Appendix A — Blank Master Worksheets

These are your blank copies. Photocopy the pages, or write in pencil so you can change a number as your plan firms up. Fill the load list first, then walk the seven steps in order—each one hands the next the number it needs. Four of the numbers have their own small boxes, because they take a few inputs of their own. When all seven are filled, run the self-check to confirm they agree before you buy anything.

Work these pages together with the quick tables in Appendix B, which hold the ampacity, voltage-drop, and fuse figures the wire step needs. Where a step names a factor—0.9, 0.75, 1.25—the chapter it points to explains why it is there.

Worksheet 1 — Your Load List (Step 1)

List every device the system will run. For each, multiply its watts by the hours it runs in a day to get its daily watt-hours. Add the inverter's own idle draw for every hour it stays on. The total is your daily energy need. The extra column feeds the surge check in Box A—fill in the starting watts only for motors and compressors that start hard.

Device	Running watts	Hours per day	Watt-hours per day	Starting watts (if it starts hard)
Inverter idle	idle watts	hours on		—
Daily total			**_______ Wh/day**	

Worksheet 2 — Your Seven Numbers

Carry your daily total down from Worksheet 1, then work each step in order. The middle column gives the formula; write your result in the last column.

Step	How to find it	Your number
1 — Load	The daily total from Worksheet 1	_______ Wh/day
2 — Sun & autonomy	Your site's design peak sun hours; the days of backup you want	_______ hours / _______ days

Step	How to find it	Your number
3 — Voltage	12, 24, or 48 V—from the decision tree in Chapter 6	_______ V
4 — Battery	Wh/day × days ÷ 0.9 ÷ *usable-depth factor* ÷ system volts = nominal amp-hours; round up to a real bank	_______ Ah → _______ Ah bank
5 — Inverter	Continuous and surge watts from Box A	_______ W cont. / _______ W surge for _______ s
6 — Array	Wh/day ÷ design sun hours ÷ 0.75 = array watts	_______ W
6 — Controller	Output amps ≥ array watts ÷ system volts, plus ~20%; input voltage clears the cold Voc from Box B	_______ A / input ≥ _______ V
7 — Main fuse	Main current from Box C; fuse ≥ main current × 1.25	_______ A fuse
7 — Cable	Wire size from Box D	_______ AWG

Usable-depth factor (Step 4): use **0.8 for LiFePO4**, or **0.5 for AGM/lead**, unless the battery's manual states otherwise. It is the share of the bank you plan to draw before recharging.

Box A — Surge Check (Step 5)

The inverter must carry your heaviest running load without pause, and the brief peak when a motor starts. Size both (Chapter 8).

- Heaviest total that runs at once (add the running watts of everything on together): _______ W
- The largest hard-starting motor's starting watts (from Worksheet 1): _______ W
- **Peak** = the other running loads already on + that motor's total starting watts = _______ W
- If the label gives only the *increase* at startup, add that increase to *all* your running watts instead.
- How long the peak lasts (seconds): _______ s
- **Continuous target** = heaviest total that runs at once × 1.20 = _______ W
- **Inverter continuous rating** = a real size at least that target: _______ W
- **Inverter surge rating** ≥ the peak, for at least that many seconds: _______ W
- Confirm the bank and its BMS allow both currents at the bank's lowest working voltage.

Box B — Cold-Voltage Check (Step 6 controller)

A string's open-circuit voltage rises as it gets colder. The controller's maximum input voltage must clear the coldest-morning value, or the controller can be destroyed.

- Panel Voc at standard conditions (from the datasheet): _______ V
- Panels in series in one string: _______
- Voc temperature coefficient, as a positive decimal (0.30%/°C is 0.003): _______
- Coldest local temperature, in °C (from °F: (°F – 32) × 5 ÷ 9): _______ °C
- **Cold string Voc** = panel Voc × panels in series × [1 + coefficient × (25 – coldest °C)] = _______ V
- Controller maximum PV input voltage (from its manual): _______ V
- **Check:** the cold string Voc must be *less than* the controller's maximum input voltage.

Box C — Main-Current Check (Step 7)

The battery-to-bus feeder carries current both ways. Size it for the larger of discharge and charge, not the inverter alone.

- Discharge current = inverter continuous watts ÷ (bank's lowest volts × 0.9) + any simultaneous DC-load amps = _______ A
- Charge current = the sum of every charge source's maximum output amps that can run at once = _______ A
- **Main (feeder) current** = the larger of the two = _______ A
- **Main fuse** ≥ main current × 1.25 = _______ A, then rounded to a real fuse size: _______ A
- **Confirm:** the component's manual prevails; the fuse is DC-rated with an interrupt rating above the bank's short-circuit current.

Box D — Wire Check (Step 7)

Pick a cable, then prove it two ways: it must carry the current safely, and it must not lose too much voltage over its length. Use the tables in Appendix B.

- The current this cable carries (from Box C for the main, or the branch's own current): _______ A
- Cable size you are testing: _______ AWG
- Its ampacity from Appendix B, then derated for your temperature and bundling: _______ A
- **Ampacity check:** the derated ampacity must be at least the fuse rating (Box C). The fuse must not exceed it.
- One-way run length: _______ feet
- **Voltage drop** = (2 × one-way feet × amps × ohms-per-1,000-ft ÷ 1,000) ÷ system volts × 100 = _______ % (the resistance and this formula are in Appendix B; use your continuous operating current)
- **Drop check:** keep it at or below about 3%—under about 2% on the main battery-to-inverter cable (Chapter 10). If it fails, use a larger cable and test again.

Before you buy: check the battery, inverter, and controller against all three manuals. For every fuse and cable, follow the Step 7 sequence, and confirm your actual run length, derating, voltage drop, and local code.

Worksheet 3 — Self-Check

Before you spend a dollar, run your seven numbers down this list. Each line is a quick check. If one fails, go back to the step it names and fix it there first—on paper, where it is cheap.

- [ ] **Daily need (Step 1).** The total is every device's watts × hours, plus the inverter's idle.
- [ ] **Battery (Step 4).** Nominal Ah = Wh/day × days ÷ 0.9 ÷ usable-depth factor ÷ system volts, rounded up to a real bank. The factor matches your chemistry (0.8 $LiFePO_4$, 0.5 AGM/lead).
- [ ] **Inverter (Step 5).** Continuous rating ≥ your heaviest simultaneous running total × 1.20, rounded to a real size. The surge rating clears the starting peak, for as long as it lasts (Box A). The bank and BMS allow both.
- [ ] **Array (Step 6).** Watts = Wh/day ÷ design sun hours ÷ 0.75.
- [ ] **Controller (Step 6).** Output amps ≥ array watts ÷ system volts, plus about 20%. Its maximum input voltage is above the cold string Voc from Box B.
- [ ] **Main current (Step 7).** The larger of discharge and charge (Box C). The main fuse is at least that × 1.25, rounded to a real size.
- [ ] **Wire (Step 7).** The cable's derated ampacity clears the fuse, and its voltage drop is at or below about 3%—under about 2% for the main battery-to-inverter cable (Box D).

If every line checks, your seven numbers agree, and you are ready to shop with the blueprint for the build closest to yours.