardware: minimum 5% spare SPD fuse modules (where replaceable), ground rod clamps, and bonding jumper connectors delivered at closeout.

09 PRE-SLAB CHECKLIST

Every item below is verified before concrete is placed. Any unchecked item holds the schedule until remediated. This checklist is the gate between rough-in and the slab pour.

- ☐ Panel labeled and directory completed: all breakers identified with circuit ID, load description, and amperage; directory card secured inside panel door before energization
- ☐ Breakers spec verified: each EVSE breaker confirmed at 60A two-pole for 48A chargers; lift at 30A two-pole; compressor at 30A or 40A per model; dust collector at 20A or 30A per model
- ☐ Long-radius sweeps installed: minimum 18-inch radius for 1-inch conduit, 24-inch radius for 2-inch conduit at all below-grade direction changes; no standard 90-degree elbows underground
- ☐ Burial depth verified: inspector tape pulled over conduit before backfill; depth confirmed at 18-inch minimum for general runs, 24-inch at vehicle lanes
- ☐ All conduit sleeves stubbed 18 inches above finished slab surface and capped with removable PVC plugs labeled with circuit ID before concrete pour
- ☐ Pull string installed in each stub-up: nylon pull string confirmed present and accessible at cap before pour
- ☐ EGC pulled in all conduit runs: equipment grounding conductor confirmed in all branch circuit conduits; isolated neutral bar at subpanel confirmed
- ☐ ASTM F2170 sensor wells installed: probe sleeve holes drilled at 40% slab depth at minimum 3 positions per 1,000 sq ft; wells capped until testing
- ☐ GFCI verified at all 120V/15-20A garage receptacles: test button confirmed on all GFCI outlets per NEC 210.8(A)(2); EVSE circuits have integral CCID, not panel GFCI
- ☐ AFCI protection: confirm AHJ requirement for attached garage branch circuits per NEC 210.12; install AFCI or AFCI+GFCI dual-function breakers per local interpretation
- ☐ Photo-doc grid completed: overhead photo grid of all stub-up locations photographed before concrete pour; photos archived to project record and signed by Restrepo PM
- ☐ Trench drain set to finished floor elevation: NDS Mini Channel or equivalent set in formwork with top elevation confirmed at final finished floor level including coating thickness
- ☐ Ground rod installed and documented: exterior ground rod driven at foundation perimeter for detached structure; location documented on as-built sleeve plan
- ☐ SPD installed at subpanel: Type 2 SPD (HEPD80 or equivalent) mounted at panel; indicator light confirmed active after energization
- ☐ 4-wire feeder confirmed: two hot conductors, one neutral, one EGC confirmed in feeder conduit; green bonding screw removed at garage subpanel
- ☐ Neutral bar isolated: floating neutral bar confirmed; no bonding to panel enclosure at subpanel (bonded only at main house panel)
- ☐ Lift bay equipotential bonding: bonding jumper from each lift column to EGC bus confirmed installed and accessible
- ☐ Expansion fittings on PVC runs: expansion fittings installed on all PVC Schedule 40/80 runs exceeding 25 linear feet
- ☐ Vapor barrier continuity: 10-mil polyethylene confirmed lapped 12 inches at seams, sealed with Tyvek tape, turned up 6 inches at perimeter walls, and punctures at stub-up locations sealed
- ☐ Compressor and dust collector disconnects: lockable safety switches installed within sight of each motor per NEC 422.31
- ☐ Mini-split circuit stub: dedicated 240V conduit stub for mini-split at outdoor unit location; circuit confirmed at correct MCA/MOP per installation manual
- ☐ Sleeve schedule signed: sleeve schedule completed with all stub-up IDs, conduit type, size, depth, and end termination; signed by GC and Restrepo PM before concrete pour
- ☐ Detectable warning tape installed: red warning tape at 6-8 inches above conduit runs in open landscape or exterior burial; tape labeled CAUTION BURIED ELECTRICAL LINE
- ☐ Spare hardware delivered: minimum 5% spare breakers, PVC fittings, pull-box covers, and conduit caps staged, labeled with project ID, and delivered to owner at closeout
- ☐ ASTM F2170 test completed and documented: RH probe readings documented for each test position; results below coating manufacturer threshold before primer/basecoat application; report signed by installer

QC

QC GATE · 10-ITEM PRE-SLAB PASS/FAIL

All 10 items must be PASS before concrete pour proceeds and before system is delivered to owner. Every item is reviewed by the project lead. Any failed item holds the schedule until resolved.

#	QC GATE ITEM	PASS	FAIL
1	Panel labeled + breakers spec verified All breakers ID'd, amperage confirmed; panel directory staged for installation	PASS / SIGN	FAIL / HOLD
2	Sweeps, depth, caps, and pull strings confirmed Long-radius sweeps at all bends; depth verified; stubs capped 18 in above slab; pull strings confirmed	PASS / SIGN	FAIL / HOLD
3	EGC pulled; isolated neutral at subpanel EGC in all conduit runs; floating neutral bar confirmed; green bonding jumper installed	PASS / SIGN	FAIL / HOLD
4	ASTM F2170 test passed RH probe results below manufacturer threshold at all test positions; report signed	PASS / SIGN	FAIL / HOLD
5	GFCI verified at all 120V garage receptacles GFCI tester pass at every 15/20A outlet; CCID integral to each GFCI confirmed	PASS / SIGN	FAIL / HOLD
6	NEC 230.67 Type 2 SPD installed and lit SPD mounted at subpanel; indicator light active after examination; documented	PASS / SIGN	FAIL / HOLD
7	4-wire feeder confirmed; bonding jumpers installed 4-wire feeder verified; lift bay equipotential bonding jumpers confirmed as applicable	PASS / SIGN	FAIL / HOLD
8	Photo-doc grid archived + sleeve schedule signed Overhead photo grid of all stub-ups archived; sleeve schedule signed by GC and Elected PM	PASS / SIGN	FAIL / HOLD
9	Trench drain set at finished floor elevation NDS Mini Channel (or equivalent) top elevation confirmed at FFL including expansion joints	PASS / SIGN	FAIL / HOLD
10	Spare hardware >= 5% delivered and labeled 5% spare breakers, fittings, caps, and connectors staged, labeled with project ID, delivered	PASS / SIGN	FAIL / HOLD

PROJECT LEAD SIGN-OFF

Signature / printed name

DATE

PROJECT

MM/DD/YYYY

REF

CITATIONS & PRIMARY SOURCES

- 1 **NEC 2023 Article 625 · EVSE Requirements · NFPA**
NEC 2023 Article 625 — Electric Vehicle Charging Systems. Source for NEC 625.40 individual branch circuit, 625.42 continuous load/EMS, 625.47 CCID personnel protection, and 625.17 cord length.
<https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=70>
- 2 **NEC 625.42 · EVSE Rating and 80% Continuous Load Rule**
ElectricalLicenseRenewal.com. 2020 vs. 2023 NEC 625.42 language comparison; EMS provisions NEC 625.42(A) and adjustable-setting NEC 625.42(B).
<https://www.electricallicenserenewal.com/Electrical-Continuing-Education-Courses/NEC-Content.php?sectionID=1534>
- 3 **NEC 422.31 · Appliance Disconnect (Lift and Compressor)**
NEC 422.31 code requirement: lockable disconnecting means within sight of motor for fixed motor-driven appliances. Applies to vehicle lifts and air compressors.
<https://captaincode2023.leviton.com/node/357>
- 4 **NEC 250.32(B) · Feeder Grounding · EC&M Magazine**
Electrical Contractor Magazine. Detailed analysis of NEC 250.32(A) and 250.32(B)(1) for attached/detached garage subpanel grounding, 4-wire feeder, isolated neutral bar requirement.
<https://www.ecmag.com/magazine/articles/article-detail/codes-standards-equipment-and-structure-grounding-and-bonding-sep...>
- 5 **NEC 230.67 · SPD at Service Entrance · DITEK**
DITEK Surge Protection. Explains Type 1 and Type 2 SPD mandatory requirements for all new dwelling unit services per NEC 230.67 (2020 and 2023 NEC); downstream distribution panel exception.
<https://www.ditekssurgeprotection.com/understanding-the-2023-nec-rules-for-surge-protection/>
- 6 **NEC 408.36 · Panelboard OCPD · Captain Code 2020**
Leviton/CaptainCode2020. Current rule requires all panelboards to have rated overcurrent protection; 2020 NEC deletion of Exception 1 to 408.36.
<https://captaincode2020.leviton.com/node/256>
- 7 **NEC 220.83 · Load Calculation · GreenBuildingAdvisor**
GreenBuildingAdvisor. Step-by-step explanation of NEC 220.83 (clipboard survey) and NEC 220.87 (actual demand monitoring) methods; EV load calculation examples.
<https://www.greenbuildingadvisor.com/article/calculating-electric-service-needs>
- 8 **NEC 220.87 · Actual Demand Load Method · ExpertCE**
ExpertCE. Explains new NEC 2023 625.42(A) EMS and 625.42(B) adjustable settings provisions and their effect on EVSE load calculations.
<https://expertce.com/courses/electricians-guide-for-nec-2023/lessons/how-do-2023-nec-changes-affect-evse-load-calculation...>
- 9 **NEC Table 300.5 · Underground Burial Depths · ExpertCE**
ExpertCE. NEC 300.5 Table 300.5 column categories, wiring method differentiation, 18-inch general, 12-inch residential branch 120V/20A GFCI, 24-inch under roadway.
<https://expertce.com/learn-articles/nec-300-5-underground-burial-depths/>
- 10 **IRC R506 · Concrete Floors on Ground · R&R Painting**
R&R Painting & Concrete. Comprehensive guide: IRC R506.1 minimum 3.5-inch slab, vapor retarder R506.2.3 (10-mil recommended), 4-inch gravel base R506.2.4.
<https://rrpaintandstain.com/how-thick-should-garage-slab-be-custom-guide-concrete-thickness/>
- 11 **IRC R309.3 · Garage Floor Slope · Building Code Trainer**
Building Code Trainer. Explains IRC R309 garage floor slope requirement; 1/8 inch per foot consensus standard; slope to drain or door threshold.
<https://buildingcodetrainer.com/garage-floor-slope/>
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MyBuildingPermit.com. IRC R302.5.1 and R302.6 garage/dwelling fire separation: solid-wood or fire-rated door, self-closer, Type X gypsum on garage side.
https://mybuildingpermit.com/sites/default/files/TS_04_SmokeCarbon%20Heat%20Detectors_2021_Final_0.pdf
- 13 **ANSI/ALI ALCTV-2017 · Vehicle Lift Standard · BendPak**
BendPak. ALI Gold Label, ETL certification, ANSI/ALI ALCTV-2017 standard governing all vehicle lift installations; slab and anchor requirements.
<https://www.bendpak.com/car-lifts/four-post-lifts/hd-9xw/>

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TCC Materials / ICRI. Technical Guideline 310.2R: CSP 1-10 scale, CSP 3-4 for polyaspartic systems (10-40 mils DFT), diamond grinding methods, comparator chip assessment.
<https://www.tccmaterials.com/wp-content/uploads/2020/06/ConcreteSurfaceProfiles.pdf>
- 15 ASTM F2170 · RH In-Situ Probe Testing · DeFelsko**
DeFelsko Corporation. ASTM F2170 detailed procedure: drill at 40% slab depth, 24-hour equilibration, calibrated probe, 3 probes per first 1,000 sq ft, acceptable RH thresholds.
<https://www.defelsko.com/resources/how-to-measure-concrete-rh>
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Tesla Support. Gen 3 Wall Connector product guides: 48A continuous, 60A breaker, #6 AWG Cu, NEMA 3R, J3400/NACS connector, Group Power Management, Dynamic Load Management.
<https://www.tesla.com/support/charging/product-guides>
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<https://docs.chargepoint.com/ref-docs-sec/content/pdfs/1-home/flex/flex-ds.pdf>
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Wallbox. Complete installation instructions for 40A and 48A North American models: wiring, current selector positions, hardwire terminal torques, Type 4 (IP55) enclosure, 1.25-inch conduit aperture.
https://support.wallbox.com/wp-content/uploads/ht_kb/2021/01/Pulsar-Plus-N.-A.-Installation-Guide.pdf
- 19 BendPak HD-9XW · Four-Post Lift Specs · BendPak Store**
BendPak. Full specifications: 9,000 lb capacity, 220V/1Ph motor, 82-inch max rise, 100-inch columns, 110.25-inch width, ETL/ALI certified, 30A dedicated 240V circuit required.
<https://www.bendpak.com/car-lifts/four-post-lifts/hd-9xw/>
- 20 Quincy QGS Rotary Screw · Northern Tool**
Northern Tool. QGS-5 (5HP, 230V/1Ph, 16.6 CFM, 60 gal, model 4152051926) and QGS-7.5 (7.5HP, 21.2 CFM) rotary screw compressors with integrated air dryer, 100% duty cycle.
<https://www.northerntool.com/categories/rotary-screw-air-compressors>
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Oneida Air Systems. V-System 3000 HEPA cyclone: 3HP, 220-240V, 13A, NEMA 6-20, 1,349 actual CFM, 74 dBA, non-sparking impeller, cETLus, NFPA compliance ready, 20A recommended breaker.
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<https://www.ndspro.com/us/en/products/drainage/channel-trench-drains/mini-channel-drains>