

FIELD MANUAL · VOLUME 17

Tight. Tested. Tagged.

The envelope is poured once. Wire it like it cannot be opened.

PREPARED FOR

Operators · Project Managers · Designers · Integrators · Owner's Reps

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MANIFESTO

The envelope is poured once. Wire it like it cannot be opened.

Vol 17 governs the building envelope of Restrepo Innovations luxury residential construction across air sealing, energy recovery ventilation, spray foam insulation, pre-foam wiring discipline, vapor and moisture control, high-performance glazing, and penetration sealing. Every conduit, every pull string, every box, and every inch of cable that might ever be needed is installed before the foam contractor arrives. The envelope is poured once. There is no second chance.

SCOPE

Residential-only. Applies to new luxury construction and major renovations within Restrepo Innovations projects in the NJ/NY metro corridor (IECC Climate Zone 4A). Specifies ventilation system selection and sizing, air sealing targets and test protocol, spray foam chemistry and sequencing, pre-foam infrastructure discipline, vapor control strategy, window and door performance, and penetration sealing. Cross-references Vol 02 (Electrical Rough-In) for branch wiring and Vol 13 (HT Calibration) for theater envelope coordination.

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PART 1

Air & Ventilation

Sections 01–04 — Why Envelope Now, ERV/HRV Systems, Air Sealing Targets, Mechanical Ventilation

§ 01

Why Envelope Now

PART I — AIR & VENTILATION

Modern luxury construction in the NJ/NY metro targets envelopes that are intentionally near-hermetic. The same air-sealing discipline that delivers thermal comfort and energy efficiency eliminates the natural infiltration that historically provided background ventilation. Without deliberate mechanical ventilation, the result is elevated CO2, accumulated VOCs from luxury finishes and furnishings, moisture buildup, and measurable indoor air quality degradation. The envelope is not insulation. It is a system.

Three premises drive this volume. First, the envelope is a one-shot event: conduit, foam, WRB, window flashing, and air sealing are performed in a defined sequence — not patched in later. Second, every decision must reference an audited spec — manufacturer, model, code citation, and field measurement. Third, this standard is residential-only; we apply IRC, NEC, ASHRAE, and NJ UCC requirements with luxury-grade discipline, never commercial assumptions.

THE FOUR PARTS OF THIS VOLUME

Part	Domain	Governing Code
I — Air & Ventilation	ERV/HRV selection, sizing, air sealing, blower door	ASHRAE 62.2-2019/2025; IRC M1505; IRC N1102
II — Foam & Insulation	Spray foam chemistry, pre-foam wiring, vapor strategy	IRC R316; NEC 2023 Articles 334/362/300; ASHRAE 160
III — Glass & Penetrations	Doors, windows, WRB, penetration sealing	IRC R703; Energy Star v7.0; NFPA 70
IV — Discipline & Closeout	Without written direction, pre-foam checklist, QC	NJ UCC; PHIUS; Indoor AirPlus

FIELD RULE

The envelope is a framing decision.

Conduit pathways, spray foam scope, WRB selection, and window performance targets are defined before framing is complete — not selected after drywall. We do not patch infrastructure into a finished envelope.

§ 02

ERV/HRV Systems

PART I — AIR & VENTILATION

An Energy Recovery Ventilator (ERV) transfers both sensible heat and latent heat (moisture) between exhaust and supply airstreams. A Heat Recovery Ventilator (HRV) transfers sensible heat only. In NJ Climate Zone 4A — mixed-humid, hot summers, cold winters — the ERV is the correct specification for whole-house ventilation in the overwhelming majority of luxury residential projects. The ERV pre-dehumidifies incoming outdoor air in summer, reducing HVAC latent load, and retains interior moisture in winter when an HRV would exhaust it and drive relative humidity below comfort range.

PRIMARY PRODUCTS — ERV/HRV

Product	Type	Max CFM	SRE @ 32°F	PH Cert.	Notes
Zehnder ComfoAir Q350	ERV	208	92%	Yes	Luxury default ≤4,500 SF; ComfoConnect LAN C; 93% humidity recovery
Zehnder ComfoAir Q450	ERV	265	90%	Yes	4,500–6,000 SF; same ComfoConnect ecosystem
Zehnder ComfoAir Q600	ERV	353	89%	Yes	Estates 6,000+ SF; 1,850 W max with pre-heater at -15°C
Panasonic Intelli-Balance 100/200	ERV	101/Higher	N/P	No	Mid-tier; 100 for 2,500–4,500 SF; 200 any-climate; 120V
Renewaire EV Premium M/L/XH	ERV	250–390	AHRI cert	No	Cellulosic core; no halogenated FR; MERV 13 OA option; CO2 sensor
Broan AI B160H65RT / B210E75RS	HRV/E RV	160/210	68–81%	No	Entry tier; VIRTUO self-balance; EC PMSM motors; HVI Certified
Lifebreath Max 155/205/267	HRV	148–267	75–76%	No	Sensible only; lifetime core warranty; pair with dehumidification

SPECIFICATION**Zehnder ComfoAir Q Series — luxury default.**

Passive House Institute certified across Q350/Q450/Q600. Diamond-shaped heat exchanger delivers up to 93% sensible efficiency (Q350) and 86% humidity recovery. ComfoConnect LAN C gateway exposes a local-network API supporting KNX, Modbus, and third-party smart home integration including Crestron custom driver development. Specific electric power: 0.22 Wh/m³ — among the lowest in the residential market.

SPECIFICATION**Renewaire EV Premium Series — healthy materials.**

Cellulosic static-plate cores contain no halogenated flame retardants or PVC — a differentiator for projects pursuing healthy materials certifications. AHRI certified for low-to-zero Exhaust Air Transfer Ratio (EATR). Compatible with CO₂-W demand-controlled ventilation sensor and IAQ-W monitoring accessories.

BEST PRACTICE**Size to ASHRAE 62.2–2019 with headroom.**

Calculate minimum fan rate: $Q_{tot} = 0.15 \times \text{floor area (SF)} + 3.5 \times (\text{bedrooms} + 1)$. For balanced ERV/HRV, the unit must deliver the full Q_{tot} — no infiltration credit is taken on a balanced system. Select the next model tier above the calculated minimum to provide boost mode headroom and accommodate future occupancy growth. Q350 handles most homes to ~4,500 SF; Q450 to ~6,000 SF; Q600 above that.

NOTE**HRV in NJ — when acceptable.**

Lifebreath Max HRV series may be specified when the GC or owner explicitly prefers an HRV and the building has dedicated mechanical dehumidification (Aprilaire E100/E130 or equivalent). Without confirmed dehumidification capacity, specify ERV for all NJ Climate Zone 4A new construction.

§ 03

Air Sealing Targets

PART I — AIR & VENTILATION

Air changes per hour at 50 Pascals (ACH50) is the standard metric for building envelope airtightness, measured via blower door test per ASTM E779 or ANSI/RESNET/ICC 380. The Restrepo standard is 2.0 ACH50 or better on every new construction project — a meaningful step beyond the 2021 IRC code minimum of 3.0 ACH50 without requiring the extraordinary craft discipline of Passive House. At 2.0 ACH50, mechanical ventilation is essential; no infiltration credit applies.

ACH50 BENCHMARK TABLE

Standard / Program	ACH50 Target	Authority
2021 IRC Section N1102.4.1.2	≤3.0	Code minimum — Climate Zones 1–8; NJ maximum per NJ UCC
ENERGY STAR v3.2	≤3.0	Energy Star Homes program national threshold
DOE Zero Energy Ready Home	1.5–3.0	Climate zone dependent
Restrepo Innovations Target	≤2.0	Standard specification — all Restrepo new construction
PHIUS 2021 Prescriptive Path	≤0.04 CFM50/sf envelope	Approx. 0.6 ACH50 equivalent for typical residential
Passive House Institute (PHI)	≤0.6	Per PHIUS airtightness documentation

FIELD RULE

Pre-drywall blower door test.

Perform an ASTM E779 diagnostic test after MEP rough-in, after spray foam application, and after WRB and window installation — but before drywall. A failed sealing point costs minutes to correct at pre-drywall and hours or days after. Record CFM50 and ACH50 using measured building volume. Final code-compliance test occurs after all finishes, fixture installation, and AV trim-out.

§ 04

Mechanical Ventilation Code

PART I — AIR & VENTILATION

The 2021 IRC, Section M1505, mandates whole-house mechanical ventilation for new construction. New Jersey adopted IRC 2021 via NJAC 5:23-3.21 with an operative date of September 6, 2022. ANSI/ASHRAE Standard 62.2-2019 establishes minimum dwelling-unit ventilation (DUV) rates based on floor area and occupant count and is the baseline referenced by current NJ code adoptions. ASHRAE 62.2-2025 raises minimum filtration from MERV 6 to MERV 11 and adds toilet room exhaust requirements; the Restrepo standard specifies MERV 13 on all ventilation equipment, satisfying both editions.

CODE STACK — VENTILATION

Reference	Scope
ASHRAE 62.2-2019 Section 4.1	Qtot formula: 0.15 x floor area (SF) + 3.5 x (bedrooms + 1); balanced ERV/HRV = full Qtot, no infiltration credit
ASHRAE 62.2-2025	MERV 11 minimum filtration for ventilation systems; toilet room exhaust added; optional IAQ Procedure path
IRC 2021 Section M1505	Whole-house mechanical ventilation — new construction mandate; NJ operative September 6, 2022
IRC 2021 Section M1601.4	Duct insulation R-6 minimum for all ERV/HRV runs in unconditioned space (attic, crawlspace, unheated garage)
Energy Star Indoor AirPlus v2	MERV 13 required for ventilation and ducted HVAC systems; available for homes permitted on/after August 1, 2024
NJ UCC (NJAC 5:23-3.21)	IRC 2021 adopted September 6, 2022; NEC 2020 enforced; verify current code edition at date of submittal

SPECIFICATION

MERV 13 filtration — Restrepo baseline.

Specify MERV 13 on all ventilation equipment. MERV 13 captures particles 1–3 microns at 50–75% efficiency — effective against fine particulate matter, most bacteria, and tobacco smoke-sized particles. This satisfies ASHRAE 62.2-2025 (MERV 11 minimum) and Energy Star Indoor AirPlus v2 Gold requirements. Zehnder offers HEPA upgrade kits for ComfoAir Q — verify unit fan curve can maintain design airflow at higher pressure drop before specifying HEPA.

BEST PRACTICE**CO2 demand-controlled ventilation.**

Configure ERV to boost to high speed when CO2 exceeds 1,000 ppm; return to continuous low speed at 800 ppm or below. Install Renewaire CO2-W wall-mount sensor or equivalent. Per ASHRAE CO2 position document, sensors must be located and configured to maintain the per-person ventilation rate in accordance with ASHRAE 62.2. CO2 data surfaces on Crestron/Lutron touchpanel as part of the IAQ monitoring interface.

PART 2

Foam & Insulation

Sections 05–07 — Spray Foam Chemistry, Pre-Foam Wiring, Vapor & Moisture Strategy

§ 05

Spray Foam Chemistry

PART II — FOAM & INSULATION

Spray polyurethane foam (SPF) is the dominant insulation strategy in Restrepo Innovations luxury construction for rim joists, cathedral roof assemblies, unvented attics, and wall cavities requiring maximum R-value per inch. Two chemistries are in use: closed-cell (ccSPF) and open-cell (ocSPF). The choice between them is a moisture, structural, and wiring coordination decision — not a budget decision alone.

CLOSED-CELL vs OPEN-CELL

Property	Closed-Cell (ccSPF)	Open-Cell (ocSPF)
R-value per inch	~R-6.5 to R-7.0	~R-3.6 to R-3.7
Nominal density	~2 lb/ft³ (medium density)	~0.5 lb/ft³
Vapor permeance at 1.5 in	<1 perm — Class II retarder	>10 perms — vapor-open
Air barrier	Yes, at 1 in minimum	Yes, at 3.5 in minimum
Structural contribution	Yes — improves racking strength	Minimal
Sound attenuation	Good	Better — preferred for theater walls
Post-foam wiring access	Rigid, very difficult to penetrate	Softer, still very difficult

APPROVED MANUFACTURERS

Manufacturer	Product Line	Type	Notes
Huntsman / Icynene-Lapolla	Foam-LOK FL2000-3G; FL-450; FL-750	ccSPF	ICC ESR-4501; do not apply inside electrical boxes
Huntsman / Demilec	Heatlok Soy 200 Plus; Agribalance	ccSPF / ocSPF	HFO-blown (low GWP); bio-based content
BASF	Walltite US; Walltite One Series	ccSPF	GREENGUARD Gold; HFO blown (GWP <2); mold resistant per ASTM C1338
SES Foam / Sucraseal	SES SucraSeal 0.5; SES 0.5	ocSPF	ICC-ES ESR-3375; ASTM E-84 Class 1; bio-based
Johns Manville	JM Corbond IV; Corbond IIIe; JM NMOC	ccSPF / ocSPF	Corbond IV: R-35 @ 5 in, HFO blown, GWP <2; re-entry 12 hr non-SPF / 24 hr occupants

SPECIFICATION**HFO-blown closed-cell — Restrepo preference.**

Fourth-generation HFO blowing agents (BASF Walltite One, JM Corbond IV) deliver global warming potential below 2 and substantially reduced residual off-gassing compared to HFC-blown products. Specify HFO-blown ccSPF where available from the foam contractor's product line. Confirm current ESR numbers and formulations at time of specification — manufacturer acquisitions have altered product lines.

FIELD RULE**Fire protection — IRC R316.**

IRC 2021 Section R316 requires all SPF to be separated from the building interior by an approved 15-minute thermal barrier. Standard compliance: 1/2-inch gypsum wallboard. Alternative: DC315 intumescent coating (ICC-ESR 3702, Warnock Hersey Intertek W/N-20947) — particularly useful for cathedral assemblies where drywall installation is difficult, and for attic knee walls requiring ignition barrier compliance. Attic and crawlspace exception: thermal barrier not required where space is maintenance-access only and prescriptive ignition barrier is installed.

DO NOT**Do not apply foam inside electrical or junction boxes.**

Icynene-Lapolla FL-450 and FL-750 installation instructions explicitly state: do not use inside electrical or junction boxes. This applies across all foam products. The foam contractor must mask all boxes before application. GC is responsible for including box masking in the foam contractor's scope of work.

§ 06

Pre-Foam Wiring

PART II — FOAM & INSULATION

The fundamental principle governing all envelope wiring at Restrepo Innovations: before foam, every conduit, pull string, box, and cable can be installed at normal trade cost. After foam, every addition is a surgical procedure at premium cost with unavoidable finish disruption. In a luxury home with \$80–150/SF finish carpentry and stone cladding, a single retroactive cable run through a foamed wall costs \$400–1,200 in direct labor plus repair, repainting, and re-finishing. The pre-foam window is the only window. It does not reopen.

ENT CONDUIT STANDARD (NEC ARTICLE 362)

ENT — Electrical Nonmetallic Tubing, per NEC 2023 Article 362 (formerly Article 331), listed per UL 1653 — is the Restrepo standard conduit for all pre-foam low-voltage work. ENT (commonly called smurf tube for its blue color) is lightweight, hand-bendable, corrugated PVC that bonds well with spray foam while maintaining cable pullability inside the conduit. 3/4 in ENT is the standard size; 1 in for multi-cable runs at TV and display locations. Both ends of every ENT run crossing the building envelope must be sealed with duct-seal compound — ENT is a potential air bypass pathway between conditioned and unconditioned space.

MINIMUM CONDUIT DEPLOYMENT PER LOCATION

Location Type	Conduit Requirement	Cable at Rough-In
TV / display wall	Two 1 in ENT to attic or basement chase	Cat6A (x2) + HDMI; pull string in spare conduit
Camera	One 3/4 in ENT to accessible chase	Cat6A; pull string
Shade pocket	One 3/4 in ENT per shade to chase	18/2 or mfg-r-specified motor wire; pull string
Keypad / control	One 3/4 in ENT to MDF chase	CresNet (Belden 9534 eq.) or Lutron QS link; pull string
Ceiling speaker	One 3/4 in ENT per speaker location	14 AWG CL3 two-conductor; 12–18 in service loop at box
Wireless access point	Two 3/4 in ENT to accessible chase	Cat6A solid-core (PoE); spare conduit with pull string
Exterior camera / intercom	One 3/4 in ENT per device to attic/MDF	Cat6A; pull string; seal at envelope transition

SPECIFICATION**Pull strings — every conduit, before foam.**

Install nylon pull string minimum 200 lb test, or Mule-Tape flat pull tape, through every conduit before foam day. Leave 12 in hanging from each end; tape end to conduit with short loop — enough tension to prevent retraction, free enough to pull. Label each string with its destination (e.g., 'To MDF — North wall TV'). After foam, pull strings are the only path to each conduit interior. A lost pull string renders the conduit functionally useless.

FIELD RULE**BX/MC cable — without written direction.**

Branch wiring uses NM-B (line voltage) and ENT conduit (low voltage) as the Restrepo standard for residential concealed spaces. Armored cable (BX/MC, NEC Article 334) is not used without written direction from the engineer of record or AHJ specifying it for the project. NEC Article 334.80 requires NM-B to use 60°C ampacity; bundled cables must be derated per NEC 310.15.

BEST PRACTICE**Box depth — set proud of stud face.**

Set all rough-in boxes proud of the stud face by the anticipated foam application thickness plus drywall thickness. A box set flush with the stud face ends up recessed behind the drywall plane after foam and drywall are installed. Consult the foam contractor at the pre-foam coordination meeting for exact anticipated foam depth at each wall location. Use adjustable-depth boxes wherever possible.

INSPECTION STANDARD**Pre-foam photo and video documentation.**

Before foam day: photograph every exterior wall cavity (from each stud bay end), every conduit run from start to finish, every box location (labeled in frame), and all pull strings installed and visible. Record a 4K continuous walkthrough video with narration identifying each room, wall, and conduit endpoint. Upload to project cloud folder the same day. Annotate floor plans in Bluebeam or Adobe Acrobat with conduit locations and pull string destinations.

§ 07

Vapor & Moisture Strategy

PART II — FOAM & INSULATION

New Jersey occupies IECC Climate Zone 4A — mixed-humid, with hot humid summers and cold winters. Traditional 6-mil polyethylene vapor barrier is not required and is generally not recommended in Zone 4A. The correct strategy pairs a smart vapor retarder on the interior (vapor-variable, low perm in winter, high perm in summer) with a vapor-open WRB on the exterior. An air barrier is far more important than a vapor retarder for moisture management: air-transported moisture moves 10–100 times more moisture per unit time than vapor diffusion alone.

VAPOR RETARDER CLASSES — ASHRAE 160 / IRC 2021 N1102.5

Class	Permeance	Examples	NJ Zone 4A Use
Class I (vapor barrier)	≤0.1 perm	6-mil polyethylene, aluminum foil	Not required; generally not recommended
Class II (vapor retarder)	>0.1 and ≤1.0 perm	Kraft-faced batts; CertainTeed MemBrain (variable); ProClima Intello	Preferred interior vapor control layer
Class III (vapor retarder)	>1.0 and ≤10 perms	Latex paint on drywall	Acceptable with adequate exterior insulation ratio
Vapor-open	>10 perms	Tyvek HomeWrap; Henry Blueskin VP100 (33 perms); Huber ZIP System (12 perms); open-cell foam	WRB layer; exterior face of assembly

WEATHER-RESISTANT BARRIER (WRB) PRODUCTS

Product	Type	Vapor Perm	Air Perm at 75 Pa	Notes
Huber ZIP System	Structural OSB + factory WRB	12 perms	<0.037 L/s·m ²	ICC-ES ESR-1473; tape seams with ZIP System Tape; eliminates separate housewrap
Henry Blueskin VP100	Self-adhered membrane	33 perms	0.004 cfm/ft ²	Self-seals around fasteners; >95% drainage efficiency per ASTM E2273; min install temp 20°F
Tyvek HomeWrap	Nonwoven polyethylene	Vapor permeable	Tape seams required	Standard residential; adequate for non-premium applications

ProClima Intello	Smart vapor retarder (interior)	Variable 0.17–13 perms	Air barrier at seams when taped	Tescon Vana tape at seams; interior air barrier + vapor control in one product
CertainTeed MemBrain	Smart vapor retarder (interior)	Variable class II/III	Not primary air barrier	MERV-rated; Class II in heating, Class III in cooling season

SPECIFICATION

Closed-cell foam at rim joist — vapor control built in.

Two inches of closed-cell SPF at the rim joist delivers R-14 and a Class II vapor retarder in a single application. This is the most efficient rim joist treatment available. Closed-cell vapor permeance is less than 1 perm at 1.5 in thickness — verified per ASTM E96. For Climate Zone 4A, this inward vapor control is appropriate where the insulation layer is entirely on the warm side of the assembly.

BEST PRACTICE

Rainscreen detailing — minimum 1/4 in drainage gap.

A rainscreen system creates a drainage cavity between exterior cladding and the WRB. Minimum effective gap: 1/4 in per Penn State PHRC research. Restrepo standard: 3/4 in vertical furring strips over WRB at each stud, creating a 3/4 in drainage/ventilation gap. For brick veneer: minimum 1-in air gap per IRC and ASTM C270/C90; WRB behind brick must be vapor-permeable for exterior drying. All conduit penetrations through WRB: flashed with 3M 8067 or SIGA Wigluv above and down both sides; sealed at conduit-to-fitting interface with OSI Quad.

NOTE

Smart vapor retarder — NJ climate rationale.

Products like CertainTeed MemBrain and ProClima Intello change permeance with relative humidity: low perm in winter (vapor retarder behavior) and high perm in summer (allows drying). This variable response is ideal for Zone 4A where the moisture drive direction reverses seasonally. Class I polyethylene on the interior would trap summer moisture in the assembly and is not appropriate for NJ mixed-humid climate.



PART 3

Glass & Penetrations

Sections 08–10 — Doors & Windows, Penetration Sealing, WRB & Sheathing

§ 08

Doors & Windows

PART III — GLASS & PENETRATIONS

High-performance glazing is among the most consequential envelope decisions in luxury residential construction. Window and door systems account for 25–35% of total building heat loss in a well-insulated home. In NJ Climate Zone 4A, Energy Star Version 7.0 requires U-Factor ≤ 0.25 for the North-Central climate zone. For Passive House-influenced luxury projects, the Restrepo target is U-Factor ≤ 0.20 overall unit, SHGC 0.30–0.40 on south-facing units (passive solar gain), and 0.20–0.25 on east/west/north to limit summer overheating.

HIGH-PERFORMANCE WINDOW PRODUCTS

Brand / Product	Construction	Best U-Factor (US)	Notes
Marvin Modern / Ultimate	Clad wood; triple-pane option	See NFRC by product	Multiple Low-E options; HeatLock coating on E4/SmartSun; full NFRC data per product at marvin.com/support/energy-data
Pella Architect / Reserve	Clad wood; triple-pane available	U-0.19 (350 series triple)	Designer Series dbl-hung: U-0.24, SHGC 0.24; Reserve = highest-performance line with wood interiors
Andersen E-Series	Clad wood; triple-pane available	See NFRC by product	Low-E4, Low-E4 Sun, SmartSun glass; HeatLock coating; impact-resistant glass option
Schuco AWS 75.SI+	Aluminum composite	~U-0.13 (from EU Uw ~0.75)	Triple-glazed; >130mm thermal break; Passive House applicable; convert EU: $U(US) = U(SI) \times 0.1761$
Internorm (wood/alu)	Wood/aluminum composite	~U-0.12 (from EU Uw ~0.71)	Passivhaus-certified Uw values as low as 0.71 W/m ² K; luxury European tilt-turn operation

DOOR AIR SEALING — THREE SEAL POINTS

High-performance exterior doors require positive sealing at: (1) perimeter gasket — compression gasket at door stop and jamb; foam-in-place or compression weatherstrip in the door frame rebate; check visible deflection when door is latched; (2) automatic bottom sweep — Zero International or National Guard Products adjustable automatic sweep preferred over static sweep; automatic versions retract when door opens, deploy when door closes, eliminating floor wear; (3) threshold — raised threshold with compression seal at correct height relative to finished floor material. Garage-to-conditioned-space doors must be air-sealed equivalent to any exterior door and meet NJUCC R302.5 fire-rated assembly requirements. Air sealing at garage doors reduces CO infiltration — a critical life-safety requirement.

SPECIFICATION**Four-sided window flashing protocol.**

1. Sill pan: sloped self-adhered membrane (3M 8067, Henry Blueskin VP100) at rough opening sill before window is set; 5% minimum outward slope; end dams on both jambs. 2. Jamb tape: SIGA Fentrim at both jambs after window is shimmed, overlapping sill pan at bottom. 3. Head flashing: aluminum or galvanized metal head flashing over window head nailing flange, sloped outward, minimum 1/2 in drip edge projection; end dams on each side. 4. Tape to WRB: SIGA Wigluv or 3M 8067 at all window-to-WRB transitions. WRB always lapped shingle-style — upper layer over lower.

INSPECTION STANDARD**Window installation verify.**

Confirm: sill pan installed and sloped; jamb tapes lapped over sill pan; head flashing mechanically fastened with end dams; all tapes adhered without bridging or fishmouths; low-expanding foam (not standard expanding) at frame perimeter; exterior sealant (OSI Quad or equivalent) at all frame-to-cladding interfaces; all installation photographed before WRB is covered by cladding.

BEST PRACTICE**European tilt-turn — luxury performance standard.**

For projects targeting $U \leq 0.20$ and Passive House-level envelope performance, European tilt-turn systems from Schuco (AWS 75.SI+) and Internorm represent the highest available performance in aluminum and wood/aluminum composite construction. Specify early — European window lead times in the NJ market commonly run 16–24 weeks from order to delivery. Confirm US NFRC testing or EU-to-US U-value conversion with the manufacturer's technical representative.

§ 09

Penetration Sealing

PART III — GLASS & PENETRATIONS

Every penetration through the building envelope — walls, ceiling, floor — is a potential air leakage and moisture infiltration pathway. At the Restrepo standard of ≤ 2.0 ACH50, penetrations must be sealed with field-verified materials appropriate to the assembly type, fire rating, and location in the drainage plane. The AV and low-voltage trades create the largest number of penetrations per square foot of any MEP trade. Every ENT conduit that crosses from conditioned space to unconditioned space is an air bypass pathway until proven otherwise.

PENETRATION SEALING BY TRADE

Trade / Penetration	Standard Sealant	Fire-Rated Assembly
Plumbing — small gaps	Low-expanding foam (minimal-expanding at frames)	3M CP25WB+ or Hilti CP 627 intumescent caulk + collar
Electrical conduit at exterior wall	Duct-seal compound interior; OSI Quad or foam exterior	Listed intumescent foam: 3M Fire Barrier FS-200+, Hilti CP 620
Service entrance conduit	Non-hardening clay or duct-seal at cable-to-conduit interface	Maintain required assembly fire rating at penetration
HVAC duct at air barrier	Duct mastic or aluminum tape at duct-to-framing; low-expanding foam at gap	Intumescent collar/sleeve where rated assembly is penetrated
AV/LV conduit (ENT) at attic/basement	Duct-seal compound packed at transition — both sides; do not over-pack	Intumescent foam at fire-rated floor/ceiling assembly penetrations
Refrigerant line set	Insulated sleeve through penetration; foam-seal at wall plane both sides	Verify clearance from heat-producing equipment per mfgr spec

ENT CONDUIT AIR SEALING AT ENVELOPE TRANSITIONS

Every ENT or rigid conduit transitioning from conditioned space to attic, crawlspace, or unheated garage: apply Gardner Bender DS-080 or Ideal Industries #31-388 duct-seal compound into the conduit interior at the transition point, filling the annular space around cables present. Do not pack so tightly that future cable removal is prevented. Apply at both top and bottom of penetration where accessible. After sealing, apply a permanent label to the visible conduit end in the attic or basement: destination room, contents, installation date, and Restrepo project name.

FIELD RULE**Intumescent foam at fire-rated assemblies.**

Where AV conduit passes through a fire-rated assembly — garage-to-living space floor-ceiling, rated party wall, or any assembly with an assigned fire rating — use a listed intumescent foam or caulk: 3M Fire Barrier Foam FS-200+, Hilti CP 620, or equivalent. Maintain the required fire rating at the penetration per the assembly listing. Standard duct-seal compound does not qualify as a fire-stop in a rated assembly.

INSPECTION STANDARD**Penetration inspection at pre-foam gate.**

Before foam day: verify all AV ENT conduit penetrations through exterior walls and floors are identified and accessible; confirm conduit sleeves are non-corrosive and all WRB penetrations are flashed with 3M 8067 or SIGA Wigluv above and down both sides; verify foam contractor scope explicitly excludes foaming into electrical boxes or over heat-producing equipment; photograph all penetrations before foam application begins.

§ 10

WRB & Sheathing

PART III — GLASS & PENETRATIONS

The weather-resistant barrier (WRB) is the outermost continuous water control layer of the building envelope. It must be vapor-permeable (allowing inward drying from the cladding), air-barrier-continuous when joints are taped, and integrated with window, door, and penetration flashing to maintain a continuous drainage plane. In Restrepo construction, the WRB selection is made before framing is complete — it determines the flashing tape system, the penetration sleeve details, and the cladding attachment strategy.

WRB SELECTION MATRIX

Product	Best For	Seaming System	Cladding Attachment
Huber ZIP System	New construction where structural sheathing and WRB are combined in one product	ZIP System Tape (proprietary) — tested per ESR-2227	Direct to ZIP sheathing face; furring for rainscreen
Henry Blueskin VP100	Premium self-adhered application over ZIP or OSB; maximum air barrier continuity	Self-adhered laps; 3M 8067 or SIGA Wigluv at transitions	Furring over Blueskin for rainscreen drainage gap
Tyvek HomeWrap	Standard residential where self-adhered membrane not required	Tape seams for air barrier continuity; staple or cap-nail	Direct or over furring strips
ProClima Intello (interior)	Interior air barrier + smart vapor retarder in one product; paired with exterior-only WRB	Tescon Vana tape at all seams; lapped and taped at wall-ceiling intersection	Interior finish over Intello + service cavity framing

SPECIFICATION

ZIP System — Restrepo standard for new construction.

ZIP System wall sheathing combines structural OSB (7/16 in, PS 2 Span Rating 24/16, ICC-ES ESR-1473) with a factory-bonded WRB overlay rated at 12 perms (vapor-open). Air barrier assembly: <0.037 L/s·m² infiltration at 75 Pa (ASTM E2357). Seal all seams, joints, and penetrations with ZIP System Tape (ESR-2227). This is the fastest path to a continuous air barrier at rough framing and is compatible with all subsequent WRB products applied over it.

BEST PRACTICE**Blueskin VP100 over ZIP — belt and suspenders.**

For projects targeting ≤ 1.5 ACH50 or Energy Star Indoor AirPlus Gold, consider Henry Blueskin VP100 over ZIP System sheathing. Blueskin provides a secondary self-adhered air/water barrier layer, self-seals around fasteners, and achieves 33 perms vapor-open performance — excellent drying potential for the assembly. Apply from bottom up; lap all seams 2 in minimum; flash window and door openings with Blueskin before window installation.

NOTE**Furring for rainscreen — always over WRB.**

Furring strips for rainscreen cladding attachment must be installed over the WRB surface, never through it without proper flashing. Vertical 3/4 in treated furring at each stud creates a 3/4 in continuous drainage and ventilation gap. Bottom of gap must be open with insect screen or coarse mesh to allow drainage and ventilation while excluding pests. Top of gap may be open or screened depending on cladding profile and designer preference.

PART 4

Discipline & Closeout

Sections 11–13 — Without Written Direction, Pre-Foam Checklist, QC · Commissioning · Closeout

§ 11

Without Written Direction

PART IV — DISCIPLINE & CLOSEOUT

This section catalogs the practices we do not perform on a Restrepo building envelope installation without written direction from the engineer of record, the architect of record, or the AHJ. None of these are universally wrong — many are common practice in other markets or under different project conditions. They simply require explicit, documented written direction in advance. Verbal direction does not satisfy this requirement.

FIELD RULE

BX/MC armored cable — without written direction.

Line-voltage branch wiring uses NM-B and low-voltage work uses ENT conduit as the Restrepo standard for residential concealed spaces. BX/MC armored cable (NEC Article 334/330) is not used without written direction from the engineer of record or AHJ specifying it for the specific project. Armored cable in tight wall cavities before foaming can prevent the foam contractor from fully filling the cavity.

FIELD RULE

Class I vapor barrier (6-mil poly) on interior — without written direction.

Traditional 6-mil polyethylene is not required in NJ Climate Zone 4A and is generally not recommended. Installing Class I vapor barrier on the interior warm side in a Zone 4A mixed-humid assembly can trap summer moisture driven inward from the exterior. Without written direction from the building scientist or engineer of record specifying a Class I interior vapor barrier for the specific assembly, do not install polyethylene on interior walls or ceilings.

FIELD RULE

Skipping pre-foam blower door test — without written direction.

The diagnostic pre-drywall blower door test is a Restrepo standard requirement on every new construction project. We do not substitute a final-only test. Without written direction from the project manager and owner waiving the pre-drywall diagnostic test, it is performed after MEP rough-in and foam but before drywall installation.



§ 12

Pre-Foam Checklist

PART IV — DISCIPLINE & CLOSEOUT

The pre-foam gate is the single most consequential quality control event in the Restrepo building envelope sequence. Drywall does not close and foam does not begin until every item on this checklist is verified, photographed, and signed by the project manager, AV lead, and electrical lead. The checklist is the document of record for the pre-foam coordination meeting.

PRE-FOAM COORDINATION MEETING — REQUIRED ATTENDEES

General contractor (project manager level), framing foreman, rough electrician foreman, plumber foreman, HVAC foreman, spray foam contractor (mandatory — must walk building and confirm all boxes masked and all conduit identified before application day), Restrepo Innovations AV project manager or site lead, and owner's representative (recommended).

PRE-FOAM GATE — ENVELOPE INFRASTRUCTURE

- ☐ **VERIFY** WRB installed continuously; all seams and laps taped per manufacturer requirement
- ☐ **VERIFY** All windows and exterior doors installed and four-side flashed; sill pan, jamb tape, head flashing, WRB tape complete
- ☐ **VERIFY** Rim joist and band joist spray foam scope confirmed; closed-cell foam location and depth documented
- ☐ **VERIFY** All exterior wall penetrations identified, sleeved, and flashed; drainage plane maintained at each penetration
- ☐ **VERIFY** All AV ENT conduit installed at every rough-in location per room-by-room deployment matrix
- ☐ **VERIFY** Pull strings installed in all ENT conduit; ends secured and labeled with destination and contents
- ☐ **VERIFY** All rough-in boxes set to correct proud depth; adjustable boxes confirmed for foam thickness
- ☐ **VERIFY** All boxes masked with cardboard, foam board, or purpose-made protectors — foam contractor notified
- ☐ **VERIFY** Pre-foam photo walkthrough complete: all wall cavities, conduit runs, boxes, pull strings documented
- ☐ **VERIFY** Pre-foam 4K video walkthrough recorded, narrated, and uploaded to project cloud folder
- ☐ **VERIFY** Blower door diagnostic test scheduled — to occur after foam, before drywall
- ☐ **VERIFY** Foam contractor re-entry timing confirmed: 12 hr MEP trades; 48 hr AV/low-voltage crews



INSPECTION STANDARD**Pre-foam gate — sign-off requirement.**

Drywall does not close and the foam contractor does not begin application until every item above is verified and the pre-foam gate sign-off form is signed by the GC project manager, electrical lead, and Restrepo AV lead. The signed form is filed in the project record. The pre-foam gate is not a suggestion.

SPECIFICATION**Spare hardware — 5% minimum delivered and labeled.**

Restrepo Innovations delivers a minimum 5% spare hardware supply with every project: spare ENT conduit fittings and boxes, spare coils of Cat6A, speaker wire, and control cable, spare pull tape and pull string rolls, and spare low-voltage rings and cover plates. All spare hardware is labeled with project name and date and delivered to the owner in a labeled bin stored in the mechanical room at project completion.

§ 13

QC · Commissioning · Closeout

PART IV — DISCIPLINE & CLOSEOUT

Commissioning is the bridge between an installed envelope system and a warranted, measured, owner-operated home. Every Vol 17 project passes through the same closeout sequence: verify, document, register, train, deliver. Nothing leaves Restrepo's hands until all closeout gates are closed. The envelope is poured once — the closeout record proves it was done correctly.

CLOSEOUT GATES — ENVELOPE

- ☐ **VERIFY** Final blower door test completed per ASTM E779 or ANSI/RESNET/ICC 380; result ≤ 2.0 ACH50; test report on file
- ☐ **VERIFY** ERV/HRV commissioned: airflow balanced at all supply and exhaust registers; CFM verified at unit and at registers
- ☐ **VERIFY** ERV/HRV controls confirmed: continuous low speed, boost mode, CO₂-DCV threshold tested and documented
- ☐ **VERIFY** All window and door air sealing verified by blower door test result and field inspection with fog machine
- ☐ **VERIFY** All conduit endpoints labeled; pull strings intact and accessible; documentation updated with as-built locations
- ☐ **VERIFY** WRB and flashing inspection photo set complete and filed in project record
- ☐ **VERIFY** All spare hardware ($\geq 5\%$ of installed) delivered to owner in labeled mechanical-room bin
- ☐ **VERIFY** AHJ final inspection sign-off on file: envelope, mechanical ventilation, electrical rough-in
- ☐ **VERIFY** Homeowner training: ERV operation, filter maintenance schedule, CO₂-DCV threshold, boost mode use
- ☐ **VERIFY** Commissioning report signed: Restrepo project manager, AV lead, mechanical lead, homeowner

INSPECTION STANDARD

Final QC gate — all ten items verified and signed.

All ten closeout items verified, documented, and signed before project handover. Blower door test result of ≤ 2.0 ACH50 is the non-negotiable performance threshold. If the final test result exceeds 2.0 ACH50, the project manager is notified before homeowner walkthrough, corrective action is taken, and the test is repeated. The result is delivered to the homeowner in writing with the commissioning report.

CLOSING

The envelope is poured once. Wire it like it cannot be opened. Every conduit was run, every pull string was installed, every box was set proud, and every penetration was sealed before the foam contractor arrived. The blower door result is in the record. The ERV is commissioned. The

windows are flashed. Vol 17 is the standard. Vol 17 is the discipline. Vol 17 is what we deliver.

Tight. Tested. Tagged.

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