Building Wire Antennas

Dan Rinaman- AC8NP

Ohio

Section Traffic Manager

ARRL The national association for AMATEUR RADIO

Radio Relay International

How to Design and Build Wire Antennas

A Step-by-Step Guide for Hams

Dan Rinaman AC8NP

Antenna Rigging for the Lonely Ham | GAD's Ramblings

What Are Wire Antennas?

- Simple antennas made from ordinary wire
- Most popular type for amateur radio (especially HF)
- Lightweight, cheap (< $50 to build), and surprisingly effective
- Can be hung from trees, poles, or rooftops

Why they work so well:

- Easy to design using basic math
- No fancy hardware needed
- Perform nearly as well as commercial antennas

ARRL The national association for AMATEUR RADIO

Radio Relay International

Why Choose Wire Antennas? Advantages

- Extremely low cost
- Quick to build (1–2 hours)
- Multi-band capable with a tuner
- Stealthy – blends into the environment
- Proven performance for DX and local contacts

Real-world benefit: Many hams make their first 100+ countries using nothing but wire!

ARRL The national association for AMATEUR RADIO

Radio Relay International

Basic Antenna Theory

Key concepts every ham should know:

- **Resonance** = antenna length matches ½ wavelength (or multiple)
- **Impedance** ≈ 50–75 Ω for good match to your radio
- **SWR** (Standing Wave Ratio) – goal is < 2:1
- **Radiation pattern** – dipoles are bidirectional

Formula for half-wave dipole length (feet):

$L = \frac{468}{f}$ where f =frequency in MHz

(Example: 20 m band = 14.2 MHz → ≈ 33 feet total)

ARRL The national association for AMATEUR RADIO

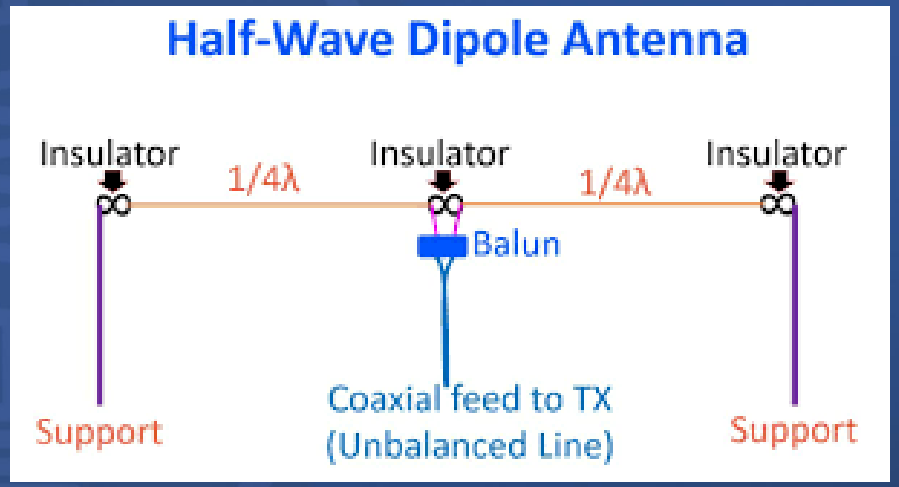
Radio Relay International

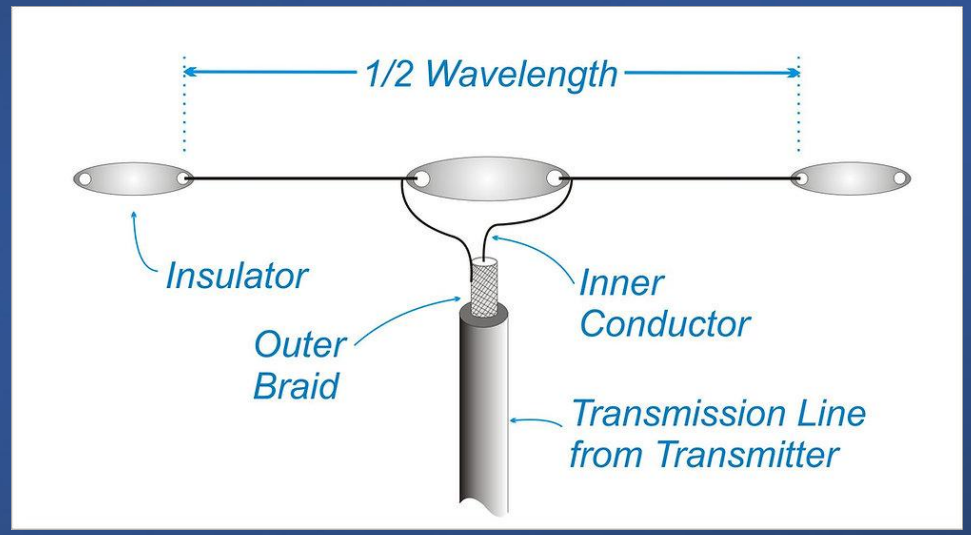
Most Popular Type – Half-Wave Dipole

- Classic “flat-top” design
- Needs two supports
- Excellent performance and easy to feed with coax

Key features:

- Center-fed
- Best height: ½ wavelength or higher
- Use a 1:1 balun to keep RF off the coax shield





ARRL The national association for AMATEUR RADIO

Radio Relay International

Dipole Design & Calculations Quick design steps:

1. Pick your target band/frequency
2. Calculate total length: $L = \frac{468}{f}$
3. Each leg = L / 2
4. Add 6–12 inches extra for tuning

Tips:

- Use insulated #14–18 AWG wire (copper or copper-clad steel)
- Trim in 1–2-inch increments while checking SWR
- Works great on one band; add a tuner for others

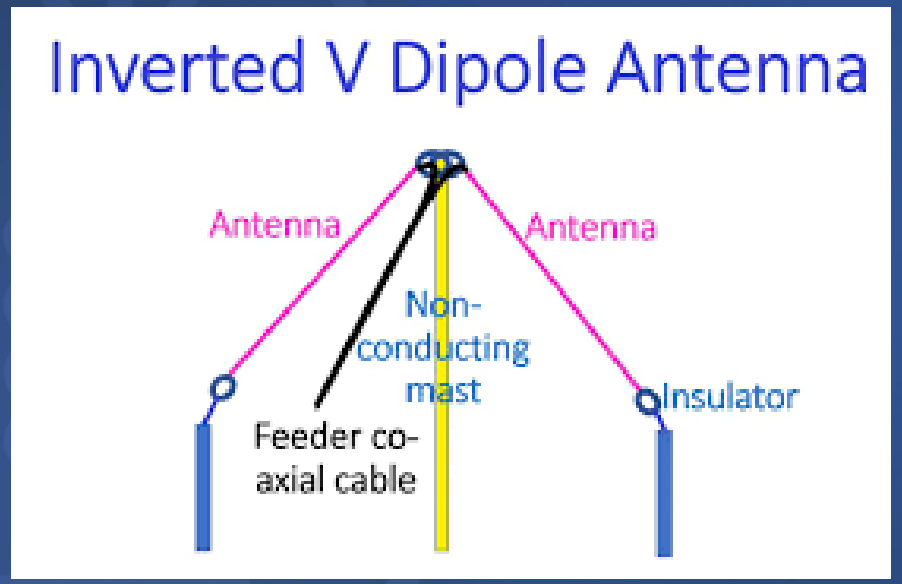
ARRL The national association for AMATEUR RADIO

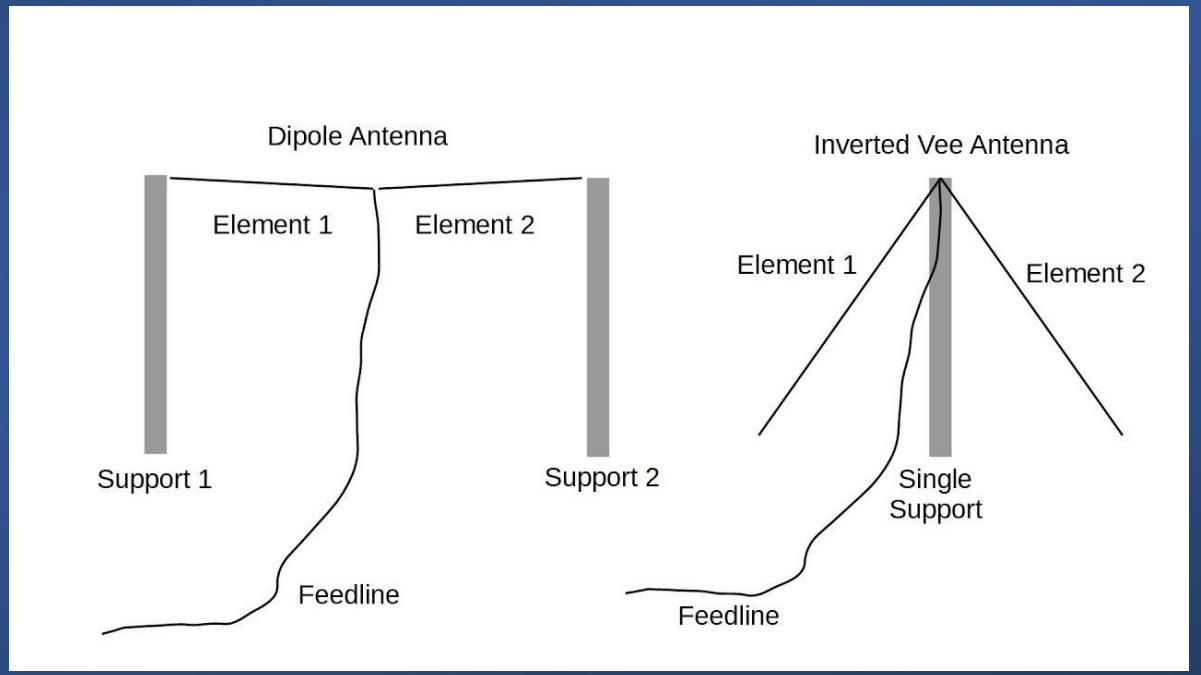
Radio Relay International

Inverted-V Dipole

- Same wire as a regular dipole but **one support** in the center
- Ends closer to ground (easier in small yards)
- Slightly shorter elements (3–5% due to ground effect)
- More omnidirectional pattern

Apex angle: 90–120° is ideal





ARRL The national association for AMATEUR RADIO

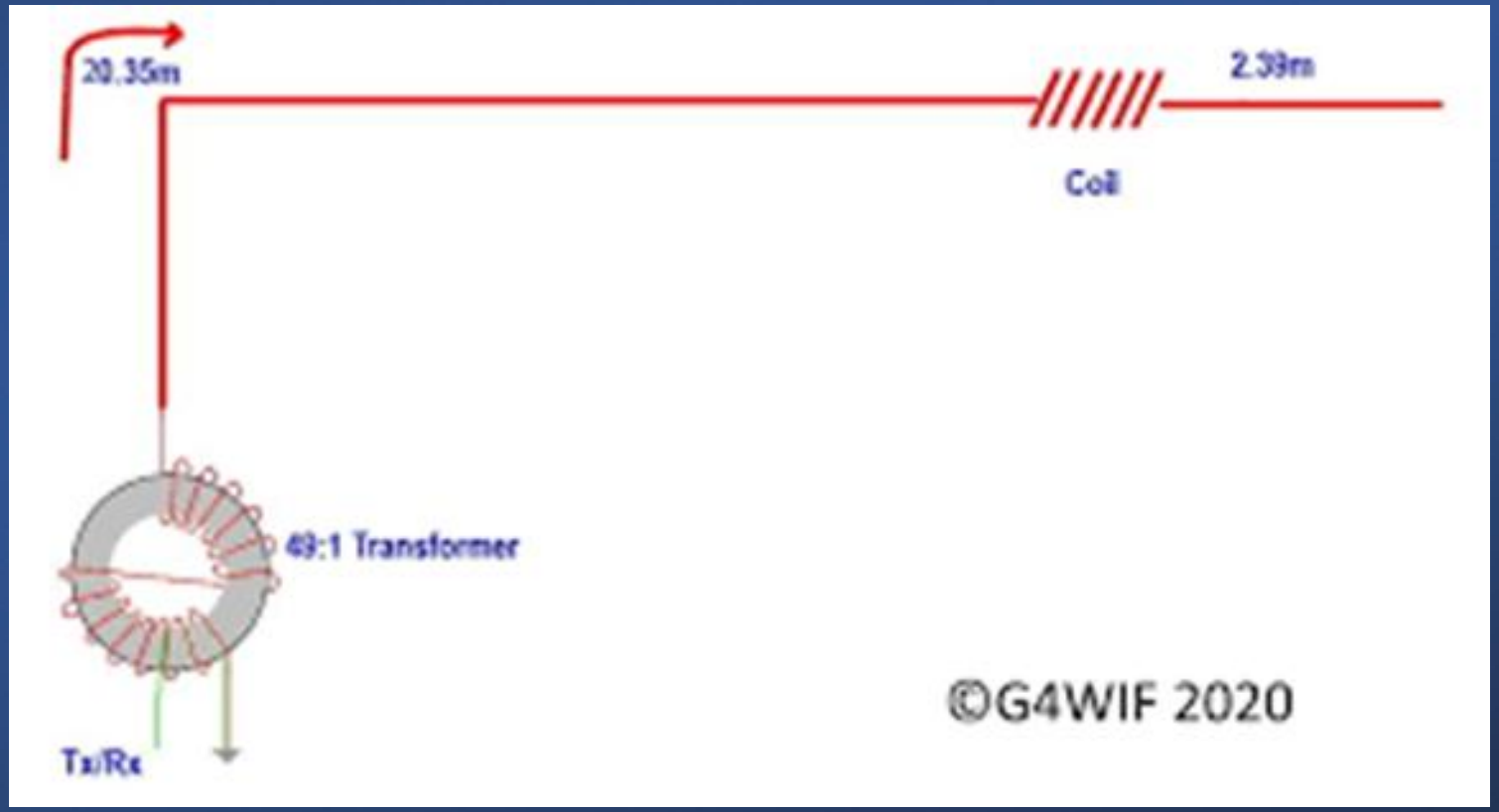
Radio Relay International

End-Fed Half-Wave (EFHW)

- Only **one end** needs support – super stealthy!
- High impedance (~2,500–5,000 Ω) → needs 49:1 unun/transformer
- Great for portable ops and limited-space stations

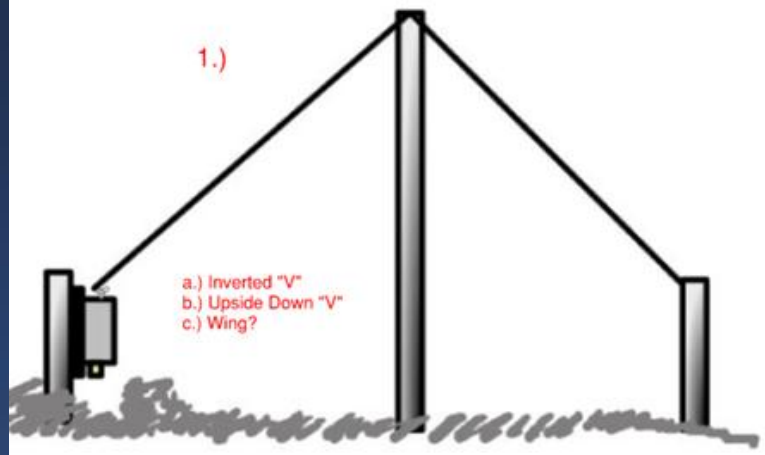
Common versions:

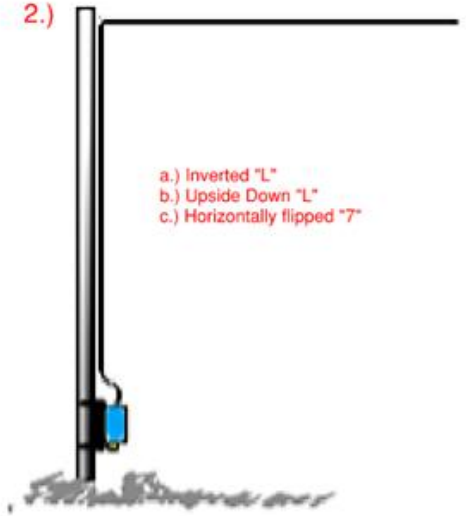
- Single-band
- Multi-band with loading coil

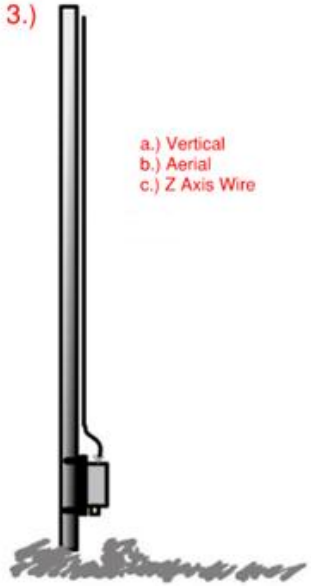


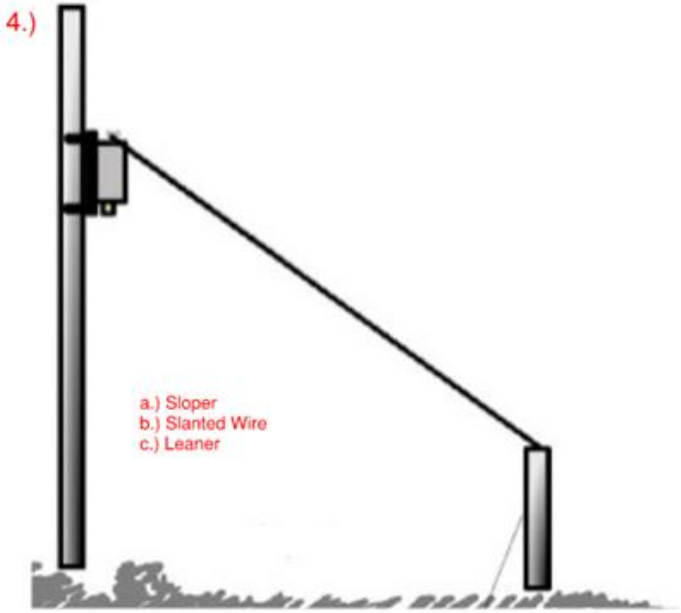
ARRL The national association for AMATEUR RADIO

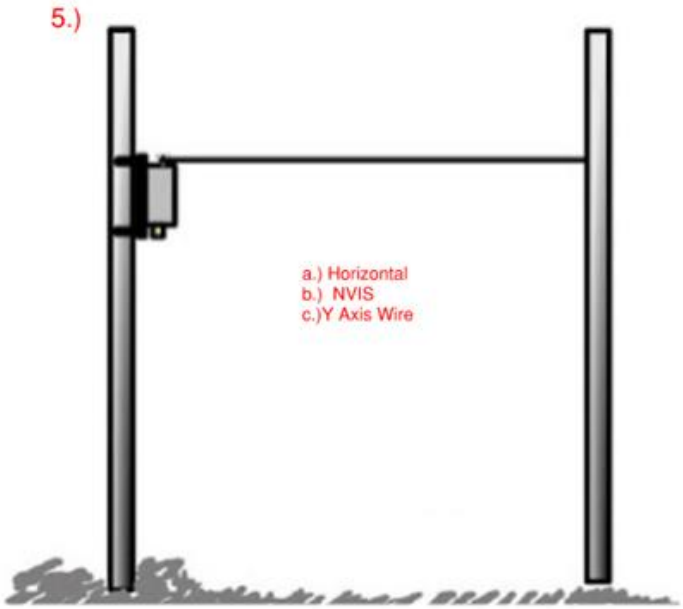
EFHW Antenna











Radio Relay International

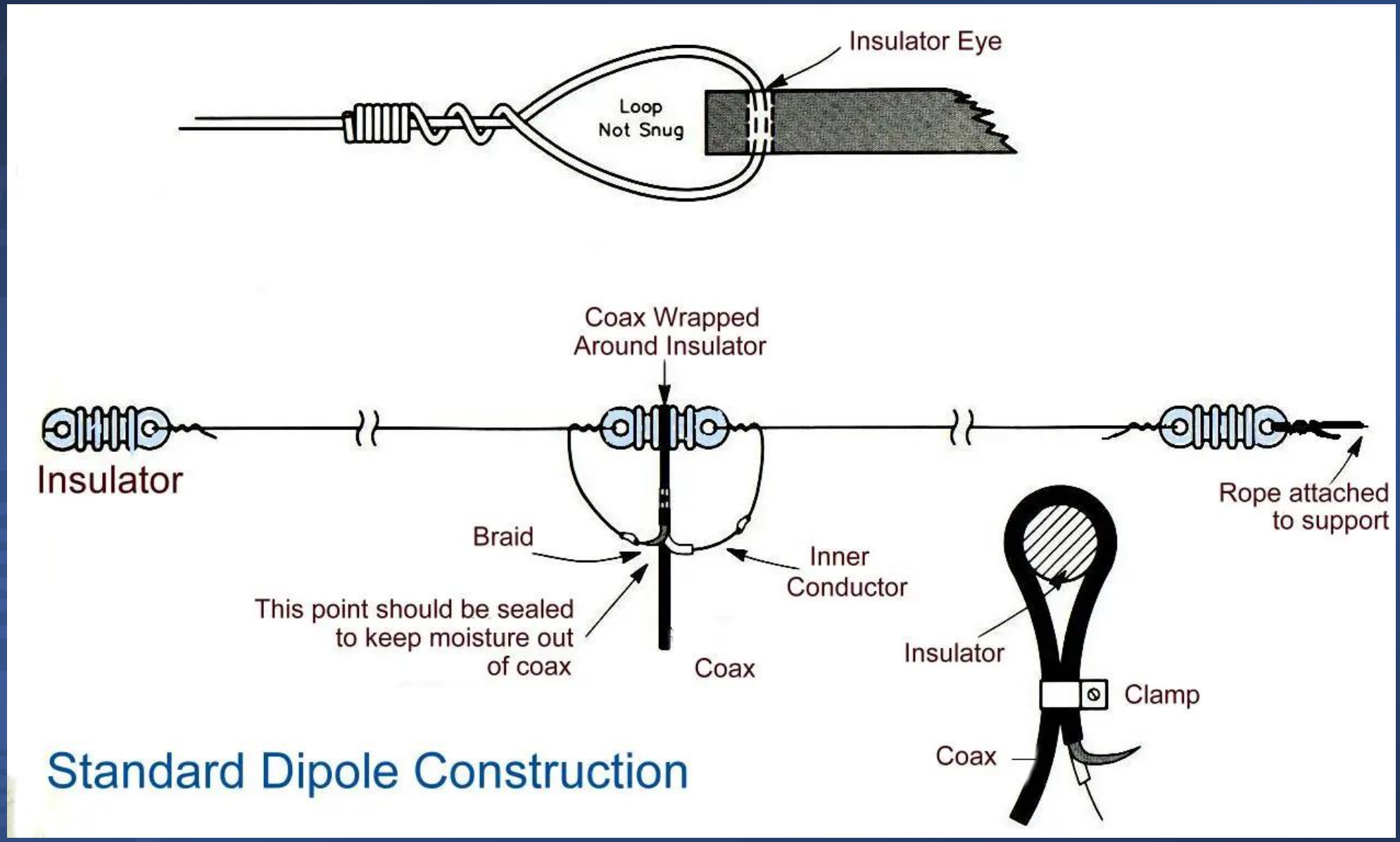
Materials You'll Need Basic shopping list:

- Antenna wire (14–18 AWG insulated)
- Insulators (dog-bone or homemade)
- Center insulator or balun/unun
- Coax (RG-8X or RG-213)
- Rope & pulleys for supports
- SWR meter or antenna analyzer

Optional but recommended: 1:1 balun (dipole) or 49:1 unun (EFHW)

ARRL The national association for AMATEUR RADIO

Radio Relay International



Standard Dipole Construction


Palomar Engineers 80-6 Meter, 9 Band End Fed OCF antenna with 4:1 current balun + 1:1 Balun + RC-8040 Resonance Compensator
80-40-30-20-17-15-12-10-6 OCF
Part # PAL-OCF8006RC-500 (500 watts)
Antenna long leg is 93 feet, short leg is 38 feet
Palomar-Engineers.com

Step-by-Step Construction

1. Calculate & cut wire
2. Attach insulators at ends and center
3. Solder or crimp connections
4. Install balun/unun at feedpoint
5. Seal connections with coax seal or tape
6. Add support rope

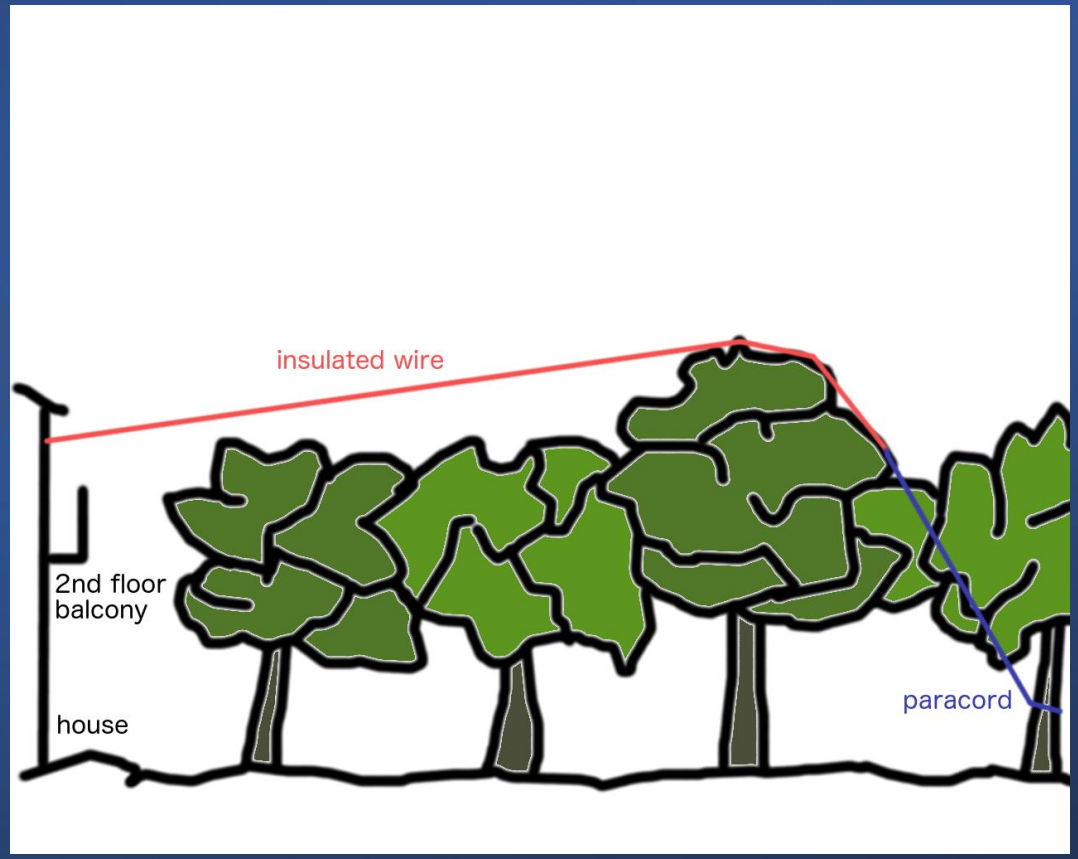
Pro tip: Build on the ground first, then hoist into place

ARRL The national association for AMATEUR RADIO

Radio Relay International

Installation Tips

- Get the antenna as high as possible
- Use trees, masts, or even a house roof
- Keep ends away from metal/power lines
- Use pulleys & rope for easy lowering to tune
- Common-mode choke near the shack



ARRL The national association for AMATEUR RADIO

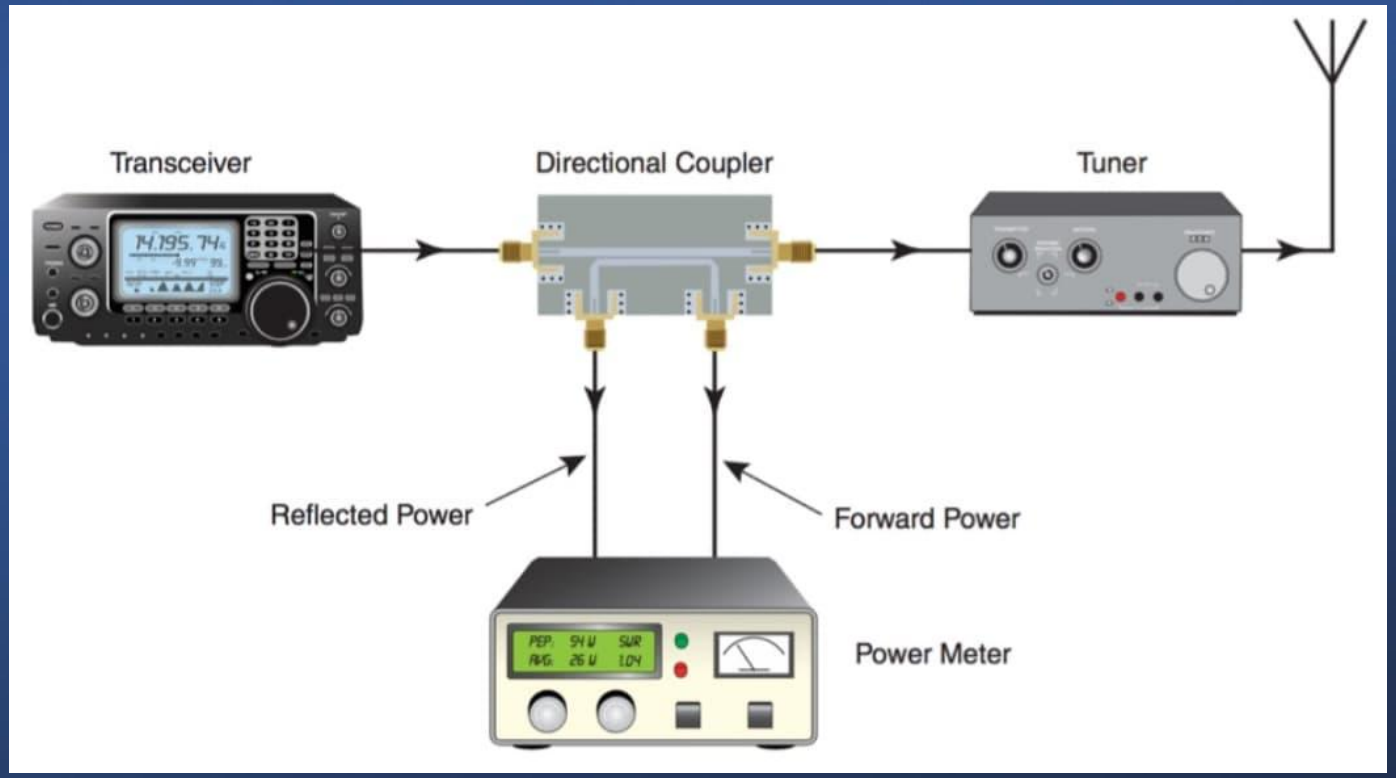
Radio Relay International

Tuning & Testing Tools:

SWR meter or NanoVNA/antenna analyzer

Process:

1. Raise antenna
2. Transmit low power on desired frequency
3. Check SWR
4. Trim wire 1–2 inches at a time until SWR < 2:1
5. Re-check after rain (wire can change slightly)



ARRL The national association for AMATEUR RADIO

Safety First!

- Never near power lines
- Ground the coax shield at the shack entrance
- Lightning protection (arrestor + grounding)
- RF exposure – keep people away from high-power antennas
- Use common sense when climbing trees/ladders

Rule #1: If it looks unsafe, it is.

ARRL The national association for AMATEUR RADIO

Radio Relay International

Conclusion & Resources You can now build effective antennas!

Start simple → dipole or inverted-V → upgrade to EFHW later

Great free resources:

- ARRL Antenna Book
- YouTube: “KB9VBR Antennas”
- eHam.net forums & QRZ.com

Final thought: The best antenna is the one you put up!

Thank you! Questions?

Dan AC8NP@AC8NP>COM

ARRL The national association for AMATEUR RADIO

Radio Relay International