Wire Antennas

Care and Feeding of the Inverted “V” Dipole

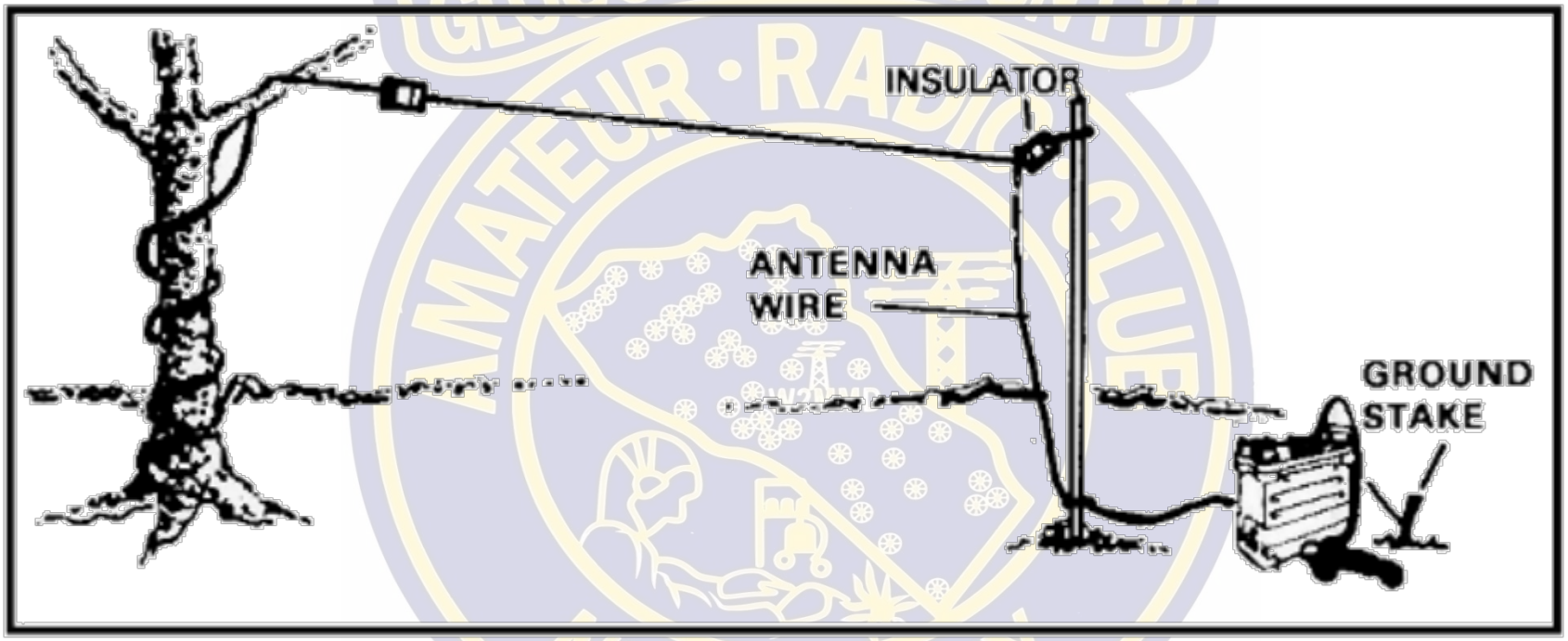
Fabrication of Wire Antennas

Wire antennas are probably the simplest form of antenna in widespread use in the ham radio environment. They consist of a length (or multiple lengths) of wire fed by a fitting to which the feed line is connected. They are very easily home-brewed and can be installed relatively easily and quickly. Natural features can be used as supports, or purpose-made supports can be installed.

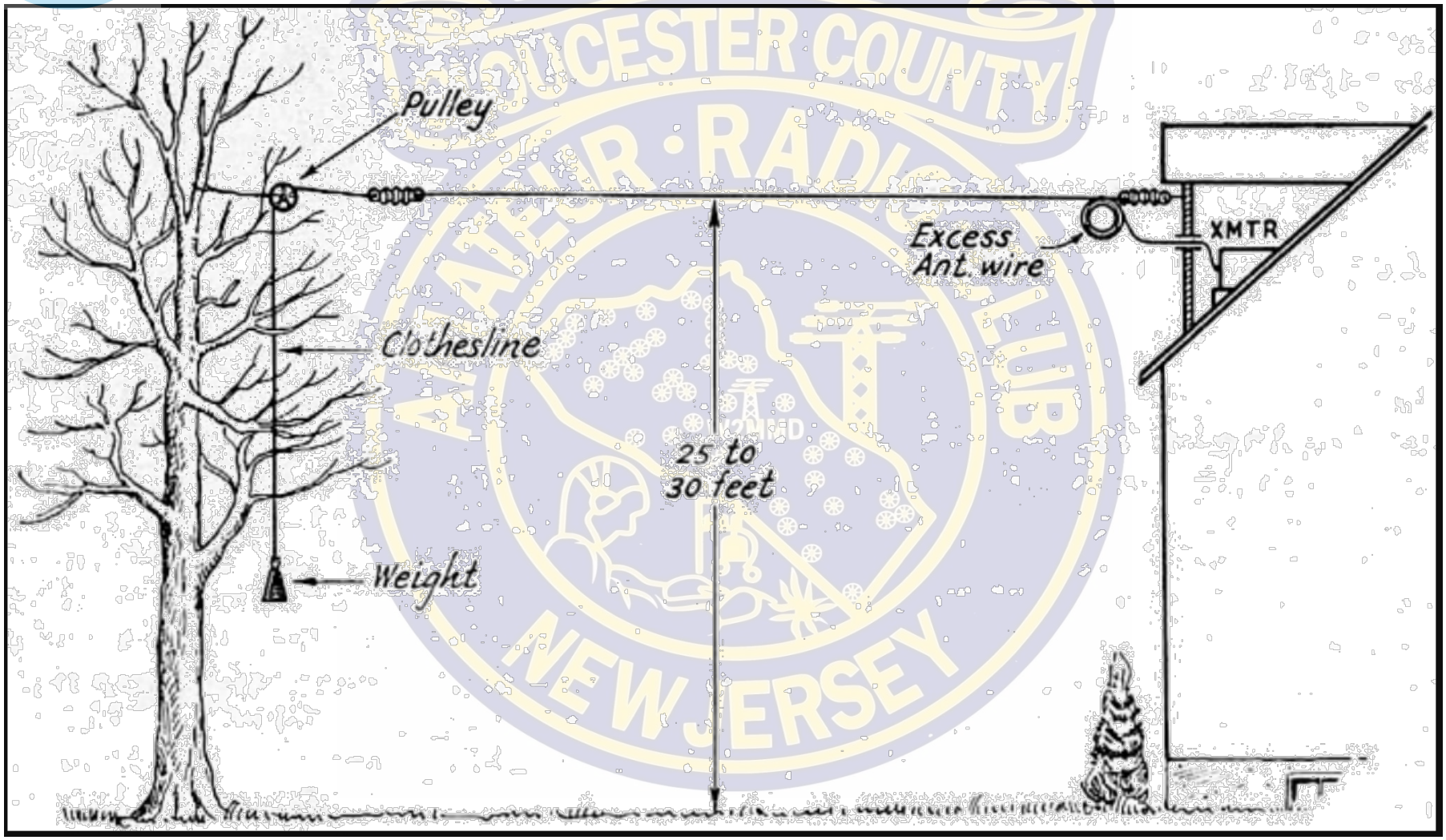
Most Common Types

- End-Fed
  - The end-fed half-wave (EFHW) antenna is quite popular when space and supports exist.
- Off-Center Fed
  - A variation of the center fed, often used for wire placement space considerations, but feed point impedance changes considerably.
- **Center-Fed**
  - **The center-fed dipole is arguably the most common of all wire antennas.**

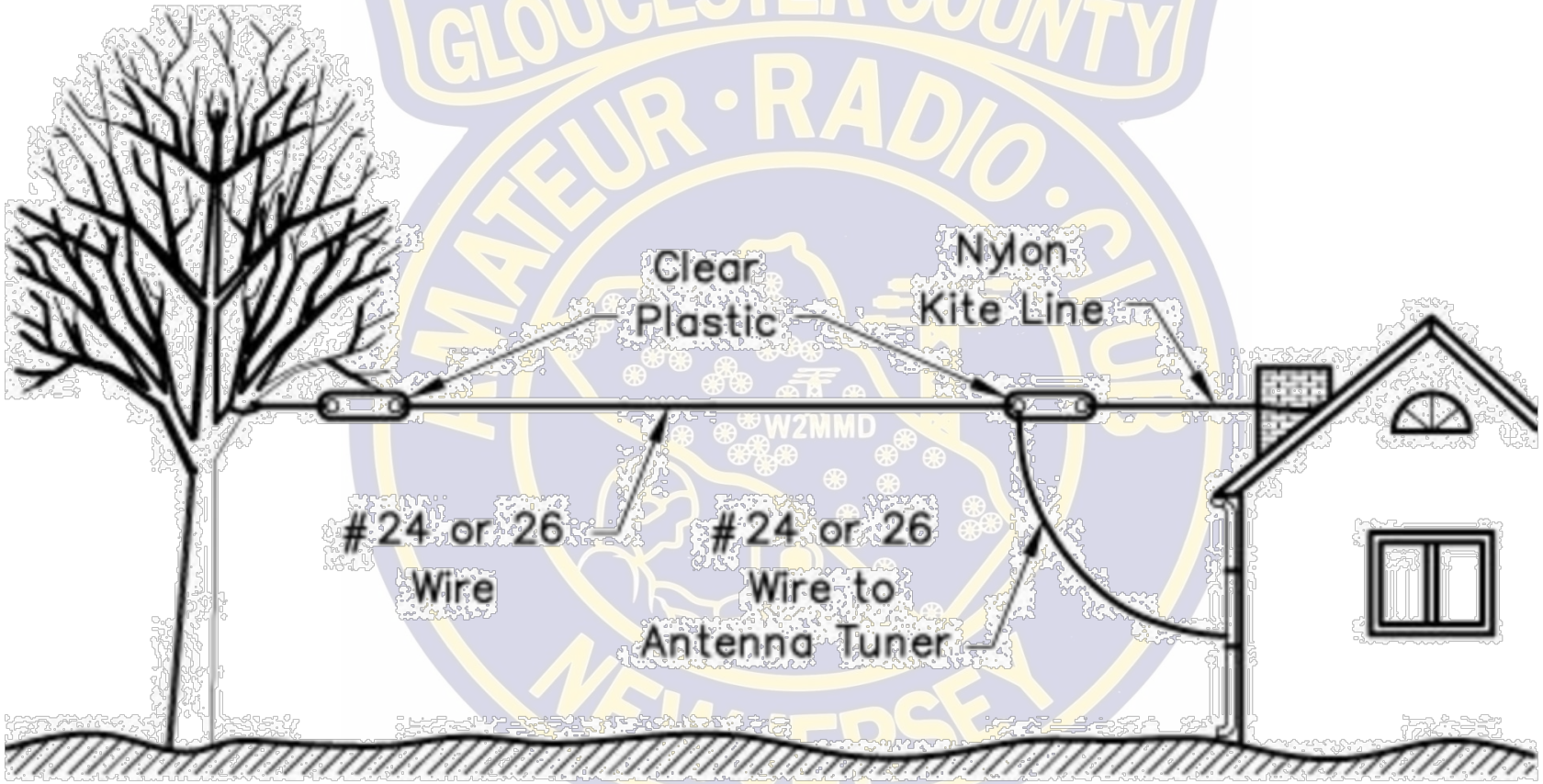
End-Fed Inverted “L” Form



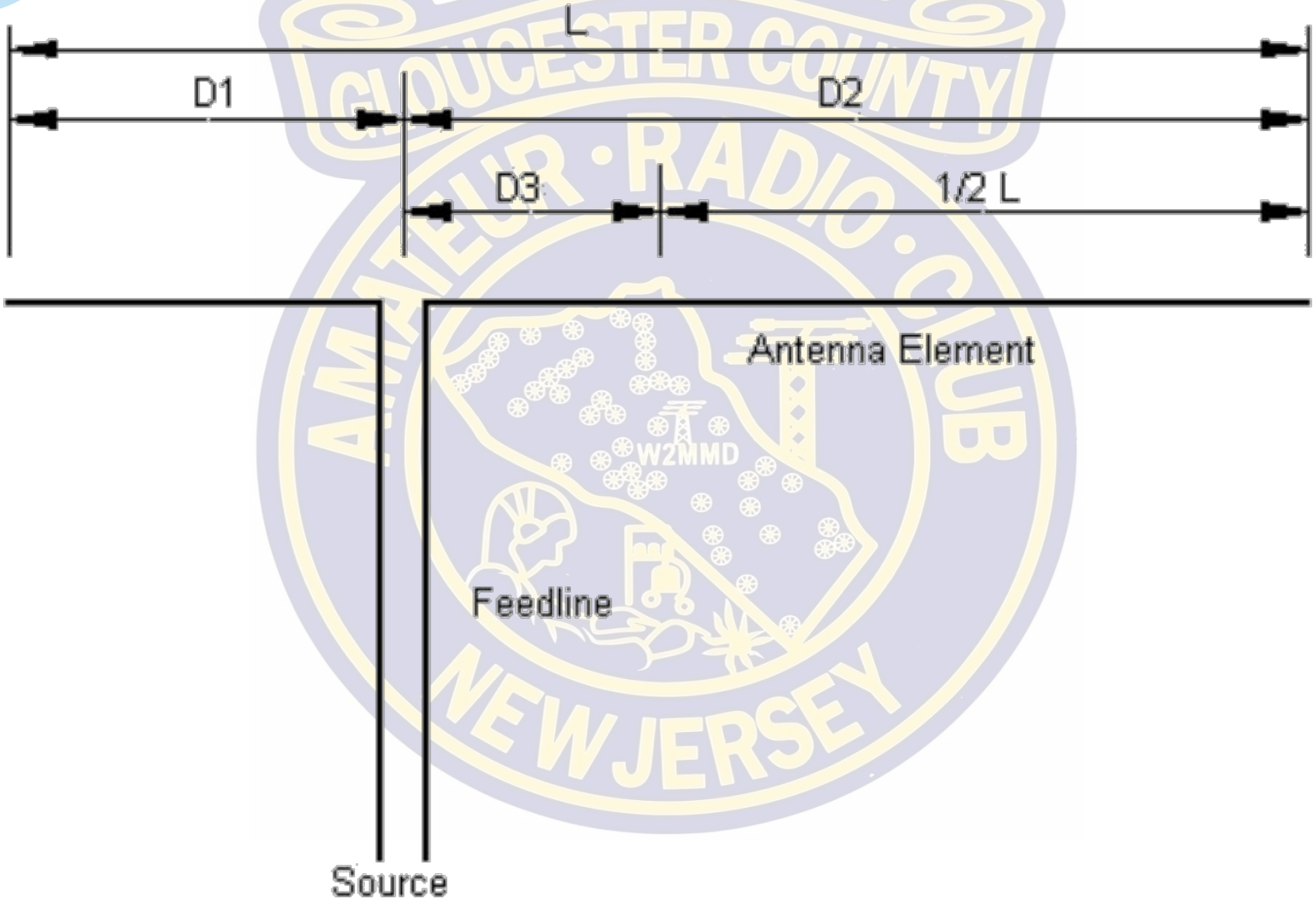
End Fed House-to-Tree



End Fed House to Tree



Off-Center Fed Dipole



Off-Center Fed Dipole

- Lengths are by design:
- L = 492 / MHz, two common approaches
  - D3 / L = 0.167
    - Believed to locate 300Ω point
    - Uses 4:1 or 6:1 balun for 50Ω feed line
  - D1 / L = 0.38 *and* D2 / L = 0.62
    - Believed to locate 100Ω point
    - Uses 2:1 balun for 50Ω feed line
    - Antenna works for even harmonics

US Amateur Radio Bands

ARRL The national association for AMATEUR RADIO®

US AMATEUR POWER LIMITS

FCC 97.313 An amateur station must use the minimum transmitter power necessary to carry out the desired communications.
(b) No station may transmit with a transmitter power exceeding 1.5 kW PEP.

Amateurs wishing to operate on either 2,200 or 630 meters must first register with the Utilities Technology Council online at **https://utc.org/plc-database-amateur-notification-process/.** You need only register once for each band.

2,200 Meters (135 kHz)

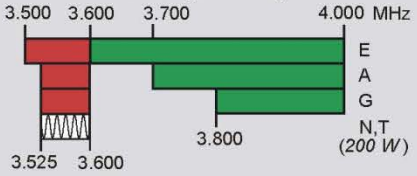
630 Meters (472 kHz)

5 W EIRP maximum, except in Alaska within 496 miles of Russia where the power limit is 1 W EIRP.

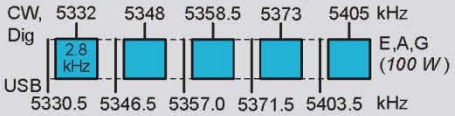
160 Meters (1.8 MHz)

Avoid interference to radiolocation operations from 1.900 to 2.000 MHz

80 Meters (3.5 MHz)

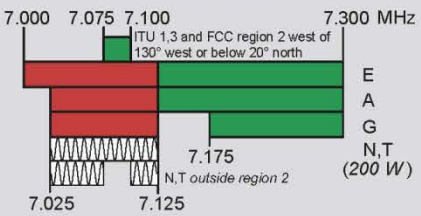


60 Meters (5.3 MHz)



General, Advanced, and Amateur Extra licensees may operate on these five channels on a secondary basis with a maximum effective radiated power (ERP) of 100 W PEP relative to a half-wave dipole. Permitted operating modes include upper sideband voice (USB), CW, RTTY, PSK31 and other digital modes such as PACTOR III. Only one signal at a time is permitted on any channel.

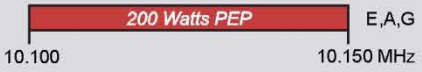
40 Meters (7 MHz)



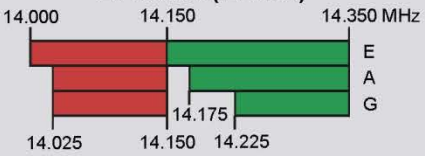
See Sections 97.305(c), 97.307(f)(11) and 97.301(e). These exemptions do not apply to stations in the continental US.

30 Meters (10.1 MHz)

Avoid interference to fixed services outside the US.

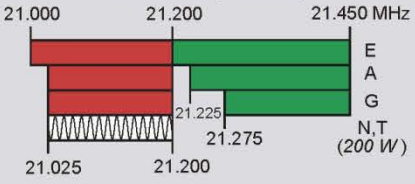


20 Meters (14 MHz)



17 Meters (18 MHz)

15 Meters (21 MHz)



12 Meters (24 MHz)

10 Meters (28 MHz)

6 Meters (50 MHz)

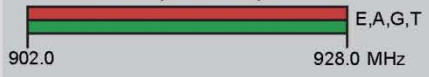
2 Meters (144 MHz)

1.25 Meters (222 MHz)

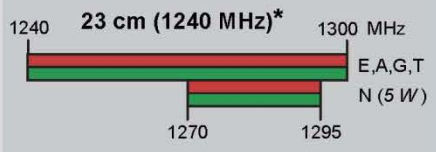
*Geographical and power restrictions may apply to all bands above 420 MHz. See *The ARRL Operating Manual* for information about your area.

70 cm (420 MHz)*

33 cm (902 MHz)*



23 cm (1240 MHz)*



All licensees except Novices are authorized all modes on the following frequencies:

2300-2310 MHz	10.0-10.5 GHz ‡	122.25-123.0 GHz
2390-2450 MHz	24.0-24.25 GHz	134-141 GHz
3300-3500 MHz	47.0-47.2 GHz	241-250 GHz
5650-5925 MHz	76.0-81.0 GHz	All above 275 GHz

‡ No pulse emissions

KEY

Note:
CW operation is permitted throughout all amateur bands.

MCW is authorized above 50.1 MHz, except for 144.0-144.1 and 219-220 MHz.

Test transmissions are authorized above 51 MHz, except for 219-220 MHz

- = RTTY and data
- = phone and image
- = CW *only*
- = SSB phone
- = USB phone, CW, RTTY, and data
- = Fixed digital message forwarding systems *only*

E = Amateur Extra
A = Advanced
G = General
T = Technician
N = Novice

See *ARRLWeb at www.arrl.org* for detailed band plans.

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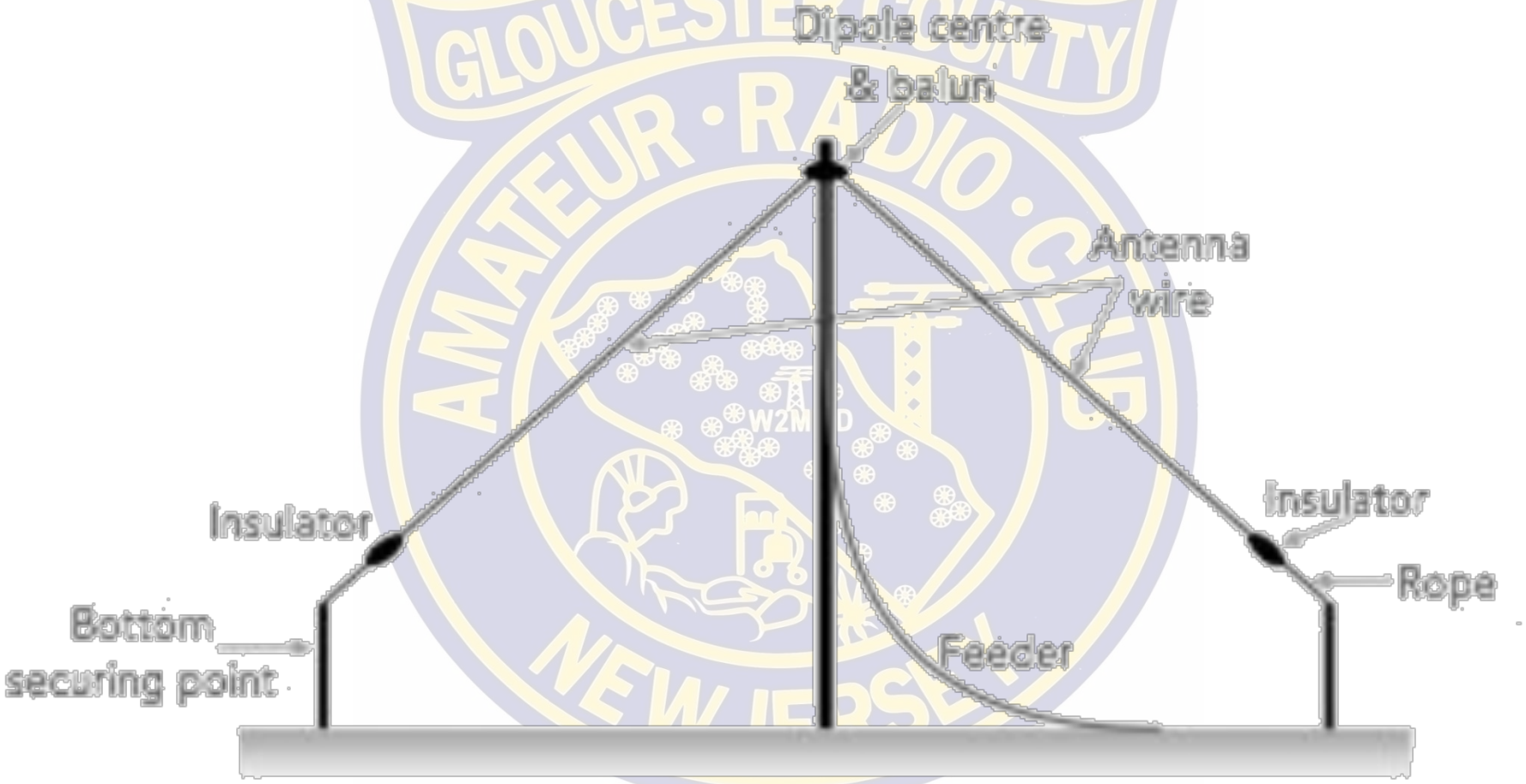
 rev. 9/22/2017

Center-Fed Inverted “V” Dipole



Center-Fed Inverted “V” Dipole

The inverted V dipole antenna has a number of advantages. One is that the maximum radiation from any antenna is from the points of high RF current, and a half-wave dipole has this maximum at its center and for a few feet on either side of the feed line connection. Therefore, it is best to set the center of the dipole as high above ground level as possible.

Center-Fed Inverted “V” Dipole

- If it is only possible to have one high support, an inverted-V arrangement is probably ideal.
  - In this way it is possible to use one fairly high mast in the center of a lot in locations where the erection of a pair of similar supports with their required guy wires would be difficult.
- A roof-mounted or chimney-mounted mast may also serve as the center support for a “V”, and the two ends of the dipole can then drop down on either side of a house roof.
  - Such a chimney mount will allow the feed line to be dropped into the shack quite easily if it is located in the house.

Inverted “V” Dipole Performance

- An inverted-V has its greatest degree of radiation at right angles to the axis of the antenna
  - This does not mean that the antenna is limited in other directions
  - Its radiation pattern is more omni-directional than that of a horizontal dipole as a result of the fact that the legs are angled downwards.

Inverted “V” Dipole Performance

- The inverted-V has an excellent reputation for long distance communication on the lower-frequency amateur bands where the installation of large verticals or high horizontal dipoles is not practicable.
  - 80 meters
  - 40 meters
  - 20 meters

Inverted “V” Dipole Performance

- As an example, the inverted “V” dipole performs very well at low frequencies and will give good results on the 80-meter ham radio band when the mast is only about 45 feet high.
  - This makes it a very attractive proposition for many amateur radio stations.
  - Inverted “V” dipole antennas for other bands also perform well.

Building an Inverted “V” Dipole

- Building an inverted “V” dipole is very much like that of a standard dipole. There are several elements to the installation and erection of the inverted “V” dipole:
  - Mast
  - End Anchor Points
  - Insulators
  - Antenna Wire
  - Center Fixture
  - Balun

Building an Inverted “V” Dipole

- Mast
  - The mast should be robust and firmly mounted into the ground, and guyed as required.
  - If it is metal construction it is suggested that a good ground connection is provided.
  - A good ground, *e.g. solid* copper or copper-clad ground rod, should be provided for the feed line shield or braid.
  - A pulley should be installed at the top to enable easy hoisting of the inverted “V” dipole antenna.

Building an Inverted “V” Dipole

- End Anchor Points
  - Anchor points must be located so that they do not pose a hazard to anyone in the area.
  - They should also be located so that the antenna wire ends are out of reach.
  - The anchor points should be located to cause the wires to form an included angle greater than 90° at the top center point.

Building an Inverted “V” Dipole

- Insulators
  - Wires should be connected to the anchor points via Dacron® or polyester UV-resistant rope.
  - The rope must not connect directly to the wire, as wet rope changes the antenna properties when connected to the wire.
  - Insulators are used between the wire and the rope.

Insulators

- www.thewireman.com #802
- Budwig HQ-2

Building an Inverted “V” Dipole

- Antenna Wire
  - The antenna wire should be of suitable quality for use outdoors.
  - Ideally hard-drawn copper wire is desirable so it does not stretch as much.
  - Wire can be solid or stranded, bare or insulated.
  - Copper-clad steel wire is a popular choice and is extremely durable.

Wire Lengths

- Dipole wire lengths for various bands – note that wire should be cut long and then trimmed to tune for final lengths, calculated by formula ***Length = 492/MHz*** at center of band
  - 160m – 129.5 feet
  - 80m – 65.6 feet
  - 60m – 45.9 feet
  - 40m – 34.4 feet
  - 30m – 24.3 feet
  - 20m – 17.4 feet
  - 17m – 13.6 feetr
  - 15m – 11.6 feet
  - 12m – 9.9 feet
  - 10m – 8.5 feet
  - 6m – 4.7 feet
- Remember to cut ***two*** wires of this minimum length, adding about six inches for twisting at the center fixture and insulator connections (3 inches each).

Building an Inverted “V” Dipole

- Center Fixture
  - The center of the dipole requires the coaxial or open-wire feed line to be connected to it.
  - It may be tempting to simply connect the feed line and let it take the strain, but this is an especially poor idea when there is a long drop for the feed line.
  - The center fixture will take the strain caused by the tension on the wire, thereby avoiding damage to the feed line over a period of time.
  - The center fixture will also provide a means of attaching a rope to enable the pulley system to hoist the antenna center.
  - The best quality center fixture that you can afford should be used.
  - The best center fixtures will include drip shields to prevent rain water from reaching the feed line connection.

Center Fixtures

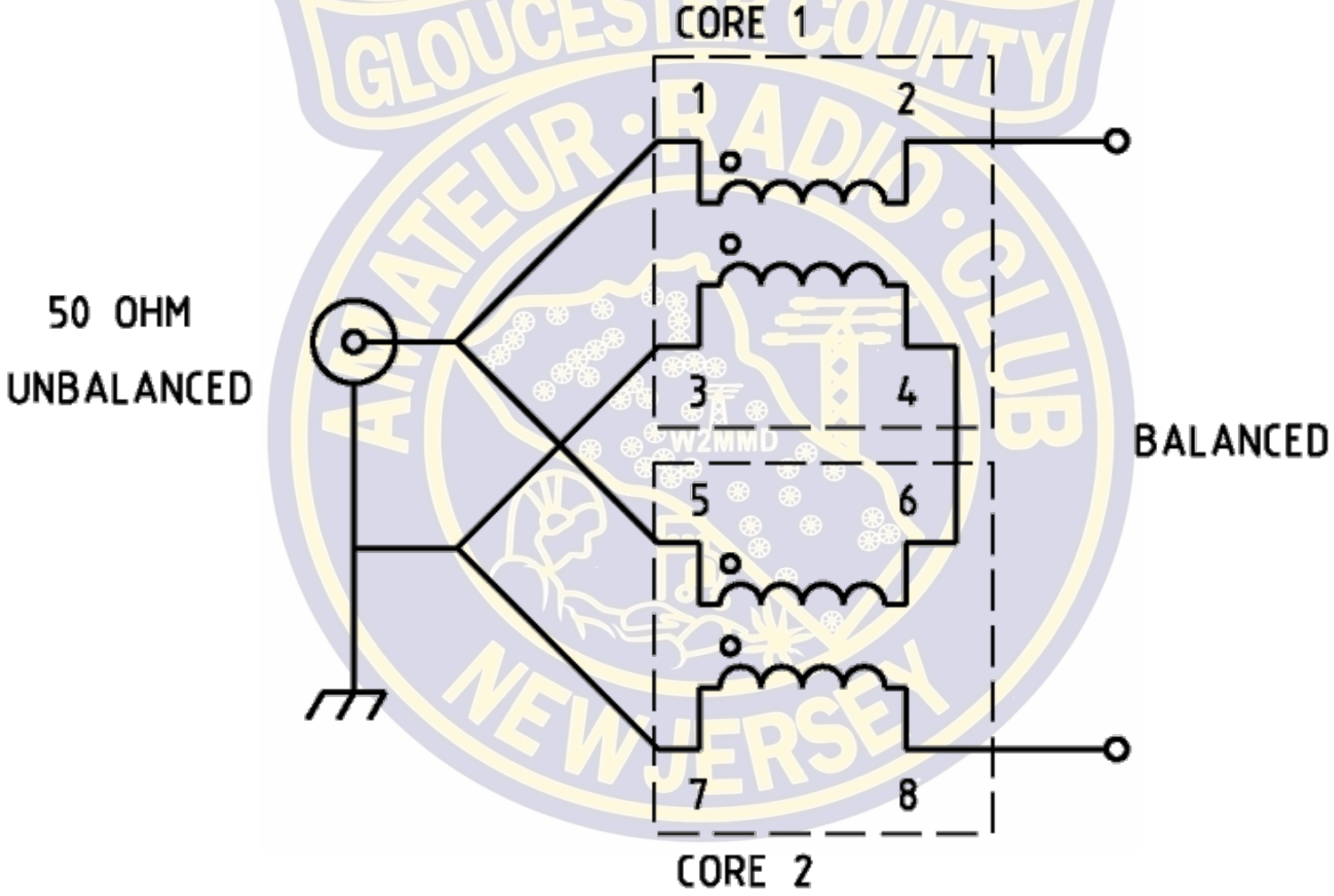
- www.thewireman.com #801

- Budwig HQ-1

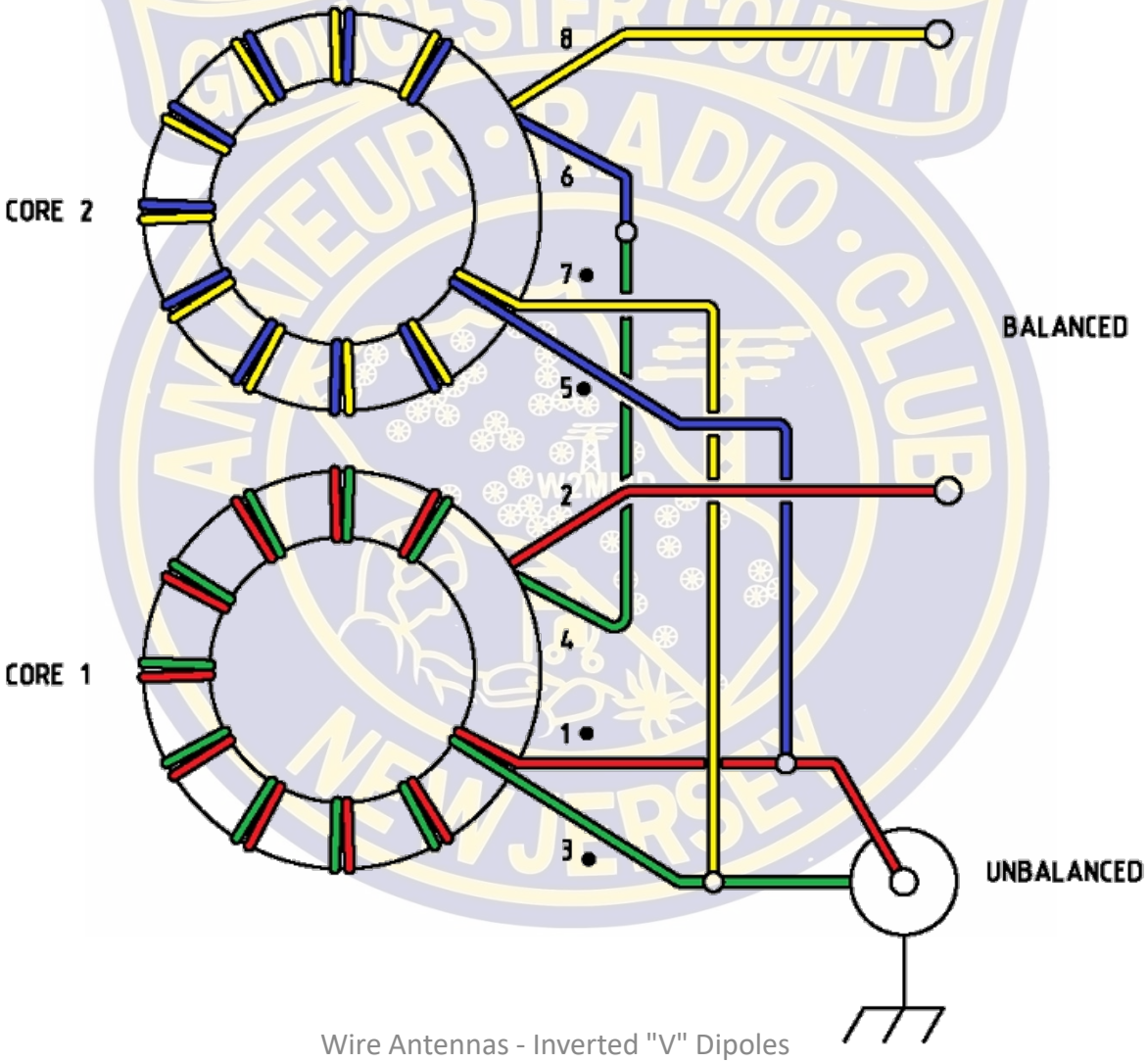
Building an Inverted “V” Dipole

- Balun
  - BALUN is a short form of BALanced/Unbalanced
    - Used to join an unbalanced feed line to a balanced antenna or *vice-versa.*
  - A balun is used to provide for:
    - Impedance matching
    - Antenna isolation
  - Typically, a 1:1 current balun is appropriate for the wire center-fed dipole antenna

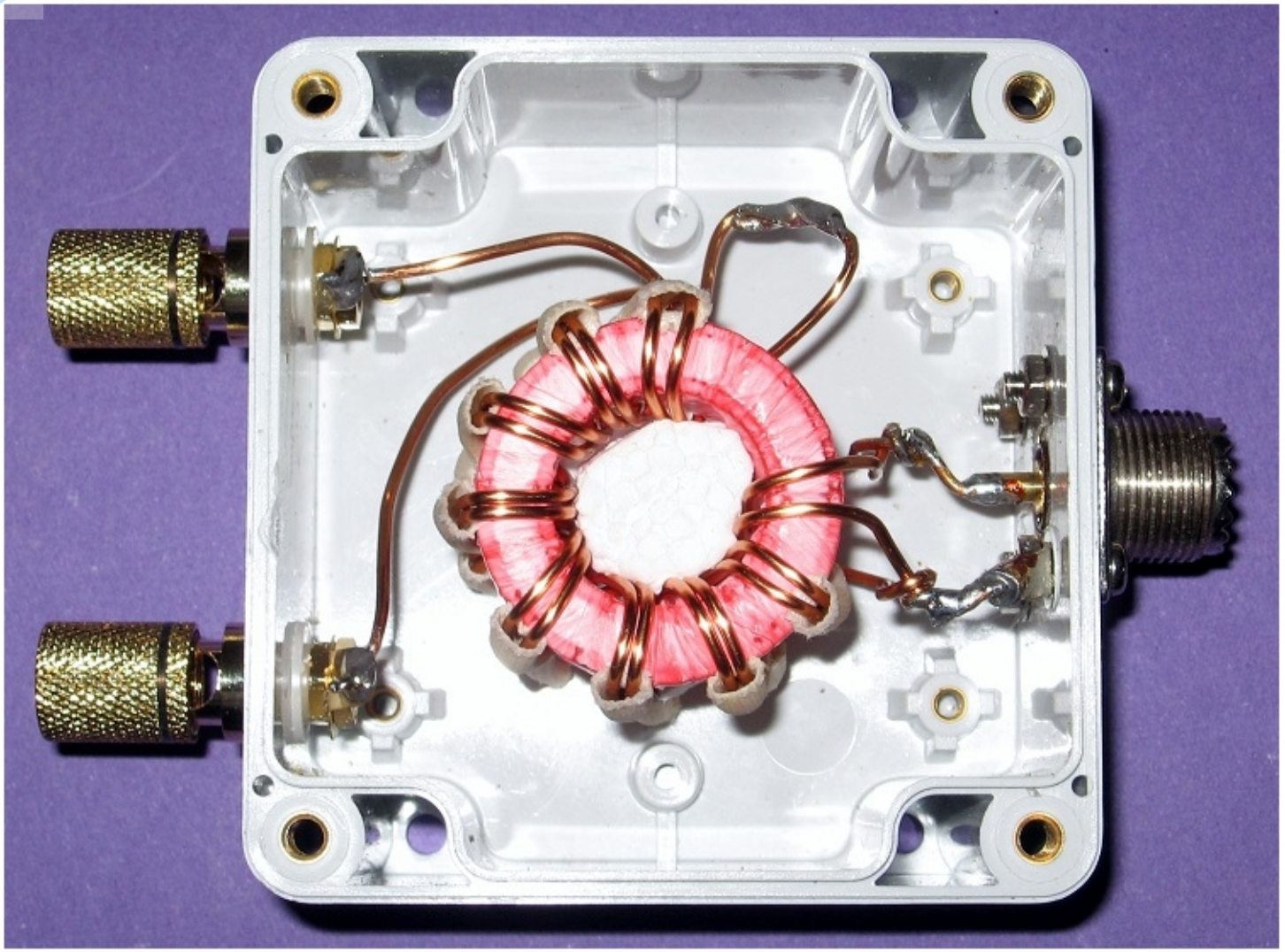
Balun Schematic (4:1)



Balun Wiring (4:1)



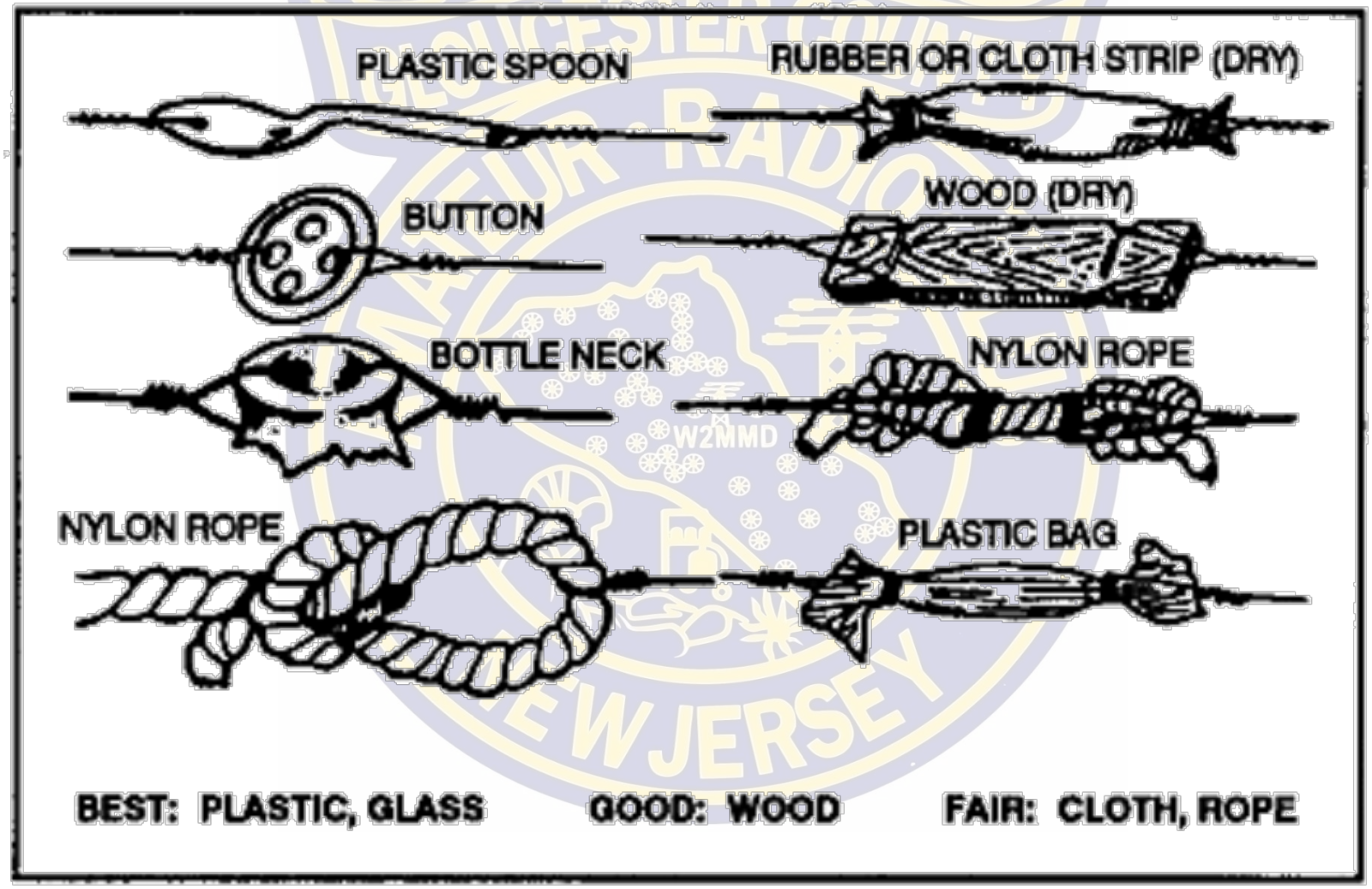
Balun Photo (4:1)



Antenna Repairs

- From time to time, emergency repairs may be required.
  - Plastic components degrade in sunlight over time.
  - This is especially true of insulators.
  - Many emergency insulators are available in the average household or garage.
  - These are temporary measures only – be sure to replace with proper insulators ASAP.

Emergency Insulator Ideas



Any Questions?