RESTREPO STANDARD

# Trenched.
# Sealed.
# Signed.

## Pre-Trench Gate & Operator Standard

Door · Gate · Loop · Trench

The trench is dug once. Lay the conduit before the gate posts set.

EDITION
v1.0 · 2026 · Door · Gate · Loop · Trench

VOLUME
22 · Sidecar Reference

## 00 PREFACE

The trench is dug once. Every conduit sleeve, every loop lead-in, every low-voltage home run is stubbed before the pavers set. Once the driveway is poured and the gate posts are set in concrete, any missed sleeve requires breaking pavement and disrupting finished landscaping. This standard codifies the pre-trench conduit discipline for the Restrepo Innovations Gate & Operator automation program: operator pad geometry, conduit types and depths, power stub-outs, low-voltage gate wiring, vehicle loop pre-sawcut sleeves, photo eye mounting, intercom pedestal pre-set, grounding and surge, pedestrian gate hardware rough-in, ASTM F2200 construction pre-check, a 25-item QC gate, and 25 cited primary sources. The trench is dug once.

This standard does not replace manufacturer instructions, code authorities, or professional licensing. NEC 2023 Articles 210, 230, 250, 300, 352, 725, UL 325-2018, ASTM F2200-24, ANSI/DASMA 102, ICC 600, NJ UCC NJAC 5:23, FCC Part 15, 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. BX/MC cable on any underground or gate operator circuit requires written direction from the Restrepo principal.

**The trench is dug once.**

**Lay the conduit before the gate posts set.**

## 01 OPERATOR PAD & MOUNTING PLAN

Concrete pad sizing for swing operators (LA500UL, FAAC 412/422) and slide operators (SL3000UL, FAAC 844). Pier/post-mount geometry, frost-line depth (36-42 in. Bergen County NJ), embed J-bolts, pad reinforcement 2x #4 rebar mat.

### Swing Operator Concrete Pad — LA500UL / FAAC 412 / FAAC 422

LiftMaster LA500UL (24VDC, 120VAC input, 2x7Ah backup, 18 ft max leaf): pad minimum 12 in. x 12 in. x 8 in. deep, 3,000 PSI concrete, 2x #4 rebar mat, embedded J-bolts per operator template. FAAC 412 (115VAC, 280W, 14 ft max leaf): surface mount on pillar or pad per installation drawing. FAAC 422 (electro-hydraulic, 115VAC): pillar-face mount, minimum 8 in. embedment anchors, fixed positive stops required. Frost-line depth Bergen County NJ: 36-42 in.; all pads and piers extend to 42 in. below finished grade as Restrepo standard.

### Slide Operator Concrete Pad — SL3000UL / FAAC 844

LiftMaster SL3000UL (1/2 HP 1,000 lbs/50 ft; or 1 HP 2,000 lbs/50 ft): pad minimum 18 in. x 18 in. x 10 in., 3,000 PSI, rebar mat, J-bolt pattern per SL3000UL template. FAAC 844 ER (650W, 7A, 120VAC, 4,000 lbs, 131 ft max): base frame requires 24 in. x 18 in. x 12 in. pad, rebar mat, anchor-bolt pattern per 844 ER drawing. J-bolts: 1/2-in. x 6 in. galvanized with nut and washer; 2.5 in. thread above pad; set with template; photograph before pour.

### Pier & Post-Mount Geometry

Gate operator columns (swing pivot post, slide track support post, intercom pedestal) set in poured piers: minimum 12 in. diameter x 36 in. deep for ornamental iron posts. Operator attachment posts sized by structural engineer when gate exceeds 800 lbs or opening width exceeds 16 ft. Post base plate: 3/8 in. A36 steel; four 1/2-in. anchor bolts at 6-in. bolt circle for residential operators; 8-in. bolt circle for FAAC 844 ER and SL3000UL 1 HP. Non-shrink precision grout at 0.5 in. min under plate.

### Pad Reinforcement — 2x #4 Rebar Mat

All standalone operator pads and pedestal piers: 2x #4 (1/2 in.) deformed rebar, 6 in. on center in both directions for pads over 100 sq in. footprint. Minimum 2 in. concrete cover on all rebar. Piers: two #4 vertical bars + #3 spiral at 6 in. pitch. Concrete minimum 3,000 PSI at 28 days; cure minimum 7 days before operator mounting. Conduit stub-up exits pad bottom or side per sleeve plan.

> **SPEC · OPERATOR PAD LOCK**
> No gate operator is mounted until: (1) pad photographed before pour and archived, (2) J-bolt bolt circle confirmed per operator template, (3) concrete minimum 3,000 PSI at 28 days and 7-day cure confirmed, (4) conduit stub-up exits pad at correct location per sleeve plan. Deviations require written direction from the Restrepo principal.

### OPERATOR PAD & MOUNTING PLAN NOTES

- Photo-document all J-bolt patterns, pad dimensions, and rebar placement before concrete pour. Archive to project record with date and site reference.
- NEC 422.31 lockable disconnect: specify a fusible safety switch or lockable breaker within sight of every gate operator. For SL3000UL and LA500UL, a lockable 20A 120VAC disconnect is standard.
- BX/MC cable on operator feed conduit requires written direction from the Restrepo principal. Default is Schedule 80 PVC stub-up from pad to above-grade transition, then EMT or LFNC to operator.
- Spare hardware: minimum 5% spare anchor bolts, rebar splice couplers, and conduit fittings delivered at closeout, labeled with project ID per Restrepo closeout standard.
- For dual-swing gate (LA500UL bi-parting pair): two separate dedicated circuits with separate breakers per UL 325 dual-operator requirements.

## 02 CONDUIT TYPE & BURIAL DEPTH

NEC Table 300.5 governs minimum cover by wiring method and location. Schedule 80 PVC for all risers and driveway aprons. Separate conduits for line-voltage and low-voltage. Sweeps 24-in. minimum radius for #6 AWG and larger. Expansion fittings every 100 ft and at slab transitions.

| WIRING METHOD | MIN COVER | CODE REF | NOTES |
|---|---|---|---|
| **PVC Sched 40 (landscape, low-voltage)** | 18 inches | NEC Table 300.5 | Standard residential burial for gate control, photo eye, loop lead-in in PVC SCH 40. |
| **PVC Sched 80 (risers, driveway aprons)** | 18 inches | NEC 352 / 300.5 | Schedule 80 at above-grade risers and any run within 18 in. of finished grade. |
| **PVC Sched 40/80 under driveway/vehicle lane** | 24 inches | NEC Table 300.5 | All conduit crossing a vehicle lane: 24-in. minimum cover regardless of type. |
| **Residential branch 120V/20A GFCI in PVC** | 12 inches | NEC Table 300.5 Col 4 | Residential 120V/20A GFCI circuits in nonmetallic conduit: 12-in. minimum cover. |
| **RMC / IMC (shallow obstacles)** | 6 inches | NEC Table 300.5 | Rigid or intermediate metallic conduit where 18-in. depth is not achievable. |
| **Low-voltage landscape (<30V)** | 6 inches | NEC Table 300.5 | Irrigation-class low-voltage (<30V) gate accessories only; not for loop leads. |

### CONDUIT DISCIPLINE

- Separate line-voltage and low-voltage conduit in dedicated raceways. Minimum 12 in. physical separation between 120VAC conduit and loop lead-in or control wiring conduit.
- Sweeps: minimum 24-in. radius for #6 AWG and larger conductors; minimum 6x trade size (NEC 352.24) for smaller conductors. No standard 90-degree elbows below grade.
- Expansion fittings every 100 ft on PVC Schedule 40/80 runs and at all slab/pavement transitions. PVC expands ~3/8 in. per 100 ft per 50-degree F change; Bergen County seasonal range exceeds 110 degrees F.
- Conduit fill: NEC Chapter 9 Table 1 — maximum 40% for 3+ conductors, 31% for 2 conductors. Use fill calculators before conduit is ordered.
- All conduit stubs capped at both ends with removable PVC plugs and labeled with circuit ID before hardscape placement. Pull string confirmed present at every stub-out.
- BX/MC cable below grade or in landscape trench requires written direction. Default is PVC Schedule 40 or 80 for all Vol 22 underground runs.

## 03 POWER STUB-OUTS

120V 20A dedicated circuit per gate operator; NEC 210.8(F) GFCI all outdoor receptacles; NEC 230.67 Type 1 SPD at service entrance (mandatory 2020+); secondary SPD at operator pedestal (Ditek DTK-2LVLPHWPLUS). For UL 325 dual-operator pairs: two dedicated circuits with separate breakers.

### 120V 20A Dedicated Circuit per Gate Operator

Every gate operator installation receives a dedicated 120V, 20A circuit not shared with any other load. Justification: battery chargers draw continuous load at idle; heated operator cabinets draw 150-250W in winter; loop detectors and intercom transformers add accessory load. Conductor: 12 AWG THWN-2 stranded copper in 1.25-in. minimum PVC Schedule 80 stub-up from below grade to above-grade transition. For FAAC 844 ER and hydraulic operators with nameplate over 16A: upgrade to 30A dedicated circuit. For UL 325 dual-operator bi-parting swing pairs: two dedicated 20A circuits with separate breakers.

### NEC 210.8(F) GFCI — All Outdoor Receptacles

NEC 210.8(F): All 125V, 15A and 20A outdoor receptacles require GFCI protection. Gate operator cabinet convenience outlets qualify and must be GFCI-protected. 2023 NEC expands GFCI to include outdoor circuits 50A and below. Install GFCI circuit breaker at panel or GFCI outlet at first device on each outdoor branch. GFCI test at every pedestal outlet confirmed at commissioning and documented in project commissioning record.

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

NEC 230.67 (2020 and 2023 NEC): all new residential service entrances must include a Surge Protective Device. Type 1 SPD at service entrance (line side of main breaker): Square D HEPD80 (80 kA) or Eaton CHSPCMF for CH panels. Type 2 SPD at the gate subpanel or at the distribution panel feeding the gate circuit is the minimum acceptable secondary protection. Verify AHJ adoption of 2020/2023 NEC for Bergen County NJ via NJAC 5:23 amendment schedule.

### Secondary SPD at Operator Pedestal — Ditek DTK-2LVLPHWPLUS

Point-of-use surge protection at each gate operator cabinet. Ditek DTK-2LVLPHWPLUS (120VAC, Type 2 SPD, UL 1449): installed at operator cabinet on 120VAC line-voltage input. For 24VDC control circuit protection: Ditek LVLP Series (5,000A surge current, MCOV 33V for 24V version). Ditek Gate Access Surge Protection Guide specifies DTK-2MHLP5BWB (120VAC, UL 1449 Type 2 with UL 1283 noise filtering) plus DTK-4LVLPCR for 24V control circuit. Document SPD make, model, kA rating, and indicator status in project commissioning record.

**INSPECT · POWER STUB-OUT COMMISSIONING**

Verify: (1) dedicated 20A circuit confirmed for each operator; (2) GFCI circuit breaker or outlet at pedestal confirmed and tested; (3) NEC 230.67 SPD at service entrance confirmed and indicator lit; (4) secondary SPD at each operator pedestal installed and indicator active; (5) conduit labeled at panel and at stub.

### POWER STUB-OUTS NOTES

- Conduit stub: 1.25-in. PVC Schedule 80 from panel to grade, exiting pad at bottom or side per operator template. Stub 18 in. above grade and cap with removable plug.
- Label every circuit stub at both ends with circuit ID (GATE-01, GATE-02) before hardscape placement. Sleeve schedule signed by GC and Restrepo PM.
- NEC 422.31 lockable disconnect: spec a fusible safety switch or locking breaker handle within sight of each gate operator. Include in pre-trench layout.
- GFCI circuit breaker preferred over GFCI outlet at pedestal for improved fault-current interruption on long outdoor runs. Verify with local AHJ at permit application.

## 04 LOW-VOLTAGE GATE WIRING

10/12 AWG TFFN/THWN-2 stranded copper for operator-to-operator interconnect on dual swings; 18 AWG shielded for photo eye runs; Cat6A for video intercom and access control reader; NEC 725 Class 2 limits; conduit fill NEC 352.22 40% max.

### Operator-to-Operator Interconnect — Dual Swing Gates

For dual-swing (bi-parting) installations, the interconnect between master and slave operator control boards carries 24VDC synchronized open/close signals. Conductor: 10 or 12 AWG TFFN/THWN-2 stranded copper in a dedicated 1-in. PVC Schedule 40 conduit between operator pedestals. LiftMaster LA500UL bi-parting: wireless dual-gate sync eliminates this wire run. FAAC dual-operator pairs: 455D control board to second 455D board interconnect uses manufacturer-specified conductor size (typically 18 AWG shielded for control signals, 12 AWG for 24VDC power). Separate conduit from 120VAC line-voltage conduit per NEC 300.5(I).

### Photo Eye Wiring — 18 AWG Shielded

Photo eye conductors (EMX IRB-MON, similar): 18 AWG shielded 2-conductor cable (Belden 8760 or equivalent). Drain wire grounded at operator cabinet end only to prevent ground loops. Run in dedicated 3/4-in. or 1-in. PVC Schedule 40 conduit between gate posts or post-to-operator cabinet. Photo eye power: 12-24VDC from operator accessory power terminal (24VDC, 500mA max on LA500UL). Maximum practical photo eye conduit run without signal amplification: 200 ft with shielded cable.

### Cat6A for Video Intercom and Access Control Reader

All video intercom home runs (Aiphone IXG-2C7 + IX-DV, DoorBird D2101V, 2N Verso 2.0) and HID proximity card reader connections use Cat6A (TIA-568.2-D Category 6A, 500 MHz, 10GBase-T capable). Cat6A supports PoE+ (IEEE 802.3at, 30W) at the gate post for heated housings, IR illuminators, and powered lock outputs. Maximum run: 100 m (328 ft) for reliable PoE delivery. Beyond 100 m: PoE media converter at gate post with single-mode OS2 fiber back to IDF. Run Cat6A in dedicated 1-in. PVC Schedule 40 conduit, separate from 120VAC and 24VDC control conduit.

### NEC 725 Class 2 Limits — Control Wiring

NEC Article 725 governs all Class 2 remote-control and signaling circuits at gate operators. Class 2 circuits: maximum 100 VA, maximum 30V. Covers electric strikes (Adams Rite 7200/8400), maglocks (Securitron), keypads, REX sensors, and access control reader outputs. Minimum conductor: 18 AWG in CL2 or CL2P cable. Class 2 conductors must not share a raceway with 120VAC line-voltage or Class 1 conductors. Underground Class 2 runs: dedicated PVC SCH 40 conduit, 18-in. minimum burial depth (per NEC Table 300.5 general residential), labeled at both ends.

### Conduit Fill — NEC 352.22 40% Maximum

NEC 352.22 limits conduit fill for PVC conduit. For three or more conductors: maximum 40% of interior conduit cross-sectional area. For two conductors: 31%. For one conductor: 53%. A 1-in. PVC Schedule 40 conduit (interior area 0.864 sq in.) accommodates three 12 AWG THWN conductors at approximately 25% fill — well within limit. Low-voltage conduit with Cat6A plus shielded photo eye cable: verify fill using NEC Chapter 9 Table 4 and 5 with actual cable ODs before conduit is sized.

**DONOT · LINE-VOLTAGE AND LOW-VOLTAGE SEPARATION**

Never share 120VAC line-voltage and low-voltage control conductors in the same conduit. Loop lead-in conductors are especially sensitive to electromagnetic interference; maintain minimum 12-in. physical separation between 120VAC conduit and loop lead-in or photo eye conduit. NEC 300.5(I) permits mixed-voltage raceways only if all conductors are insulated for the highest voltage present.

### LOW-VOLTAGE GATE WIRING NOTES

- Never share line-voltage and low-voltage conductors in the same conduit. NEC 300.5(I): conductors of different voltage systems in same raceway are permitted only if all conductors are insulated for the highest voltage present. Restrepo standard: dedicated conduit for each voltage class.
- Loop lead-in conductors (Section 05) run in a dedicated low-voltage conduit. Loop leads are sensitive to electromagnetic interference from 120VAC conduit within 12 inches.
- Spare hardware: minimum 5% spare pull-box covers, conduit bodies, and conduit caps delivered at closeout, labeled with project ID.

## 05 VEHICLE LOOP & FREE-EXIT PRE-SAWCUT

Reno A&E loop sizing (4x6 ft typical residential, 4x10 ft long vehicle), 3 turns 14 AWG XHHW, sawcut 1/4 in. wide x 1.5 in. deep, twist-and-pair home run, conduit sleeve under hardscape pre-cut. Free-exit loop 8-10 ft inside gate sweep.

### Reno A&E Loop Sizing — Standard Residential

Reno A&E AX Series and AX2 dual-channel detectors are the Restrepo standard for all residential gate loop detection. Loop geometry: 4 ft x 6 ft (typical residential driveway width 10-14 ft) for single-vehicle detection; 4 ft x 10 ft for long-vehicle (SUV, truck, flatbed) detection. Wire: 3 turns 14 AWG XHHW (cross-linked polyethylene insulation, rated for direct burial and temperature extremes). The loop inductance target is 100-300 microH; verify with detector DIP frequency selection after installation. Loop wire twisted in the lead-in conduit: one full twist per foot from saw kerf to detector. Reno A&E AX2 dual-channel: one unit handles safety loop plus reverse loop, reducing cabinet wiring.

### Sawcut Dimensions and Pre-Sleeve for Post-Pour Snaking

For new concrete driveways: install a conduit sleeve (1.25-in. PVC SCH 40) crossing under the hardscape at the loop location before pour. The loop wire is snaked through the sleeve post-cure. For asphalt or existing concrete: 1/4-in. wide x 1.5-in. deep saw kerf using diamond blade; kerf filled with hot-pour sealant (Crafco 221 or equivalent) after loop is installed. Home run from saw kerf to detector cabinet: twisted-pair loop lead-in conductors in 1-in. PVC SCH 40 conduit, 18-in. minimum burial depth. Pre-sawcut sleeve location marked on as-built drawing and photographed before hardscape placement.

### Free-Exit Loop Placement — 8-10 ft Inside Gate Sweep

The free-exit (drive-out) loop triggers gate open for vehicles leaving the property without requiring a transmitter. Placement: center of loop 8-10 ft from gate post face, inside the property (after gate closes). This placement ensures the gate is fully open before the vehicle reaches it, and prevents re-closure on a slow-moving vehicle. For slide gates: free-exit loop center 10-12 ft from gate track end. BD Loops preformed direct-burial loops are the preferred specification for new construction before pavers or concrete are placed; no saw-cutting required.

### Safety Loop and Reverse Loop

Safety/center loop: positioned under gate panel in closed position; holds gate open while vehicle is present in gate path; prevents closing on stopped vehicle. Reverse loop: inside gate, property side; prevents gate from closing if vehicle is still in entrapment zone. Reverse loop satisfies UL 325 Type B1 entrapment protection in closing direction when connected to a monitored channel on the Reno A&E AX or AX2 detector. Minimum two loops for slide gates; three loops (free-exit, safety, reverse) is the Restrepo residential standard for all swing and slide gate installations.

> **BEST · PREFORMED LOOP WIRE FOR NEW CONSTRUCTION**
>
> For new concrete or paver installations, specify BD Loops preformed direct-burial loop wire set in the pavement base before pour. Preformed loops eliminate saw-cutting of finished decorative surfaces, prevent moisture infiltration at saw kerf, and align with Restrepo pre-trench discipline. Specify BD Loops RL (standard lead-in up to 40 ft) or EL (extended lead-in over 40 ft) sized to driveway width.

### VEHICLE LOOP & FREE-EXIT PRE-SAWCUT NOTES

- Loop wire minimum 1 inch above or below rebar mat to avoid inductance interference. In heavily reinforced concrete driveways, add 6-in. non-metallic fill between loop wire and rebar.
- DIP-selectable loop frequency on Reno A&E AX/AX2: select different frequencies for adjacent loops in same installation to prevent cross-talk. Document frequency settings in commissioning record.
- Pre-label all loop conduits at both ends: EXIT-LOOP, SAFETY-LOOP, REVERSE-LOOP. Sleeve schedule signed before hardscape placement.
- EMX Ultra II D-TEK plug-in style detector: acceptable alternative to Reno A&E for single-channel installations. D-TEK ASB (Automatic Sensitivity Boost) prevents dropout on high-clearance vehicles.

## 06 PHOTO EYE & EDGE SENSOR MOUNTING

UL 325 monitored entrapment devices (EMX IRB-MON, Miller Edge MGR/MGS); two independent monitored systems per direction of travel per UL 325-2018; height per manufacturer (4-12 in. vehicular, 18-24 in. pedestrian). Type B1/B2/D classification.

### UL 325 Monitored Entrapment Devices — Two Required per Direction

UL 325-2018 (7th Edition) Section 32.1.1: every vehicular gate operator shall have provisions for a minimum of two independent entrapment protection means in each direction of travel where entrapment risk exists. All external devices must be monitored (supervised circuit). The operator's inherent torque/current limiter (Type A) is Device 1. A monitored photo eye (Type B1) or monitored edge sensor (Type B2) is Device 2. Both devices are required in both open and close travel directions. If one external device fails or wiring is cut, the operator control board detects the open circuit and will not permit automatic gate operation.

### EMX IRB-MON Photo Eye — Mounting Heights

EMX IRB-MON (monitored transmitter/receiver, active infrared, Type B1): mount at 4-12 in. above ground for vehicular path beam (detects vehicles in gate opening). For pedestrian detection supplement: add second pair at 18-24 in. above grade. Mount photo eye on conduit drop from operator or on dedicated post at gate post face. Conduit drop: 3/4-in. PVC SCH 40 from operator cabinet to photo eye mounting bracket. Wiring: 18 AWG shielded 2-conductor per Section 04. Set operator control board to MONITORED mode before commissioning. Verify supervised relay output confirms alignment and functionality on an ongoing basis.

### Miller Edge MGR/MGS Sensing Edge — Type B2

Miller Edge MGR20 (round post) / MGS20 (square post): 3-sided activation, wraps around 2-in. leading edge post without mounting channel. Sensitivity: nominal 4-7 lbf. Electrical: 24VAC/DC, 1/2A max. Wire: SJTO 18 AWG, 2-ft standard lead. Maximum length: 10 ft (custom available). Monitored wiring: 2-wire with 10K or 8.2K ohm end-of-line resistor, or 4-wire supervised configuration. Install on both street-facing (closing direction) and property-facing (opening direction) leading edges of every swing and slide gate. Temperature: -30 F to +155 F. UL 325 Recognized Component.

### Type B1/B2/D Classification Summary

Type A (inherent sensor): electronic torque limiter, current sensing, or mechanical force limiter built into every UL 325-compliant operator. Always Device 1. Type B1 (non-contact): photoelectric beam (EMX IRB-MON). Detects object before contact. Must be monitored (supervised circuit). Type B2 (contact edge): pressure edge on gate leading edge (Miller Edge MGR/MGS). Activates on physical contact. Must be monitored with resistor termination. Type D (wireless): transmitter worn by person or on vehicle; prevents operation when in entrapment zone. Less common in luxury residential but permitted under UL 325 Table 32.2.

> **INSPECT · ENTRAPMENT DEVICE COMMISSIONING**
> Verify: (1) operator control board set to MONITORED mode before any automatic operation; (2) supervised relay output of photo eye (Type B1) confirmed active at board terminal; (3) Miller Edge sensing edge (Type B2) resistor termination confirmed with ohmmeter before connection to board; (4) two independent entrapment devices per direction of travel confirmed per UL 325 Table 32.2; (5) entrapment device installation photographed and filed in project commissioning record.

### PHOTO EYE & EDGE SENSOR MOUNTING NOTES

- Set all operator control boards to MONITORED mode before commissioning. Many boards ship with legacy unmonitored mode as default. Document monitored circuit verification in commissioning record.
- Photo eye conduit drop: schedule stub before gate post is set in concrete. A 3/4-in. PVC sleeve exiting the post base on each side of the gate opening allows photo eye conductors to be routed post-installation.
- UL 325 photo-document: photograph entrapment device installation geometry (photo eye height, edge sensor coverage, gate sweep radius) and file in project record.
- For swing gates opening toward open space with no entrapment zone in one direction: only one entrapment means is required in that direction per UL 325 Exception.

## 07 INTERCOM & ACCESS PEDESTAL

Aiphone IXG-2C7 + IX-DV/IX-DVF station, DoorBird D2101V, 2N Verso 2.0; pedestal height 48 in. centerline to camera/keypad; Cat6A PoE+ home run; NEMA 4X enclosure; door-side 12VDC backup loop.

### Aiphone IXG-2C7 + IX-DV/IX-DVF Door Station

Aiphone IXG-2C7 (indoor master): 7-in. color LCD touch display, PoE (IEEE 802.3af, 1.9W standby / 5.9W max), SIP support for smartphone call forwarding, visitor image capture. IX-DV / IX-DVF door stations: IP video, wide-angle camera, PoE powered, vandal-resistant, flush-mount or surface-mount for gate pillar housing. Cat6A minimum home run; Restrepo specifies Cat6A for all new intercom runs. Pedestal centerline: 48 in. from finished grade to camera/keypad center. NEMA 4X weatherproof enclosure for all outdoor pedestal components. Cat6A PoE+ (IEEE 802.3at, 30W) at intercom head-end switch to support heated housings.

### DoorBird D2101V

DoorBird D2101V: IP65 weather, IK08 vandal, FCC Part 15 / CE / UL 62368-1 listed. Power: 15VDC PoE. HD camera with IR night vision. Relay output for gate trigger on answered call. Integration: DoorBird app, ONVIF, SIP, IFTTT, Alexa, Google Home. Operating temperature: -13 F to 131 F. Compact flush-mount design ideal for gate pillar. Direct gate-trigger relay: wire relay output to gate operator open terminal. Cat6A home run required for PoE and 10G future capability.

### 2N IP Verso 2.0

2N IP Verso 2.0 (Part 9155211C): Full HD 1920x1080 camera, 138H x 105V degree FOV, Axis ARTPEC-7 chipset, WDR, Zipstream compression. Chassis: anodized aluminum (upgrade from plastic in Verso 1.0). IP54, IK08. Access methods: PIN, RFID, WaveKey mobile credential, QR code. 20+ modular accessories: keypad, card reader, fingerprint, additional cameras. SIP, REST API, ONVIF, Control4, Crestron, Genetec integration. Mounting: surface, flush, or glass mount. Specified for estates requiring modular credential expansion.

### Pedestal Geometry and NEMA 4X Enclosure

Intercom/keypad pedestal centerline: 48 in. from finished grade to camera or keypad center. Weather hood over station to reduce direct rain exposure. NEMA 4X (IP66) enclosure for all outdoor keypad, card reader, and relay boards at gate pedestal. Pedestal post: galvanized Schedule 40 steel pipe, 2-in. diameter minimum, set in concrete pier minimum 24 in. deep. Door-side 12VDC backup loop: 7Ah battery in NEMA 4X enclosure for strike/maglock on power failure. Cat6A home run from pedestal to IDF in dedicated 1-in. conduit.

**FIELD · INTERCOM PEDESTAL COMMISSIONING**

Intercom pedestal plumb verified with level; Cat6A home run pull-tested from pedestal to IDF; PoE power confirmed at door station with PoE tester before intercom station is mounted; relay output wired to gate operator open terminal and tested (gate opens on intercom call answer); FCC Part 15 certification confirmed for all wireless intercom components.

### INTERCOM & ACCESS PEDESTAL NOTES

- For gate-to-house Cat6A runs exceeding 100 m (328 ft): install PoE media converter at gate post with single-mode OS2 fiber back to IDF. Fiber eliminates ground-loop and lightning-induced surge risk on long runs.
- All wireless intercoms and RF remotes (DoorBird D2101V, 2N Verso 2.0) must carry FCC Part 15 certification. Do not install any unlicensed RF device at a gate pedestal.
- Intercom conduit stub: pre-set 1-in. PVC SCH 40 from IDF location to gate pillar before hardscape. Cap and label CAT6A-INTERCOM on both ends.
- Aiphone IXG-2C7 supports SIP call forwarding to resident smartphones. Verify SIP trunk configuration at commissioning. Missed call image capture archived to IXG-Server for review.

## 08 GROUNDING & SURGE

NEC 250.50 grounding electrode at gate operator pedestal (8-ft copper-clad rod, supplemental if remote); NEC 250.66 bonding jumper sizing; equipotential bond around metal gate frame; SPD coordination.

### NEC 250.50 Grounding Electrode at Gate Operator Pedestal

NEC 250.52 and 250.53: a grounding electrode must be installed at each gate operator pedestal. Minimum: one 8-ft copper-clad steel ground rod, 5/8-in. diameter, driven vertically adjacent to the pedestal. If rock prevents vertical driving: drive at 45-degree maximum from vertical, or trench horizontally at 30-in. minimum depth. A single rod achieving 25 ohms or less to earth satisfies NEC; otherwise a supplemental electrode is required. The gate operator is on a long driveway run and acts as a lightning collection point; grounding is critical for surge protection coordination.

### NEC 250.66 Bonding Jumper Sizing

NEC 250.66 Table: grounding electrode conductor (GEC) sized based on the largest ungrounded service-entrance conductor. For a 200A residential service (2/0 AWG Cu service entrance conductors): GEC minimum 4 AWG copper per Table 250.66. For the gate operator pedestal sub-electrode: GEC from the operator EGC to the driven rod is minimum 6 AWG copper (sized for the branch circuit conductors, not the service entrance). GEC runs in conduit from rod clamp to operator cabinet EGC terminal; use exothermic weld or listed clamp at rod connection.

### Equipotential Bond Around Metal Gate Frame

All metallic components of the gate frame, operator housing, and gate post are bonded to the equipment grounding conductor (EGC). Bonding jumper: minimum 6 AWG bare or green insulated copper from each metal gate section to the EGC at the disconnect enclosure or operator cabinet. Consistent with NEC 250.116 (bonding metallic equipment). Bonding jumper is visible and accessible; not buried or concealed inside gate structure. Document bonding jumper locations on as-built drawing.

### SPD Coordination — Primary and Secondary

Two-layer surge protection: primary SPD at service entrance (NEC 230.67 Type 1 or Type 2), secondary SPD at gate operator cabinet (Ditek DTK-2LVLPHWPLUS for 120VAC plus Ditek LVLP Series for 24VDC control). SPD coordination: primary suppresses direct utility surges; secondary suppresses residual energy and lightning-induced transients on the gate feeder run. Long driveway runs (50-200 ft) between house panel and gate operator amplify lightning-induced transients; secondary SPD is not optional on any Restrepo gate installation. Verify primary SPD indicator lit at service panel before commissioning gate secondary SPD.

**INSPECT · SPD AND GROUNDING COMMISSIONING**

Verify: (1) ground rod driven at each pedestal; location on as-built; (2) 6 AWG GEC from rod to EGC at operator cabinet confirmed; exothermic weld or listed clamp at rod; (3) equipotential bonding jumper from gate frame to EGC confirmed accessible; (4) primary SPD indicator lit at service panel; (5) secondary SPD indicator active at each gate operator pedestal.

### GROUNDING & SURGE NOTES

- Document ground rod location on as-built sleeve plan: GPS coordinates or measured dimensions from fixed landmarks. Ground rod location is difficult to recover without documentation.
- NEC 250.66: the GEC must not be smaller than the EGC in the supply conduit for the gate operator circuit. For a 12 AWG circuit EGC, GEC at the pedestal is minimum 12 AWG.
- Ground rod clamp: use listed direct-burial GEC clamp rated for 8-ft rod; do not use split-bolt connectors at rod-to-GEC connection. Exothermic weld (Cadweld or equivalent) is preferred.
- Spare hardware: minimum 5% spare SPD modules, ground rod clamps, and bonding jumper connectors delivered at closeout, labeled with project ID.

## 09 PEDESTRIAN GATE HARDWARE PRE-SET

Locinox MODULEC-SF strike rough-in box, Adams Rite 7200/8400 Series strike, Schlage Encode Plus / Z-Wave Connect for residential pedestrian, fail-secure vs. fail-safe decision tree, magnetic position sensor for monitoring.

### Locinox MODULEC-SF Strike Rough-In Box

Locinox MODULEC-SF electric strike (surface-mounted keep, 12-24V AC/DC, 15W, 500,000 cycles, 300 kg latch-bolt resistance): pre-set rough-in box in gate frame before finishing. Rough-in box: weld or bolt-mount flush with gate frame face; leave 18 AWG NEC 725 Class 2 conductor stub-out behind box for field connection. Locinox FORTYLOCK or FIFTYLOCK mortise lock: matched to gate frame profile (40 mm+ profile for FORTYLOCK; 2-in.+ profile for FIFTYLOCK). Click-It tool-free mounting. Accept Euro-profile cylinders. Strike rough-in box and lock pre-set before gate is hung; final conductor connection at commissioning.

### Adams Rite 7200/8400 Series Strike

Adams Rite 7200 Series electric strike: 12 or 24 VAC/VDC, fail-secure (field-convertible to fail-safe), holds force exceeds ANSI/BHMA Grade 1, opens with up to 30 lbs preload, ANSI/UL 294 listed. For narrow-stile aluminum gate frames paired with Adams Rite deadlatch or cylindrical lock. 8400 Series life-safety narrow-stile mortise exit device: UL 305 Panic Hardware, ANSI/BHMA A156.3 Grade 1, ANSI/UL 294. Required on pedestrian gates serving as fire egress path. Provides single-motion egress in all power states. Wiring: 18 AWG NEC 725 Class 2 in dedicated conduit.

### Schlage Encode Plus / Z-Wave Connect — Residential Pedestrian

Schlage Encode Plus: Wi-Fi direct + Apple HomeKit (Matter/Home Key via NFC on iPhone/Apple Watch). ANSI/BHMA Grade 1 deadbolt. No hub required for Wi-Fi. Built-in alarm for door-forced and door-ajar detection. Pair with Locinox housing for fully exposed outdoor pedestrian gate (Encode Plus is not weatherized for direct outdoor exposure without protective housing). Schlage Connect Z-Wave: Z-Wave Plus, Grade 1 deadbolt, compatible with SmartThings and Control4 Z-Wave module. For pedestrian gates where Crestron/Control4 integration is required, the Z-Wave variant provides deterministic local control.

### Fail-Secure vs. Fail-Safe Decision Tree

Fail-secure (locked when unpowered): default for perimeter pedestrian gates on the property boundary where unauthorized entry is the primary concern. Adams Rite 7200 assembled fail-secure. Locinox MODULEC-SF E version (Fail Close). Fail-safe (unlocked when unpowered): required for pedestrian gates on a fire egress path. Adams Rite 8400 with electric latch retraction. Securitron Magnalock (holds 600-1,200 lbs electromagnetically; releases on power loss). Restrepo standard: fail-secure at all entry pedestrian gates; fail-safe at egress-only pedestrian gates. Document decision basis in project record.

### Magnetic Position Sensor for Gate Monitoring

Surface-mount magnetic contact sensor (Seco-Larm E-945D or equivalent): one piece on gate frame, one on post, within 1/2-in. gap at closed position. Supervised 2-wire output (10K resistor end-of-line). Signal to access controller (Linear AM3-Plus) or smart-home system (Control4) for ajar and forced-entry alerts. Wiring: 18 AWG NEC 725 Class 2 in dedicated conduit from sensor to controller. Position sensor pre-set rough-in conduit stub before gate is hung; final connection at commissioning. Document sensor location on as-built drawing.

> **NOTE · FAIL-SECURE VS. FAIL-SAFE RECORD**
> Document the fail-mode decision for every pedestrian gate electric strike and maglock in the project record. The decision basis (security priority vs. fire egress path) must be signed by the Restrepo PM and the client before hardware is ordered. Field substitution of fail-safe hardware for fail-secure or vice versa after installation requires written direction from the Restrepo principal.

### PEDESTRIAN GATE HARDWARE PRE-SET NOTES

- UL 325 explicit statement: do not allow pedestrian use of the vehicular gate. Every automated vehicular gate installation must provide a separate pedestrian gate or bypass path.
- Fire department keyswitch (Knox Box compatible) on all vehicular gates opening to a public street: opens gate on emergency signal without power. Set rough-in conduit sleeve for keyswitch wiring before gate post is set.
- Pedestrian gate conduit stub: 1/2-in. PVC SCH 40 for 18 AWG Class 2 wiring. Minimum 18-in. burial depth. Label PGATE-01 at both ends.
- All electric strikes, maglocks, and position sensors require listed Class 2 power supply. Never connect Class 2 devices directly to 120VAC or unregulated DC sources.

## 10 ASTM F2200 CONSTRUCTION PRE-CHECK

Class I residential gate definition; no climb-through gap over 4 in. (below 48 in.: 2.25-in. sphere; 48-72 in.: 4-in. sphere); no exposed roller below 8 ft; kick plate to 48 in.; chain-link mesh fill compliant.

### Class I Residential Gate Definition

ASTM F2200-24 (current edition) and UL 325 Class I: residential vehicular gate installed at a dwelling with not more than four single-family units, or an estate. All Restrepo residential gate projects are Class I. There is no reduced-duty exemption for residential use; all F2200 construction requirements apply. Class IV: restricted-access residential gate (Class I location, but access controlled exclusively by keyed entry — card readers, keypads, phone entry; no open-to-all activation). Class IV adds heightened security requirements but same physical construction rules as Class I.

### Gap and Opening Requirements — No 4-inch Sphere Below 48 in.

ASTM F2200 below 48 in. above grade: any opening in gate frame or adjacent fence must not allow a 2.25-in. sphere to pass through. Chain-link fill, expanded metal mesh, or ornamental pickets at 2.25 in. or less satisfy this requirement. From 48 in. to 72 in. above grade: openings must not allow a 4-in. sphere to pass. Ornamental gates with pickets at 4 in. or less satisfy the upper zone. Gap between gate panel and support column: must not exceed 2.25 in. For swing gates: the distance from any fixed object to the swinging gate edge must be at least 16 in. to eliminate entrapment zone, or the zone must receive UL 325-compliant secondary entrapment devices.

### No Exposed Roller Below 8 ft — Guards Required

ASTM F2200: all weight-bearing exposed rollers less than 8 ft above grade must be guarded or covered. For slide gates: track rollers require covers or guards. Most premium residential gate hardware manufacturers supply roller covers; verify during shop drawing review. Exposed fasteners: all bolts, pins, and exposed hardware within the gate travel zone must be flush or capped. No protrusions on any automated gate that could snag clothing, a limb, or a neck. Anti-climb: no barbed tape below 8 ft, no barbed wire below 6 ft above grade.

### Kick Plate to 48 in. and Chain-Link Fill

Kick plate: for gates with large openings below 48 in. that cannot accommodate decorative mesh, a solid kick plate from grade to 48 in. on the gate face satisfies the 2.25-in. sphere requirement. Materials: galvanized steel, aluminum, or powder-coated steel sheet, minimum 18 gauge. Chain-link fill for ornamental iron frames: use 2-in. or 2.25-in. vinyl-coated chain-link mesh between ornamental frame members to reduce openings below the 2.25-in. sphere threshold. Verify chain-link mesh opening size with actual mesh (aperture varies by manufacturer; measure actual diagonal opening, not nominal size).

### Positive Stops and ASTM F2200 Pre-Check

ASTM F2200: positive stops (mechanical travel stops) required to limit gate travel to fully open and fully closed positions. Gates must not move by gravity when disconnected from the operator. For swing gates: positive stop in both open and closed positions; adjust for concrete pad level. For slide gates: roller track end-stop welded to track; anti-rollback confirmed through gear reduction on electromechanical operators. Pre-check before hardware installation: (1) verify all sphere-clearance zones, (2) install roller covers, (3) confirm positive stops in both directions, (4) verify no protrusions on gate travel arc.

> **SPEC · ASTM F2200 PRE-CHECK LOCK**
> ASTM F2200 construction pre-check is completed before gate is powered and before UL 325 entrapment device commissioning. All sphere-clearance zones photographed and documented. Roller covers confirmed installed. Positive stops confirmed in both open and closed positions. Any gate panel failing F2200 construction requirements is corrected before operator is installed. No gate is energized without a completed F2200 pre-check record.

### ASTM F2200 CONSTRUCTION PRE-CHECK NOTES

- ASTM F2200 pre-check is a separate inspection from the UL 325 entrapment protection inspection. Schedule both during the same site visit before final commissioning sign-off.
- For decorative gates with open ornamental designs: have the gate manufacturer certify compliance with ASTM F2200 sphere-clearance requirements in writing before installation. Do not field-verify after installation is complete.
- Solid gate panels (over 40% fill) on coastal NJ properties require structural engineer to calculate wind load per ANSI/DASMA 108 methodology applied to gate geometry.
- Document ASTM F2200 pre-check with photographs of all sphere-clearance zones, roller covers, and positive stops. File in project record with date and technician signature.

## 11 PRE-TRENCH CHECKLIST

Every item below is verified before hardscape is placed and before gate posts are set in concrete. Any unchecked item holds the schedule until remediated. This checklist is the gate between trench preparation and hardscape placement.

- [ ] Operator pad poured and cured: 3,000 PSI at 28 days; 7-day cure before mounting; pad photograph archived
- [ ] J-bolts plumb at correct bolt circle: template verified before pour; bolt circle confirmed per operator drawing; photographed
- [ ] All conduit stubs 18 in. above grade, capped with removable PVC plugs, labeled with circuit ID on sleeve schedule
- [ ] Burial depth 18 in. min (24 in. under vehicle lane): confirmed before backfill; inspector tape 6-8 in. above conduit
- [ ] Sweeps 24-in. min radius for #6 AWG and larger; 6x trade size for smaller conductors; no 90-deg elbows below grade
- [ ] Photo-doc grid: overhead and side photographs of all conduit, loop, and ground rod locations before hardscape; archived
- [ ] GFCI confirmed at all outdoor 120VAC receptacles at gate pedestals per NEC 210.8(F); test button confirmed
- [ ] SPD at service entrance: NEC 230.67 Type 1 or Type 2 SPD installed and indicator active at main service panel
- [ ] Secondary SPD at operator pedestal: Ditek DTK-2LVLPHWPLUS at 120VAC plus LVLP Series at 24VDC; indicator active
- [ ] Ground rod driven at each gate operator pedestal: 8-ft copper-clad, vertical within 45 deg; location on as-built
- [ ] Equipotential bond on metal gate frame: 6 AWG jumper from gate frame and operator housing to EGC; visible, accessible
- [ ] Loop sleeve or preformed BD Loop wire pre-set at each loop location; capped and labeled (EXIT-LOOP, SAFETY-LOOP)
- [ ] Cat6A pulled from IDF to gate pedestal in 1-in. conduit; pull-tested; both ends labeled CAT6A-INTERCOM
- [ ] Intercom pedestal plumb in concrete pier 24-in. min depth; NEMA 4X enclosure confirmed weathertight
- [ ] EGC pulled in all 120VAC line-voltage conduit runs; NEC 250.110 compliant; confirmed at panel and at stub
- [ ] Expansion fittings at all 100-ft+ PVC runs and at slab transitions; located as shown on sleeve plan
- [ ] Photo eye conduit drop pre-set: 3/4-in. PVC sleeve exits post base each side of gate opening; labeled PHOTO-EYE
- [ ] Free-exit loop sleeve pre-set: 1.25-in. PVC SCH 40 positioned 8-10 ft inside gate sweep; labeled EXIT-LOOP
- [ ] Pedestrian gate hardware rough-in: Locinox MODULEC-SF and Adams Rite rough-in boxes set; Class 2 stub-out behind box
- [ ] Position sensor conduit stub pre-set: 1/2-in. PVC from sensor to controller; labeled PGATE-SENSOR
- [ ] NEC 422.31 lockable disconnect confirmed within sight of each gate operator; fusible switch or locking breaker
- [ ] Dedicated 20A circuit per operator: 12 AWG THWN-2 in 1.25-in. SCH 80; labeled at panel and stub; GFCI installed
- [ ] Low-voltage conduit separated from 120VAC by 12 in. min; loop lead-in and control wiring in dedicated conduit
- [ ] Sleeve schedule signed by GC and Restrepo PM: stub-up IDs, conduit type, size, depth, termination completed
- [ ] Spare hardware 5% min: fittings, caps, anchor bolts, SPD modules staged, labeled with project ID, delivered at closeout

## QC GATE · 10-ITEM PRE-TRENCH PASS/FAIL

All 10 items must be PASS before hardscape placement 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 | **Operator pad poured, J-bolts plumb, depth documented** Pad photograph archived; J-bolt bolt circle confirmed; frost-depth compliance verified; | PASS / SIGN | FAIL / HOLD |
| 2 | **Conduit stubbed 18 in. above grade, capped, labeled** All line-voltage and low-voltage stubs capped; circuit ID labels confirmed; pull string in every | PASS / SIGN | FAIL / HOLD |
| 3 | **Burial depth verified; sweeps at correct radius** Depth confirmed at 18 in. minimum (24 in. under vehicle lane); sweeps 24-in. radius for | PASS / SIGN | FAIL / HOLD |
| 4 | **GFCI verified at all outdoor 120VAC receptacles** GFCI test pass at every pedestal outlet; GFCI circuit breaker or | PASS / SIGN | FAIL / HOLD |
| 5 | **SPD installed at service entrance and at operator pedestal** NEC 230.67 Type 1/2 SPD confirmed at main panel; secondary SPD at operator | PASS / SIGN | FAIL / HOLD |
| 6 | **Ground rod driven; equipotential bond on gate frame** 8-ft copper-clad rod driven at each pedestal; location on as-built; 6 AWG bonding jumper | PASS / SIGN | FAIL / HOLD |
| 7 | **Loop sleeve or preformed loop wire pre-set; Cat6A pulled** Conduit sleeve under hardscape at each loop; Cat6A from IDF to pedestal confirmed and | PASS / SIGN | FAIL / HOLD |
| 8 | **Pedestrian gate hardware rough-in complete; position sensor stub pre-set** Locinox / Adams Rite rough-in boxes set; Class 2 stub-out confirmed; position sensor | PASS / SIGN | FAIL / HOLD |
| 9 | **Photo-doc grid archived; sleeve schedule signed** Overhead photographs of all stubs, loops, and ground rods archived; sleeve schedule | PASS / SIGN | FAIL / HOLD |
| 10 | **Spare hardware >= 5% delivered and labeled** 5% spare fittings, caps, anchor bolts, and SPD modules staged, labeled, delivered | PASS / SIGN | FAIL / HOLD |

### PROJECT LEAD SIGN-OFF

Signature / printed name _____ DATE MM/DD/YYYY _____ PROJECT _____

## REF CITATIONS & PRIMARY SOURCES


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   https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=70
2. NEC 210.8(F) · GFCI Outdoor Receptacles · Legrand
   https://www.legrand.us/ideas/blogs/gfci-outlet-requirements
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   https://www.diteksurgeprotection.com/understanding-the-2023-nec-rules-for-surge-protection/
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5. NEC Table 300.5 · Underground Burial Depths · ExpertCE
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8. UL 325-2018 · Gate Operators Standard · US Automatic Gate Openers
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9. ASTM F2200-24 · Gate Construction Standard · ASTM
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14. LiftMaster LA500UL · Swing Gate Operator · LiftMaster
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15. LiftMaster SL3000UL · Slide Gate Operator · LiftMaster
    https://www.liftmaster.com/sl3000ul-slide-gate-operator/p/SL3000UL
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    https://elitegates.net/products/faac-412-single-swing-gate-opener-kit
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