Practical Sealing Techniques

This page consolidates the step-by-step procedures for assembling and commissioning a sealed outdoor enclosure, along with a maintenance checklist to keep your nodes running reliably year after year.

Step-by-Step Enclosure Assembly

Step 1: Dry-Fit All Components Before Final Assembly

Before you drill a single hole or apply any sealant, place all components inside the enclosure in their intended positions. Verify:

- The board, battery, and any ancillary modules fit without forcing
- Cable routing is achievable without sharp bends or kinks
- The lid closes fully with all components in place
- Cable gland positions are accessible and do not interfere with internal components
- The antenna connector exit point makes sense for the intended antenna direction

Adjusting the layout at this stage costs nothing. Adjusting it after drilling and gland installation costs time and may require a new enclosure.

Step 2: Clean All Sealing Surfaces with Isopropyl Alcohol

Before any gasket or sealant work, wipe down:

- The lid gasket track and the mating surface on the enclosure body
- The outer surface of the enclosure around each cable gland hole
- The gland body surfaces that will contact the enclosure wall

Use 90%+ isopropyl alcohol (IPA) on a lint-free cloth. Allow to dry for 2 - 3 minutes before proceeding. Oils from handling - even fingerprints - reduce adhesion and gasket compression. Never use acetone on polycarbonate; it crazes the surface. **Note:** IPA can promote stress cracking

on highly-stressed polycarbonate, so do not flood loaded/stressed areas with it - clean *around* (not into) loaded screw bosses. A heptane-based cleaner is a safer alternative for cleaning near stressed PC.

Step 3: Install Cable Glands Before Mounting Electronics

Install all cable glands into the enclosure walls before mounting the PCB or battery. This is much easier when the enclosure interior is clear:

1. Drill holes to the correct diameter for each gland thread (see Cable Glands page for sizes)
2. Use a step drill bit for polycarbonate - standard twist bits can crack PC on the exit side
3. Deburr the holes with a countersink bit or small file to remove any plastic burr that would prevent the gland body from seating flush
4. Apply 2 - 3 wraps of PTFE thread tape to each gland's male thread
5. Insert gland body from outside and thread the locknut from inside: hand-tight + 1/4 turn
6. Leave the cable compression nuts backed off - you will tighten them after routing cables

Step 4: Use Thread Sealant or PTFE Tape on Threaded Entries

Use one consistent gland-sealing procedure (the same one referenced across all the build pages): **PTFE (polytetrafluoroethylene) thread tape on the thread**, a **neutral-cure RTV bead at the gland-to-wall interface**, and a drop of **medium-strength thread-locker** on the locknut to prevent vibration back-off. PTFE tape is chemically inert, resists all weather conditions, and - unlike RTV silicone on the thread - does not require cure time and can be disassembled and reassembled without re-application.

Apply PTFE tape by stretching it slightly as you wrap clockwise (viewed from the gland nose), so the tape tightens as the fitting is screwed in. Two to three wraps is standard for M12 - M20 gland threads.

Step 5: Inspect the Enclosure Gasket

Before mounting electronics, inspect the lid gasket carefully:

- **Cracks or cuts:** Any visible crack in the gasket requires replacement. Even a small crack allows water ingress under pressure.
- **Permanent compression set:** If the gasket has a flat, shiny surface where it previously contacted the lid (indicating it has been permanently compressed and is no longer

resilient), replace it. A gasket that does not spring back when the lid is removed cannot seal.
- **Missing sections:** Gaskets can slip out of their groove during shipping or storage. Verify the gasket is continuous and fully seated in its track.

Replacement gaskets for common enclosure brands are available from the manufacturer or as generic cord gasket (foam or EPDM rubber) sold by the meter - cut to length and join with RTV silicone at the splice.

Step 6: Mount Electronics on Standoffs

Mount the PCB and battery on plastic or nylon standoffs (M3 or M4 × 8 - 12 mm) that raise the board off the enclosure floor. Benefits:

- Air gap under the board allows any condensation that does form to drain away from solder joints
- Vibration isolation between the enclosure floor and the PCB
- Access to bottom-side components and connectors during servicing

Use insulating (nylon) standoffs rather than metal. Their purpose is to prevent unintended electrical connections between PCB nets and any conductive parts, and to avoid corrosion at metal-to-metal contacts. (In an all-plastic enclosure the walls are insulating, so the real benefit is avoiding accidental shorts and galvanic corrosion at fastener contacts, not "bridging" to the walls; in a metal enclosure, insulating standoffs also keep PCB grounds from tying to the chassis unintentionally.)

Step 7: Route Cables with Drip Loops

Before tightening cable gland compression nuts, route each cable so it forms a drip loop - the cable exits the enclosure, drops below the gland entry point by at least 10 cm, then rises to its destination. This ensures any water running down the cable exterior reaches the lowest point of the loop and drips off rather than continuing into the gland.

After routing, tighten each cable gland compression nut: hand-tight plus 1/4 turn. Test by tugging the cable firmly - it should not move through the gland.

Step 8: Add Desiccant and Membrane Vent

Place the desiccant packet(s) inside the enclosure at the lowest point, away from direct contact with the PCB or battery. If installing a membrane vent, it should already be installed in the enclosure wall (treat it like a cable gland - install it in Step 3). Verify the vent is positioned on a

vertical wall or underside, not on the top face where water can pool.

Step 9: Close and Torque Lid Screws to Specification

Tighten the lid screws in a cross-pattern (like tightening lug nuts on a wheel) to ensure even gasket compression. **For most builders without a torque driver, use the feel test:** the screw should be snug with the gasket *visibly compressed but not crushed* - stop as soon as the gasket seats; do not keep turning, or you will crack the boss. Defer to the enclosure manufacturer's published torque spec where one is available. The figures below are rough starting guidance, not a formal standard, and **assume the screw threads into a plastic boss** (not a metal-to-metal joint); reduce them further for small or fragile bosses. Full-torque values for stainless screws in metal are much higher and would split a plastic enclosure.

Screw size	Material	Starting torque (plastic boss / gasketed lid)
M3	Nylon or stainless	~0.3 - 0.4 Nm
M4	Nylon or stainless	~0.5 - 0.8 Nm
M5	Stainless	~1.0 - 1.5 Nm

If you do not have a torque driver, calibrate by feel: the screw should be snug with the gasket visibly compressed, but not so tight that the screw head is pulling into the plastic or the enclosure body is deflecting. Over-torquing a polycarbonate enclosure cracks it around the screw bosses.

Step 10: Label the Enclosure

Apply a permanent label (laser-printed on weather-resistant label stock, or engraved with a label maker using polyester tape) on the outside of the enclosure with:

- **Install date** (month and year)
- **Node name or ID** (as configured in firmware)
- **Contact information** (your callsign, email, or phone number)
- Optional: next scheduled maintenance date

This information is invaluable when someone else encounters your node, when you forget which node is which, or when first responders need to contact the network owner.

Annual Maintenance Checklist

Outdoor electronics require periodic maintenance to maintain weatherproofing integrity. Perform the following checks annually, or following any severe weather event:

Item	What to check	Action if degraded
Lid gasket	Visual inspection for cracks, cuts, compression set, and gaps in the gasket track	Replace the gasket; clean the gasket track before installing the new one
Desiccant	Color-indicating: check color. Non-indicating: replace on a fixed annual schedule	Replace or regenerate per procedure on the Condensation Management page
Cable gland tightness	Attempt to pull each cable through its gland by hand - cables must not move	Re-tighten compression nut; if nut is cracked, replace the entire gland
Cable jacket condition	Inspect the cable jacket at the gland entry point for abrasion, cracking, or UV degradation	Replace cable if jacket is compromised; re-seal gland entry
Antenna connector weatherproofing	Inspect self-amalgamating tape for peeling, cracking, or UV degradation	Remove old tape (it will tear off in strips), clean with IPA, reapply fresh tape
Enclosure mounting hardware	Check for rust on mounting screws; verify the enclosure has not shifted on its mount	Replace with stainless hardware; re-tighten mounting fasteners
Internal inspection	Look for moisture droplets, corrosion on PCB or battery terminals, loose connectors	Address moisture source (new gasket or gland); treat any corrosion with contact cleaner; re-seat connectors
Enclosure body	Inspect for UV yellowing, cracks, or impact damage	Minor UV yellowing is cosmetic only; cracks or physical damage require enclosure replacement

Quick Reference: Common Mistakes to Avoid

- **Do not** seal cable entries with silicone RTV alone - use proper cable glands
- **Do not** over-tighten cable gland compression nuts - hand-tight plus 1/4 turn is correct
- **Do not** use standard zinc-plated hardware for mounting outdoors - use stainless
- **Do not** install the enclosure with a cable entering from the top without a drip loop
- **Do not** use black enclosures in direct sun without a radiation shield
- **Do not** close an enclosure in high-humidity conditions without a desiccant inside
- **Do not** skip the annual gasket inspection - gaskets silently fail between visits

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