

BEST-BUILD DECISIONS FOR AN RV - 8

The Contested Choices in an Aluminum Experimental Amateur-Built, Resolved

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*Research conducted by AI agents (Claude, Anthropic) under human direction.
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SECTION A — WHERE THE BUILD IS NOW (WINGS, RESUMING)

1.1 A.1 RESTART AUDIT (BEFORE ANY TOOL TOUCHES THE AIRPLANE)

Decision: Walk the existing work with an EAA Tech Counselor before resuming. Specifically: validate the spar work (both spars complete and stored), the left wing rib-to-spar joints (riveted in January 2019), the left rear spar riveting (January 2019), the top-skin match-drilling (March 2019), the right-wing rib clecoing (December 2018), and the known issue with the right rear spar W-707G. Run the Van's SB index against every part number installed.

Why: A long pause does not invalidate work, but it does invalidate the *recognition* skill that the builder relied on while doing the work. A counselor visit is the external recalibration that confirms what is good. Without it, every subsequent decision rests on a potentially-decayed self-assessment. Evidence: Community-Consensus (EAA TC program design).

1.2 A.2 RE-ONBOARDING PRACTICE PROTOCOL

Decision: Three weeks of deliberate practice on scrap before resuming airframe work, per the protocol in `skills-and-practice.md`. Specifically: rivet practice card (50 reps × 3 sessions, ≥90% pass rate on session 3), dimpling practice on flat and curved scrap, edge-prep practice with the logged pass-rate discipline. Then ailerons-and-flaps as the first new airframe work — small, replaceable, forgiving.

Why: The motor program decays slowly; the perceptual-recognition layer decays faster; the “good enough tired” tolerance decays fastest. Re-establish all three with structured practice before the airplane is the test case. Evidence: Practitioner-High (Bingelis, Wanttaja, Van's manual), aligned with the lab's deliberate-practice synthesis.

1.3 A.3 ORDER OF OPERATIONS FOR THE WINGS

Decision: Complete left wing first; address the right-rear-spar W-707G issue by ordering a replacement W-707A-R web bundled with the QuickBuild fuselage order to avoid standalone freight (~\$700-1000 saved). Build the right wing after the left is closed up. Do not jump to the fuselage prematurely; finish the wings as a coherent unit.

Why: The PI's own re-entry plan (in `wings-punch-list.md`) is correctly sequenced. The left wing has the most-developed work and offers a complete-it-and-move-on momentum win. Bundling the W-707A-R with the fuselage shipment is a freight-economy decision the PI already identified.

SECTION B — TOOLS AND SHOP INFRASTRUCTURE

2.1 B.1 TOOLS TO ACQUIRE BEFORE RESUMING

Decision: Inventory the existing shop physically before ordering. Likely missing or worn items in 2026:

1. **Verify the air compressor** is sized to the rivet gun + squeezer demand (30+ gallon, 5 HP, two-stage); add an inline desiccant air dryer (Motor Guard M-26 or similar) if planning primer work.
2. **3X rivet gun** (~\$200, Brown Aviation Tool or Cleaveland) — if not in the existing kit, acquire for AN470 spar-attach work.
3. **Daniels AFM8 D-sub crimper with the correct die** (~\$300) for the Garmin G3X wiring. This is the highest-priority avionics tool purchase. Buy or borrow from a Tech Counselor; do not improvise.
4. **Borescope** (Vividia Ablescope or DeWalt DCT411, \$100-300) and **differential compression tester** (ATS or equivalent, \$200-300) before first engine run. Both pay for themselves at the first cylinder inspection.
5. **Click torque wrench recertification** for any wrench not calibrated since 2019 (\$30-50 per wrench through Effective Engineering).
6. **Consumables resupply:** cleco springs, fresh stub-length drill bits in #40/#30/#21/#11 quantities, Scotch-Brite wheel stock, deburr cutters.

The full tool catalogue with vendors is in `tools - survey.md`. Evidence: Community-Consensus + Vendor-Acceptable.

2.2 B.2 VENDOR STRATEGY

Decision: Primary vendor: Cleaveland Aircraft Tool (the closest thing to a one-stop builder kit vendor since Avery's 2018 closure). Secondary: Brown Aviation Tool for rivet guns and dies, Aircraft Spruce for hardware and consumables, Yard Store for specialty items. McMaster-Carr for non-aviation hardware. **Avoid Harbor Freight on anything that touches the airplane** (compressors and basic hand tools are fine; rivet guns, torque wrenches, drill bits are not).

SECTION C — SURFACE TREATMENT AND PRIMING

3.1 C.1 PRIMER SYSTEM

Decision: Stewart Systems EkoPoxy (chromate-free epoxy primer) with EkoPrime as the secondary primer where the spec calls for prime-on-bare-aluminum. Apply with HVLP gun in the shop with cartridge respirator and adequate ventilation.

Why: 1. Muncie climate is moderate humidity, hangared airplane. The corrosion risk is real but not extreme — sufficient to require *some* primer in interior closeouts; not severe enough to require chromated chemistry. 2. Chromated primers (AKZO Nobel 463-12-8, Sherwin-Williams P60G2 originals) are under sustained EPA pressure since 2019. Hexavalent chromium is a confirmed carcinogen; supplied-air respirators are standard for spraying; the chemistry is increasingly restricted and increasingly hard to source. For a residential-garage shop with cartridge-respirator PPE, chromated is the wrong choice. 3. Stewart Systems is the consensus replacement in the 2024-2026 VAF threads on primer. EkoPoxy is the durable choice on bare aluminum where the part will see fuel or solvent contact; EkoPrime is friendlier for “prime as you build” small parts (effectively unlimited pot life, water cleanup). 4. Skip alodine unless the airplane’s intended environment changes. The conversion-coating step adds complexity and time for marginal corrosion benefit in a Midwest-hangar use case.

Evidence tag: Community-Consensus (VAF primer wars 2024-2026 converged here) + Vendor-Acceptable (Stewart Systems TDS) + Practitioner-High (Aviation Consumer, Mike Busch on primer choice 2018-onward).

Trade-off accepted: Stewart EkoPoxy is somewhat more expensive than rattlecan zinc-chromate alternatives and requires HVLP spray equipment. The PI’s shop accommodates this; the corrosion-protection result is durable.

SECTION D — WORKMANSHIP CHOICES APPLIED THROUGHOUT THE AIRFRAME

4.1 D.1 DIMPLING

Decision: Keep the DRDT-2 as the primary tool. Add a pneumatic squeezer with #30 and #40 dimple dies in 3" and longeron yokes for holes the DRDT-2 cannot reach; a tank-die set for the wing-tank skin closeouts; a pop-rivet dimple-die set for the inevitable retroactive dimples. Evidence: Community-Consensus on the DRDT-2 as the workhorse; Vendor-Acceptable on the supplementary dies.

4.2 D.2 RIVET METHOD STANDARDIZATION

Decision: **Pneumatic squeezer as default** wherever the yoke fits. **Back-rivet plate** for flat skin panels with full backside access. **Gun + bucking bar** for everywhere else, with 2X gun for AD3/AD4 and 3X for AD5 spar work. **AN426 flush where plans specify**; never substitute universal for flush. **Pulled rivets** (Avex preferred for visual consistency; Cherrymax for primary structure where blind is unavoidable) **only where plans specify**; never substitute pulled for solid in a structural joint.

Shop-head verification: every rivet gauged. The $1.5D \times 0.5D$ rule from AC 43.13-1B Chapter 4 is the acceptance standard. The cheat sheet has the numbers.

4.3 D.3 EDGE PREP

Decision: **Scotch-Brite wheel** (3M 7A medium) as the primary edge-finishing tool, set up at a dedicated bench within walking distance of the rivet station. **Vixen file** for heavy burr removal first pass. **Cleaveland 6" deburring wheel** for production speed on bulk work. **Swivel-blade Noga deburring tool** for hole edges. *Treat every cut edge — not just stressed edges — for both fatigue prevention and workmanship.* Evidence: Practitioner-High (Van's plans + Bingelis + AC 43.13-1B Chapter 4).

4.4 D.4 MATCH-DRILL PHILOSOPHY

Decision: **Follow Van's plans verbatim.** Match-drill in pairs to final size; disassemble per the plans; deburr every hole on both sides; dimple where called out; reassemble; rivet. Use the **pilot-first workflow** (#40 pilot → deburr → enlarge to #30) on structural parts — the cleaner hole costs only a few seconds per hole and yields better fatigue performance.

Why: The "drill once and never touch" school saves time but produces visible burr-trapped joints that fatigue-crack at edges. The cleco-everything school saves disassembly cycles but produces interlocked debris and worse hole quality. Van's plans are calibrated to the deburr-between-passes workflow.

SECTION E — SLOWBUILD VS. QUICKBUILD DECISION

Decision: Order the QuickBuild fuselage. Keep slowbuild empennage (done) and wings (in progress). Do not order a QuickBuild finish kit (the finish-kit work is itself the learning that matters).

Why: 1. The 2019 pause already cost the PI ~7 years of build calendar. He does not need an additional ~700 hours of fuselage work to validate the build's regulatory 51% threshold — the wing work, the empennage, the FWF, the avionics, the canopy, and the finishing collectively far exceed the Major Portion test. 2. The QuickBuild fuselage gives **clean reference work** for the right-side wing-attach geometry — a structural integration point where the PI's own work would otherwise have to be perfect on a single attempt. 3. The QB premium over slowbuild was roughly \$7-9K pre-Chapter-11 and is now ~\$11-14K (Van's 2025 pricing). Even at the high end, this is small relative to the calendar-time and quality-confidence win for a single-builder project resuming after a long pause. 4. **Inspect the QB fuselage carefully on arrival** for any laser-cut content; require punched parts. Document the inspection.

Evidence tag: Community-Consensus + Vendor-Acceptable.

SECTION F — POWERPLANT

6.1 F.1 ENGINE MODEL

Decision: Lycoming IO-360-M1B (parallel-valve, 180 hp, fuel-injected), factory new from Lycoming.

Why: 1. **The 180-hp IO-360 RV-8 is the well-trod path.** Performance hits Van's published numbers. Weight balance is right. The community knowledge base is the deepest. 2. **Factory new vs. mid-time core:** The PI is restarting after a long pause; the engine is the highest single cost item and the least-forgiving on assembly errors. Factory new buys the modern warranty, the modern documentation, and the absence of unknown history. The cost delta over a mid-time exchange (~\$10-15K) is real but small relative to total project cost. 3. **180 hp parallel-valve vs. 200 hp angle-valve:** The 200 hp IO-360 angle valve is now common enough in the fleet that Van's old "not recommended" caveat is essentially historical. But the parallel-valve 180 hp is *still* the well-trod default; the parts inventory is deeper; the baffling is simpler; the resale market is broader. For a returning builder building once and flying for life, the well-trod path beats the marginal-performance path.

Evidence tag: Community-Consensus + Vendor-Acceptable (Van's certification envelope) + Practitioner-High (Mike Busch on engine choice).

6.2 F.2 IGNITION

Decision: One factory Slick magneto (impulse-coupled, on the start side) + one SureFly SIM4P.

Why: 1. **Factory mag preserves a fully self-powered ignition source** through any electrical failure. 2. **SureFly has matured** post-2022 production (the early reliability concerns of 2018-2020 are largely resolved); the 2023 FAA STC for certified applications is a credible third-party reliability signal even though it does not legally apply to the experimental. 3. **SureFly enables LOP** by providing variable timing advance, which is the operational reason a builder gives up the second mag. 4. **Versus Lightspeed Plasma III:** Lightspeed remains a strong product but SureFly's installation is simpler, the form factor is a drop-in mag replacement, and the practitioner community in 2026 has shifted preference to SureFly for new builds. 5. **Versus dual SureFly:** Cost-effective in theory but gives up the magneto independence. Stay with one mag for the certainty.

Evidence tag: Community-Consensus + Vendor-Acceptable.

6.3 F.3 FUEL SYSTEM

Decision: Bendix RSA-5AD1 mechanical fuel injection with balanced GAMI injectors.

Why: 1. **IFR plan-of-record needs LOP capability** for fuel economy and reach on cross-country IFR. LOP requires balanced injectors. GAMIjector matched-spread injectors are the canonical solution. 2. **Mechanical FI over carb:** Eliminates carb-ice risk, supports LOP, gives smoother high-altitude performance. The hot-start procedure is more complex but documented and learnable. 3. **Mechanical over electronic (SDS EFI):** The SDS EFI system is a credible product but adds dual

electrical dependence on a one-airplane project. Mechanical FI with the engine-driven pump is fully self-powered. For an IFR airplane the electrical-independence argument is decisive.

Evidence tag: Practitioner-High + Community-Consensus.

6.4 F.4 PROPELLER

Decision: Hartzell BA-series scimitar two-blade metal constant-speed, model HC-C2YR-1BF/F7666A.

Why: 1. IFR plan-of-record favors constant-speed for the climb-vs-cruise pitch optimization and for the speed/altitude flexibility IFR demands. 2. **Hartzell BA over MT three-blade composite:** Hartzell is the well-trod RV-8 choice; the scimitar profile is the modern Hartzell BA variant with reduced tip noise. MT is excellent but heavier and harder to source/service. Whirlwind 200RV is composite and lighter but with shorter overhaul intervals. 3. **Versus fixed-pitch (Catto, Sensenich):** Lower cost and weight, but loses the IFR flexibility argument. Fixed-pitch is the right call for VFR-only fun-flyer RV-8s, not for IFR.

Evidence tag: Community-Consensus + Vendor-Acceptable.

6.5 F.5 EXHAUST

Decision: Vetterman crossover exhaust (the four-into-one with crossover, post-Larry-Vetterman-era successor or current Vetterman builder).

Why: The Vetterman crossover is the modern RV cooling-and-power gold standard. Substantial fleet history. Cited by Dan Horton's baffle and cooling work as the reference exhaust. Evidence tag: Community-Consensus.

SECTION G — ELECTRICAL AND AVIONICS

7.1 G.1 ELECTRICAL ARCHITECTURE

Decision: Nuckolls Z-13/8. Single 60-amp main alternator + 8-amp B&C SD-8 auxiliary alternator on the vacuum pump pad; single PC680 or Concorde RG-25XC primary battery. Standard avionics master switch arrangement.

Why: Z-13/8 is the canonical single-alternator architecture with standby for IFR. Supports the G3X load. Survives main alternator failure with adequate reserve. Nuckolls Edition 12 supports this layout directly.

Evidence tag: Practitioner-High (AeroElectric Connection 12th ed).

7.2 G.2 AVIONICS STACK

Decision: - **Garmin G3X Touch** (committed): primary EFIS + EMS via integrated EIS. - **Garmin GSA-28 servos** (committed): two-axis autopilot. - **Garmin GTN 650Xi**: WAAS GPS/Nav/Comm (the IFR-required navigator); the 750Xi is overkill for the panel size. - **Garmin GTX 345**: transponder with ADS-B In/Out (1090ES) and Bluetooth. - **Garmin GMA 245**: audio panel with Bluetooth and integrated marker beacon. - **Garmin G5 backup**: standalone backup attitude/altitude/heading on its own battery.

Why: 1. **Single-vendor Garmin stack** simplifies installation (one set of wiring conventions, one tech support number, integrated functions). The G3X Touch is the committed EFIS; the supporting items chosen for Garmin-native integration. 2. **GTN 650Xi as the WAAS navigator**: the required IFR navigator. The GNX 375 alternative is GPS-only and lacks Nav/Comm; the panel needs the integrated solution. 3. **G5 backup vs. uAvionix AV-30 or Dynon D10**: the G5 integrates with Garmin's annunciation and configuration tools; for a single-vendor stack it is the matched choice.

Evidence tag: Vendor-Acceptable (Garmin installation manuals) + Community-Consensus.

7.3 G.3 BATTERY AND MAIN ALTERNATOR

Decision: Concorde RG-25XC sealed lead-acid as primary battery. B&C BC410 60-amp main alternator. Skyway Tek (or successor) regulator. *Skip LiFePO4 for v1* — the chemistry is excellent but the BMS integration with the Nuckolls architecture and the Garmin charging-system supervision still has open questions in 2026; upgrade to LiFePO4 at first battery replacement (~5-7 years).

Evidence tag: Practitioner-High (AeroElectric) + Vendor-Acceptable.

SECTION H — INTERIOR, PAINT, AND FINISHING

8.1 H.1 PAINT TIMING

Decision: Paint after Phase I. Fly the airplane in primer or in spray-can rattlecan exterior for Phase I; then strip down and paint as the post-Phase-I finishing project.

Why: Paint-during-build invites scuffs, rework, and rivet-line damage during final assembly. Paint-after-Phase-I lets the engine run, any leaks reveal themselves, any baffle adjustments happen, and any FWF rework happens before the cosmetic finish goes on. The Phase I airplane does not need to be pretty.

8.2 H.2 PAINT CHEMISTRY

Decision: Single-stage urethane (PPG Concept DCC) or Stewart EkoPoly waterborne. Professionally applied at a Muncie-area auto-body shop is acceptable for the PI; DIY in the shop with HVLP and proper PPE is also acceptable for the PI's skill level. The single-stage urethane is more forgiving than the base/clear systems for a one-airplane builder.

8.3 H.3 INTERIOR

Decision: Classic Aero Designs interior kit. Ordered late in the build (post-Phase-I or close to it). Mid-tier (not the bare-bones, not the premium). Versus Aerosport / Abby's / Flightline: Classic Aero has the broadest RV-8 product line, the most reliable lead times, and the consensus practitioner endorsement on VAF.

Evidence tag: Community-Consensus.

SECTION I — REGULATORY AND PHASE I

9.1 I.1 THE REPAIRMAN CERTIFICATE

Decision: Apply for the Experimental Amateur-Built Repairman Certificate at the moment of Phase I sign-off (FAR 65.104 procedure). This is essentially free, requires the FSDO interview, and confers permanent authority for the Condition Inspection on this specific airplane. *Do not skip.* This is the high-yield near-term win identified in `research-streams/ap-pathway.md`.

9.2 I.2 PHASE I FLIGHT TEST PLAN

Decision: Use the EAA task-based Phase I program. Seventeen defined tasks, exit on completion rather than calendar-hours. Use a Flight Advisor (EAA chapter 226 or 67) for the ground-based co-pilot role on first flight and early sorties. AC 90-89B is the procedural reference; the EAA Flight Test Manual is the practical reference.

9.3 I.3 INITIAL OPERATING LIMITATIONS

Decision: Follow the FAA-issued limitations from the DAR; do not request expansion until Phase I is complete. The standard Phase I area (typically a 50-mile radius from the home airport) is appropriate for Muncie (KMIE).

SECTION J — WHEN SOMETHING GETS CONTESTED AGAIN

For each decision above the recommendation is calibrated to the PI's specific situation. The decisions should not be revisited without one of these triggers:

- **New evidence** (Van's issues a service bulletin, a primer is discontinued, a new STC changes the landscape).
- **Specific malfunction** in a system that requires the decision to be reconsidered.
- **Tech Counselor visit identifies a concern** specific to the airplane.

Other "let me reconsider the primer choice in light of this VAF thread I just read" updates are noise. Re-litigating settled decisions is one of the failure modes that delays builds for years. The discipline is to make the decision once, document the reasoning here, and move forward.

WHAT IS NOT IN THIS DOCUMENT

- **Paint scheme.** Aesthetics; deferred to the PI's preference closer to Phase II. - **N-number reservation.** Should already be done; if not, do it before any further regulatory work. - **Insurance.** Liability + hull coverage from a kit-aircraft specialist (Aircraft Specialty Insurance, Aviation Insurance Resources). Quote in the year before Phase I. - **Avionics software configuration.** A Phase I + Phase II refinement; document settings as you tune.

The principle that runs through this document: **decide once, build to the decision, revisit only on real new evidence.** The contested-choices research stream is the audit trail; this document is the bottom-of-the-page answer.