

# Antenna Mounting Best Practices

## Antenna Mounting Best Practices

Proper antenna mounting is the difference between a node that stays up through storms and one that fails or becomes a hazard. This page covers mechanical considerations, materials, and installation techniques for outdoor LoRa mesh antennas.

**SAFETY WARNING - read before raising any mast.** Aluminum and steel masts are electrical conductors, and contact with an overhead power line is frequently fatal. This is the leading cause of installer electrocution. Before raising any mast, confirm clearance of **at least the full mast length plus 10 ft (3 m) from every overhead power line** in the mast's entire fall radius - if the mast were to fall or swing in any direction, it must not be able to reach a line. Additionally: use fall protection for any work at height, keep people clear of the area below where a mast or antenna could fall, and never raise a mast alone. Tall or heavily loaded masts can swing unpredictably; have a second person steady the base.

## Mast Types

The mast is the structural element that holds the antenna at height. Selection depends on application, available mounting surface, and antenna weight and wind load.

Mast Type	Material	Typical Height	Best Use	Notes
J-mount / pipe mount	Galvanized steel or aluminum	0 - 0.6 m above mount point	Eave and fascia mounting; residential rooftops	Low cost; widely available; adequate for small omni antennas

Mast Type	Material	Typical Height	Best Use	Notes
Telescoping push-up mast	Aluminum sections	3 - 12 m	Temporary deployment; emergency comms	Conductive - keep clear of power lines (see safety warning above). Push-up masts generally need guying once extended past a few metres (manufacturers commonly specify guying from roughly 4 m up); not rated for permanent installation without guying. Follow the specific mast's manual.
Schedule 40 galvanized pipe	Hot-dip galvanized steel	As designed	Permanent rooftop or ground-mounted nodes	1.5" or 2" diameter accommodates most commercial antenna clamps; excellent durability
Aluminum angle/tube	6061-T6 aluminum	Variable	Lightweight permanent installations	Good where weight matters; do not use raw aluminum near dissimilar metals (galvanic corrosion)
Non-conductive fiberglass mast	Fiberglass-reinforced polymer	Variable	When RF transparency is required; stealth installations	Higher cost; consider when metal mast would detune the antenna

## Standoff Distance from Metal

Metal surfaces reflect and absorb RF energy at 915 MHz. Mounting an antenna too close to metal degrades performance, shifts resonant frequency, and distorts the radiation pattern. Pattern distortion does not vanish abruptly at any one distance - it decreases continuously as separation grows - so treat the figures below as a tiered rule of thumb (at 915 MHz,  $\lambda \approx 33$  cm):

- **Absolute minimum standoff from any metal surface:**  $\lambda/4 \approx 8$  cm. Below this, reactive near-field coupling to the metal significantly alters antenna behavior.
- **For little discernible pattern distortion:**  $\lambda/2 \approx 16$  cm or greater (a rule of thumb - distortion lessens gradually, it does not stop at exactly  $\lambda/2$ ).
- **Conservative target for high-performance fixed installs:** a full wavelength,  $\approx 33$  cm, where practical. This matches the "one wavelength from metal structures" rule given on the Base Station & Outdoor Antennas page.

- **For vertical collinear antennas mounted to a metal mast:** mount the antenna's feedpoint roughly one wavelength (about 33 cm at 915 MHz) above the top of the metal mast where practical, using a non-conductive standoff bracket or fiberglass spacer. Consult the antenna's installation manual for any mast-top clearance it specifies.
- **Metal roof surfaces:** mount the antenna well clear of the metal roof plane - on the order of a wavelength or more (roughly 0.3 - 0.6 m at 915 MHz) - to clear the roof's RF reflection zone.

Exception: if the metal IS the ground plane (e.g., a quarter-wave monopole mounted to a metal enclosure lid), close proximity is intended. A monopole needs a ground plane of at least about  $\lambda/4$  radius (~8 cm radius / ~16 cm diameter at 915 MHz); the 30 cm ( $\approx$  one wavelength) diameter recommended here is a conservative target. Ensure the metal surface is electrically bonded to the antenna's ground reference.

## J-Mount vs Direct Mount

The J-mount (also called a J-arm, chimney mount, or eave mount) is a bracket that attaches to an eave, chimney, or fence post and holds a vertical mast pipe. It is the standard residential antenna mounting solution. (Note: a "J-pole" is a type of *antenna* - an end-fed half-wave - not a mount. The bracket described here is a J-mount; don't confuse the two.)

- **J-mount advantages:** No roof penetration required; easy to install and remove; good for HOA-restricted or rental properties
- **J-mount disadvantages:** The mast end hangs below the mounting surface, limiting usable height gain; can deform in high winds if not sized correctly
- **Direct mount (U-bolt to mast):** Preferred for rooftop penetrations or wall-through installations where a base plate is attached directly to a structural surface. More permanent and secure but requires sealing any penetration against water intrusion.

## Pole Diameters and Clamp Compatibility

Commercial antenna base clamps are typically designed for specific pole outside diameters. The most common:

Nominal Pipe Size	Actual OD	Compatible Clamps
3/4" Schedule 40 pipe	26.7 mm (1.05")	Clamps rated for 1" - 1.25" poles
1" Schedule 40 pipe	33.4 mm (1.32")	Clamps rated for 1.25" - 1.5" poles
1.5" Schedule 40 pipe	48.3 mm (1.9")	Clamps rated for 1.5" - 2" poles; most commercial clamps
2" Schedule 40 pipe	60.3 mm (2.375")	Heavy-duty commercial clamps

Always verify clamp OD range before ordering. Antenna manufacturers typically specify the accepted pole diameter range in the product data sheet.

## UV-Rated Materials

At 915 MHz, antenna elements and enclosures are routinely exposed to direct sunlight for years. UV degradation is a real concern:

- **Antenna radomes:** Quality outdoor antennas use UV-stabilized fiberglass or ABS. Cheap antennas often use standard PVC or thin ABS that chalks and cracks within 2 - 3 years in direct sun.
- **Cable jacket:** Use UV-resistant (black polyethylene or LLDPE jacket) cable for any outdoor run. LMR-400 standard uses a black UV-resistant jacket. White or gray jacketed cables require conduit or UV protection coating if exposed.
- **Mounting hardware:** Use stainless steel (316 preferred for coastal; 304 acceptable inland) or hot-dip galvanized hardware. Zinc-plated (electroplated) hardware will rust within 2 - 5 years outdoors.
- **Cable ties:** Use UV-rated black nylon cable ties, not natural (white) ties which degrade in 6 - 18 months of sun exposure. Stainless steel cable ties are best for permanent high-UV installations.
- **Enclosures:** NEMA 4X (IP66) ABS or polycarbonate enclosures with UV stabilization are appropriate for electronics housing. Fiberglass NEMA 4X enclosures offer superior UV resistance for long-term outdoor use.

## Wind Load Considerations

Antenna wind loading is a frequently overlooked mechanical consideration. A 5 dBi fiberglass omni in a 60 mph wind generates more force than most people expect:

$$\text{Approximate wind load (lbs)} = 0.00256 \times V^2 \times A \times Cd$$

Where:

V = wind velocity (mph)

A = projected area (ft<sup>2</sup>) = diameter × length

Cd = drag coefficient (~1.2 for cylinders)

Example: 1" diameter × 3 ft antenna at 70 mph wind:

$$\text{Area} = (1/12) \times 3 = 0.25 \text{ ft}^2$$

$$\text{Load} = 0.00256 \times 70^2 \times 0.25 \times 1.2 \approx 3.8 \text{ lbs bending force}$$

Same method for a 5 dBi fiberglass omni (~1.25" × 4 ft, area ≈ 0.42 ft<sup>2</sup>) at 60 mph:

Load =  $0.00256 \times 60^2 \times 0.42 \times 1.2 \approx 4.6$  lbs - acting at the top of the mast.

These forces seem small but they act at the top of the mast, creating a significant bending moment (force  $\times$  height) at the mounting point - that moment, not the raw force, is what overloads a mount. This is a simplified flat-plate estimate: real structural design per ASCE 7 adds height (Kz), topographic (Kzt), and gust factors that can raise the effective load roughly 1.5 - 3 $\times$ , so tall masts see considerably more than this simple figure suggests.

To size a mast, compare the bending moment (force  $\times$  mounting height) against the mast and mount manufacturer's published moment or load rating, and apply a generous safety margin (a 3 $\times$  rule of thumb is a reasonable starting point, but it is not a substitute for the manufacturer's rating). For tall or multi-antenna installations, account for the cumulative load of every antenna on the mast, and have the design reviewed by someone with structural experience.

**Installer safety reminder:** rooftop and at-height work carries fall and dropped-object hazards independent of the structure's wind rating. Use fall protection, secure tools and hardware so nothing drops onto people below, keep the area beneath the work clear, and re-check the power-line clearance warning at the top of this page before raising anything.

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