

CODE IS THE FLOOR. STANDARD IS THE CEILING.

Scope: Luxury residential garage door openers, swing and slide gate operators, UL 325-2018 entrapment protection, vehicle loops, intercom and access control, conduit and trench discipline, pedestrian gate hardware, and smart-home integration — trenched, sealed, and signed before the pavers set. Residential-only posture throughout. NEC 2023 / NJ UCC NJAC 5:23 / Bergen County AHJ.

§01	OPERATING PRINCIPLES
- Six-pillar door and gate suite — garage door openers, swing gate operators, slide gate operators, UL 325 entrapment protection, vehicle loops and free-exit, and conduit/trench/power — each a one-shot rough-in discipline; residential-only posture throughout; NEC Article 511 hazardous-location wiring explicitly excluded from this volume. - Trench before hardscape — all line-voltage and low-voltage conduit sleeves, loop lead-in conduits, intercom home-run conduits, and photo-eye raceways stubbed and capped before any paver, concrete, or asphalt contractor begins; no saw-cut remediation after decorative driveways are placed. - Code-first — NEC 2023 Articles 110, 210, 250, 300, 352, 422, 680; NEC 210.8(F) outdoor GFCI; NEC 230.67 Type 1 SPD at service entrance; NEC 250.52/250.53 ground rod at each gate operator pedestal; NEC Table 300.5 burial depth; UL 325-2018 (7th Edition) monitored entrapment; ASTM F2200-24 gate construction; ANSI/DASMA 102-2018 door operator; ICC 600 high-wind; NJ UCC NJAC 5:23; FCC Part 15 RF transmitters; IRC R311 pedestrian egress; IRC R314 smoke — these are the floor, not the ceiling. - Residential-only scope — every operator, sensor, and wiring method in this volume is specified for single-family residential and estate (Class I) applications only; commercial operators (LiftMaster CAPXL, HySecurity SlideDriver) are not specified here; NEC Article 511 hazardous-location requirements apply to commercial garages with fuel-dispensing equipment and are excluded from this volume. - Spare hardware ≥5% delivered + labeled — spare gate operator mounting hardware, sensing-edge resistors, loop-lead wire, intercom wall-plates, keypad batteries, and conduit fittings delivered in labeled bins at closeout; operator manuals and UL 325 / ASTM F2200 compliance documentation filed with owner before final payment. - As-built conduit schedule archived with owner before final payment — conduit routes, loop locations, circuit labels, ground rod locations, and SPD installation records filed in owner closeout archive; Crestron Home and myQ configuration committed to cloud and local media; NJ UCC permit and inspection certificate included in project closeout package.	

§02	GARAGE DOOR OPENERS
- LiftMaster 8500W Elite Series jackshaft — 24V DC brushless; 115V AC input; mounts to torsion spring shaft; clears ceiling for 4-post lift rise; integrated battery backup 40 cycles/24 hr; 200W LED remote light; myQ Wi-Fi + Security+ 2.0 + PosiLock; doors up to 14 ft / 850 lbs; NEC 210.8 GFCI at receptacle; NEC 422.31 disconnect within sight; ANSI/DASMA 102 jackshaft hardware-configuration requirement confirmed before spec. - LiftMaster 87504-267 — DC brushless belt drive, 3/4 HP equivalent; 120V AC; integrated battery backup; 2,000-lumen 360° LED; 1080P Secure View camera with night vision, 140° wide-angle, two-way audio via myQ app; Security+ 2.0; PosiLock; lifetime motor and belt warranty; Restrepo default for standard-headroom belt-drive residential applications. - LiftMaster 84501 mid-range belt-drive — DC motor; 1,500-lumen dual LED; myQ + Security+ 2.0; no integrated backup (optional upgrade); lifetime motor and belt; documented here for client-supplied substitutions that must be reviewed for backup and camera completeness before acceptance. - Sommer Synoris 800 / Synoris Duo (550N / 800N) — DC brushless; chain-in-sealed-aluminum-tube direct drive; perceptibly quieter than open-belt at equivalent load; 1.5-inch low headroom clearance; 70 operations/hr; HomeLink compatible; 120V AC 60 Hz; specified for master-bedroom garages and attached garages with living space above. - Hörmann SupraMatic 4 / ProMatic Akku — SupraMatic 4E: 800N peak, up to 13.75 m² door, 20 LED chase, HCP bus, BlueSecur Bluetooth, <1W standby; ProMatic 2 Akku: 400N battery-only for detached garages and outbuildings without power connections, optional solar charging; US market 120V AC; Marantec Synergy 270 (750N, 315 MHz, HomeLink) / Synergy 370 (850N, 9.3 in/sec, 1,100-lumen LED, optional backup) — premium German DC belt-drive alternatives; 120V AC 60 Hz; dedicated 20A circuit Restrepo standard for all operators. - Aladdin Connect by Genie — Wi-Fi monitoring and control for Genie quiet-drive DC openers; 2.4 GHz; open-API posture (Control4 and Crestron third-party drivers); Alexa and Google Home; no native HomeKit; preferred alternative to myQ when client requires an open-API platform following the 2023 Chamberlain myQ API restriction; NEC 210.8 GFCI and NEC 422.31 disconnect apply to all operators	

QC GATE — VERIFY BEFORE CLOSE-IN

☐	UL 325-2018 monitored entrapment verification — two independent tests	☐	ASTM F2200-24 gate construction of travel-free 25° Type A spheres at 110° ± 10°	☐	NEC 210.8 GFCI at receptacle	☐	UL 325-2018 monitored entrapment verification — two independent tests	☐	ASTM F2200-24 gate construction of travel-free 25° Type A spheres at 110° ± 10°	☐	NEC 210.8 GFCI at receptacle
☐	Ground rod resistance ≤25 ohms at each gate operator pedestal	☐	NEC 250.52/250.53 ground rod at each gate operator pedestal	☐	UL 325-2018 monitored entrapment verification — two independent tests	☐	ASTM F2200-24 gate construction of travel-free 25° Type A spheres at 110° ± 10°	☐	NEC 210.8 GFCI at receptacle	☐	UL 325-2018 monitored entrapment verification — two independent tests

eliminates low-voltage wire between posts on dual-leaf installations.

- FAAC S418 / S450H CBAC / 412 / 415 / 422 / 770N — S450H CBAC (P/N 1041001577.5): 24VDC

§06	VEHICLE LOOPS & FREE-EXIT
- Reno A&E LM-200 / LM-422 / LL-622 dual-channel — AX2 Series dual-channel: 120VAC (AX2-3) or 12/24VDC/24VAC (AX2-4); two channels in one unit (combine safety loop + reverse loop on single card); four DIP-selectable frequencies per channel (prevents crosstalk); relay outputs 6A 300VAC; loop inductance 20-2,000 μH; transformer-isolated input; lightning protection 10 μF at 2,000V. - EMX D-TEK / IL2-12VDC loop detectors — Ultra II D-TEK plug-in: 12-24VDC or 24VAC, 10-level sensitivity (UltraMETER display), 4 selectable frequencies, ASB (Automatic Sensitivity Boost) for high-clearance vehicles, Extend Detect 3/6/9 seconds, −40°F to +180°F, 7-position detachable terminal block. - BD Loops PreFormed direct-burial — installed in pavement base before concrete or pavers are placed; no saw-cutting of existing surface; short leg 4 ft, long leg = driveway width minus 4 ft; slide gates: 2 loops minimum (free-exit + safety), 3 loops recommended (add reverse loop); swing gates: 3 loops minimum, 4 recommended for high-traffic estates. - Standard loop positions — (1) free-exit loop outside gate, street side: triggers open for exiting vehicles without transmitter; (2) safety/center loop under gate panel in closed position: holds gate open while vehicle detected, prevents closing on stopped vehicle; (3) reverse loop inside gate, property side: prevents gate closing if vehicle still in entrapment zone, satisfies UL 325 Type B1 entrapment in closing direction; loop in reverse position is the Restrepo standard third loop. - Loop lead-in conduit and burial — PVC Schedule 40 minimum 1-inch (1.25 inch preferred for two conductor pairs plus pull string); 18-inch minimum burial depth per NEC Table 300.5 for PVC Schedule 40; separate conduit from line-voltage runs, minimum 12-inch physical separation to prevent electromagnetic interference on loop lead-in conductors; loop wire minimum 1 inch above or below rebar mat in reinforced driveways. - Loop lead-in conductor — No. 14 AWG twisted pair per Reno A&E and BD Loops specification; drain wire grounded at operator cabinet end only; 4 DIP-selectable frequencies to prevent cross-talk in multi-loop installations; loop lead-in labeled at both conduit ends with circuit ID and loop position (free-exit, safety, reverse); photographed in conduit before pavers placed.	

§07	GATE INTERCOM & ACCESS CONTROL
- Aiphone IXG-2C7 + IX-DV/IX-DVF — IXG-2C7: 7-inch color LCD touch, PoE 802.3af Class 0, full-duplex audio/video, SIP smartphone forwarding, visitor image capture on missed calls; IX-DV/IX-DVF: IP video door station, PoE, vandal-resistant, surface or flush mount in gate pillar housing; Cat6A minimum for all new IXG home runs; beyond 100 m use fiber media converter at gate post — eliminates ground-loop and lightning-induced surge risk. - DoorBird D2101V / D21DKV — IP65/IK08; FCC Part 15 certified; 15VDC PoE; HD camera + IR night vision; relay output for gate trigger; DoorBird app / ONVIF / SIP / IFTTT / Alexa / Google Home; −25°C to +55°C; D21DKV multi-button for properties with multiple entry points; ideal for compact gate pillar installations. 2N IP Verso 2.0 (P/N 9155211C) — Full HD 1920×1080, 138° H, WDR, Zipstream H.265-class compression; Axis ARTPEC-7 chipset; anodized aluminum chassis (IP54/IK08); PIN, RFID, WaveKey, QR code; 20+ modules (keypad, card reader, fingerprint); SIP / REST API / ONVIF / Control4 integration; Comelit ULTRA (UT8020): 160° H, dual MEMS microphone, SimpleBUS1 2-wire or ViP IP — simplifies retrofit where Cat6A is not available to the gate post. - Linear AM3-Plus — up to 4 controlled entry points; 20,000 entry codes; 45,600 block-coded + 20,000 individually enrolled transmitters/cards; four Form C relays 3A @ 24V; four RTE inputs; four door-sense inputs; RS-485 to Linear telephone entry; two Wiegand inputs (26/30/31-bit); 12-24 VAC/DC; estate-standard access controller for vehicular gate, pedestrian gate, pool house, and service entry managed from a single credential database. - LiftMaster KPW250 wireless keypad — Security+ 2.0 rolling code, 250 codes, battery, backlit, weather-resistant, programs directly to LiftMaster myQ openers and gate operators without wiring; LiftMaster 893MAX: Security+ 2.0 3-button remote, 200 ft line of sight, −40°F to +150°F. - HID ProxKey III (1346) + MiniProx / ProxPro / MaxiProx — 125 kHz passive proximity, 26-bit H10301, over 137 billion unique codes; MiniProx: up to 2-inch read range; ProxPro: up to 3 inches; MaxiProx 5375: up to 12 inches with ProxPass vehicle tag, hands-free drive-through access for luxury estate vehicular gates; all readers output Wiegand 26-bit to Linear AM3-Plus or any Wiegand-compatible	

§10	SMART-HOME INTEGRATION & SCENES
- Crestron Home + Control4 + myQ primary platform — Crestron Home OS native Garage Door screen controls LiftMaster myQ-connected openers and gate operators via Intrinsic Dev authorized partner API module; local relay board + magnetic contact sensor provides deterministic cloud-independent gate control through Crestron or Control4 I/O Extender; Aladdin Connect by Genie maintains an open-API posture and is the preferred alternative platform for clients requiring open automation integration following the 2023 Chamberlain myQ API restriction. - Five locked scenes — Departure Mode (all garage doors confirmed closed, driveway gate confirmed closed, perimeter cameras armed, exterior lighting to security level, EVSE charge schedule set, gate keypad deactivated); Arrival Mode (driveway gate opens on geofence + camera detection secondary trigger, garage opens for expected vehicle, path lighting to 80%, myQ/Crestron notification confirms status); Delivery Mode (pedestrian gate unlocks for 15-minute window via access code, intercom relays call to resident smartphone, gate auto-closes and relocks after window expires, event logged); Lockdown (all gates confirmed closed, all operators in hold-close mode, exterior cameras recording, keypad deactivated, push alert to resident); Storm Mode (all gates and doors confirmed closed, garage door openers disconnected from auto-open triggers, wind-load monitoring alert active, UPS battery backup status confirmed online). - Lutron RA3 keypad triggers — dry-contact relay output from Lutron RA3 output relay via 18 AWG NEC 725 Class 2 wire to operator open/close terminal; local, deterministic, cloud-independent; RA3 VCRX visor control enables Departure Mode trigger from driveway; all Lutron RA3 zone assignments, button labels, and scene rules archived in Lutron Designer file and cloud backup at closeout. - Matter / Thread status (2025) — Matter finalized garage door device-type specification in 2023; no major US residential gate operator has shipped a field-deployable Matter-certified unit as of early 2025; for projects requiring Matter interoperability today, use Crestron or Control4 integration via authorized API driver; revisit this specification annually. - Notification matrix — push alerts for: gate or door open more than 15 minutes daytime or 5 minutes after 10 PM; operator fault or UPS battery low; entrapment sensor monitored circuit open; intercom missed call or failed relay trigger; SPD indicator status change; camera offline or tamper event; Crestron LAN loss to any gate or garage IP device; notification matrix documented in Crestron program notes and owner closeout archive. - Integration commissioning — all smart-home integration tested with gate/door physically operating before punch-list closeout; myQ and Crestron/Control4 credentials for all gate and garage devices transferred to owner account before final payment; authorized partner API driver version and configuration committed to project closeout archive; geofencing radii and notification thresholds documented in program notes.	

§11	WITHOUT WRITTEN DIRECTION
- BX/MC cable in any buried or trench gate conduit run — default to PVC Schedule 80 for all risers and Schedule 40 for all buried runs; armored cable in any buried or conduit-encased gate wiring run is without written direction from the engineer of record. - Gate operator circuit shared with any other load — Restrepo standard is one dedicated 20A circuit per gate operator location; sharing an operator circuit with lighting, convenience receptacles, intercom, or any other load is without written direction and inconsistent with NEC 210.11 dedicated circuit requirements for motor-driven appliances. - Monitored entrapment device bypassed or wired unmonitored — UL 325-2018 Table 32.2 requires all external entrapment sensors to be continuously monitored; installing a sensing edge or photo eye in unmonitored mode is without written direction and renders the installation non-compliant with UL 325; document monitored-mode commissioning verification in the project record. - Gate operator installed without ASTM F2200 gate construction review — automating a gate that was not built to ASTM F2200 requirements (gap widths, entrapment clearances, positive stops, roller guards) is without written direction from the project engineer; F2200 compliance is required for any gate that will be or is currently automatically operated. - Loop lead-in wire sharing conduit with 120VAC operator feed — electromagnetic interference from line-voltage conductors on loop lead-in signal wires causes false detect and loop failure; separate conduits with minimum 12-inch physical separation are required; sharing is without written direction from the engineer of record.	

§12	PRE-TRENCH & PRE-POUR CHECKLIST
Line-voltage conduit stubs photographed and filed — all 1.25-inch PVC Schedule 80 line-voltage	