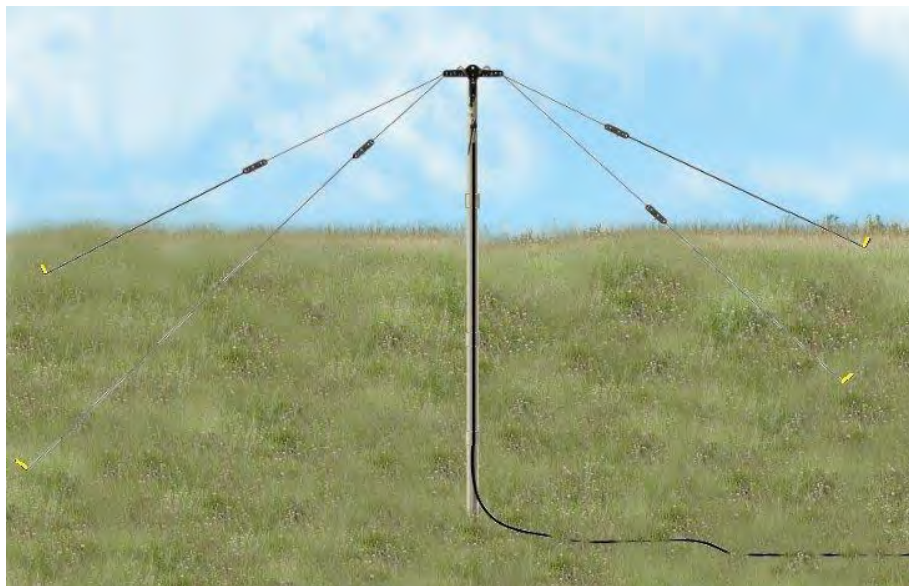




## A Practical NVIS Antenna for Emergency or Temporary Communications

WP-NVIS Rev. 3



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## WARNING!

### INSTALLATION OF ANY ANTENNA NEAR POWER LINES IS DANGEROUS



**Warning:** Do not locate the antenna near overhead power lines or other electric light or power circuits, or where it can come into contact with such circuits. When installing the antenna, take extreme care not to come into contact with such circuits, because they may cause serious injury or death.

### Overhead Power Line Safety

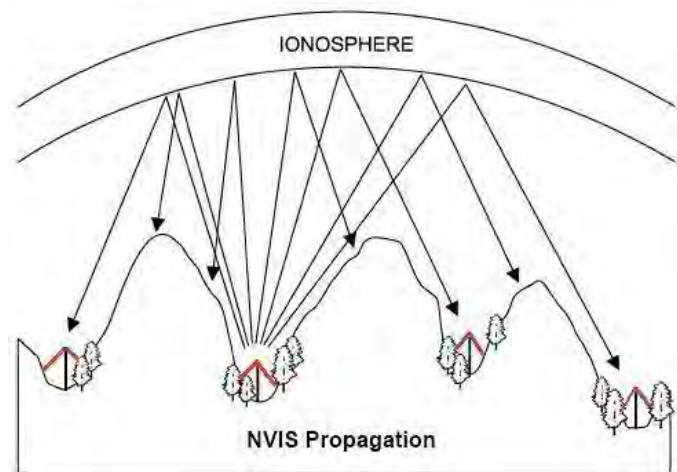
Before you begin working, check carefully for overhead power lines in the area you will be working. Don't assume that wires are telephone or cable lines: check with your electric utility for advice. Although overhead power lines may appear to be insulated, often these coverings are intended only to protect metal wires from weather conditions and may not protect you from electric shock

Keep your distance! Remember the 10-foot rule: When carrying and using ladders and other long tools, keep them at least 10 feet away from all overhead lines - including any lines from the power pole to your home.

## NVIS

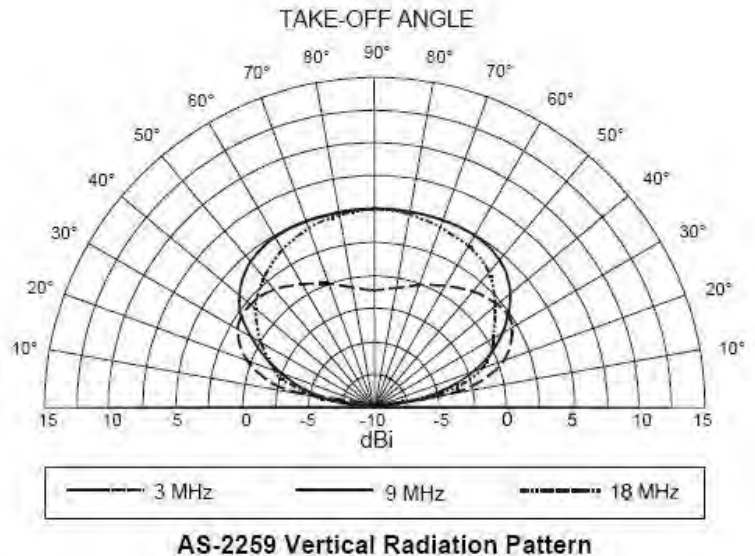
Near Vertical Incidence Skywave (NVIS) is a propagation mode which uses high angle radiation to send signals almost straight up to be reflected back to Earth for very effective short to medium distance communications. This mode of operation makes it ideal for in-state communications during disasters or other emergency situations. The military has used NVIS techniques for decades to provide short haul communication with other units on the ground.

NVIS only works at frequencies from 2 MHz to 10 MHz. The signal must penetrate the D layer of the ionosphere, and bounce off the F layer. Lower-frequency signals will not penetrate the D layer; higher frequencies will not bounce off the F layer at these sharp angles and just goes out into space. Remember the Maximum Useable Frequency (MUF) For amateur radio operators, we're looking at 40 and 80 meters primarily for NVIS use.



A good NVIS antenna will not work well at DX distances. Antenna gain is a zero sum game. There is a fixed amount of energy radiating. If we push it all out in one direction (the near-vertical angles), we have to take it away from another direction (the low DX angles).

Regular height dipoles or vertical antennas have a lower take off angle and your signal may be heard three states away, but not in your state due to the skip zone. This skip zone is the area between the maximum ground wave distance and the shortest sky wave distance where no communications are possible. Depending on operating frequencies, antennas, and propagation conditions, this skip zone can start at roughly 10 to 20 miles and extend out to several hundred miles, preventing communications with the desired station. The other term called ground wave is where your signal does reach someone closer. A ground wave signal can go up to approximately 50 miles if conditions, including terrain and obstacles, are favorable.



Using no skip zone or ground wave, the NVIS mode is used for making reliable HF communications below 10 MHz effective for a range to 600 miles. The NVIS propagation mode works best on HF below 10 MHz since these high angle radio waves are reflected back to Earth. Most often a low dipole is the best antenna to use and will provide reliable communications. This makes a NVIS antenna an excellent choice for emergency communications and for staying in contact with other amateur radio operators in nearby locations.

Dipoles only exhibit directionality once they reach 1/2 wavelengths above ground. However, NVIS antennas are located from 1/4 to 1/10 wavelength above ground.

Vertical RF energy radiated at a low enough frequency is reflected back to earth at all angles. The effect is similar to taking your garden hose with a fog nozzle and pointing it straight upwards. The water coming back down gives you an omni-directional pattern without dead spots. It's a continuous circular radiation pattern coming back down. Since it is omni-directional, dipole orientation is not important.

The higher the angle, the lower the frequency needed to work properly. Therefore lower amateur radio frequencies such as 40 and 80 meters are ideal for NVIS use. NVIS generally requires takeoff angles of 70 degrees or higher. Radio waves directed vertically at frequencies higher than the critical frequency pass through the ionized layer out into space.

The military uses a dual band NVIS antenna known as the **AS-2259/GR**. It consists of two crossed inverted "V" dipoles positioned at right angles to each other and is supported at the center by a 15-foot mast. The antenna was designed for military use from 2 to 10 MHz (some references say 2 to 30 MHz). The dual dipole wires do the job of providing guying support for the mast.



**Military AS-2259/GR**

There are a number of different NVIS antenna plans on the internet that can be adopted to amateur radio use. Many hams have modified those plans to operate on the bands they have chosen. Although originally made for military use, this particular design was found to work on the 80 and 40 meter amateur bands using a good tuner without modifications for the Ohio State Parks On The Air contest held every September (since 2008) in Ohio ([www.ospota.org](http://www.ospota.org)). This design was chosen because of the simplicity, ease of construction and operation.

## Let's Build One!

- The NVIS antenna described is based on the proven information from the military AS-2259/GR antenna. It will provide excellent short range communications and is easy to set up for emergency or temporary communications.
- It's a dual band inverted "V" at a height of 15 feet.
- The area required (foot print) is approximately 45 feet by 45 feet.
- The mast support used is fiberglass to avoid any signal coupling from the low antenna wires. The fiberglass sections are widely available on the military surplus market, or you can make your own support using PVC tube sections.
- The 4 wires used for the antenna elements are also used with rope to provide the support or guying for the 15 foot mast.
- Your tuner is connected to the antenna Center "T" using 100 feet of RG-8X coaxial cable. A tuner is required to match the antenna to your transmitter.



You can get as simple as you want or you can get creative and make it more involved. As with all amateur radio gear, modifications can be made and experimenting with this design may result in even better performance for your chosen area of operation.

The antenna described was successfully used during the first Portage County (Ohio) Amateur Radio Service's contest called Ohio State Parks On The Air (OSPOTA - [www.ospota.org](http://www.ospota.org)) in September 2008. The object of this contest was to make two way contacts with amateur operators located at the 73 Ohio State Parks. Ohio is roughly 200 miles square, so the NVIS antenna was the ideal match. Contacts were made on both 80 and 40 meters ranging from 15 miles to 2,000 miles. This antenna has been in continued use for OSPOTA and other contests since 2008.

**OSPOTA Contest Station**  
**NVIS Antenna made from DX Engineering Parts**  
**Icom 706 MkIIg**  
**MFJ-969 Tuner**  
**Astron 30 amp power supply**  
**AC Power - 1 kW gas generator**



**NVIS Antenna**



**KD8GGZ and KB8VJL**



**KB8VJL and KB8UUZ**

# Parts Needed

## From DX Engineering:

- 1 **DXE-UWA8X-KIT** - Universal Wire Antenna Kit for RG-8X
- 1 **DXE-ANTW-150** - #14 Insulated Antenna Wire, 150 Ft.
- 2 **DXE-ECL-24SS** (or **DXE-ECL-2000-10P**) - Element Clamp for 1-7/8 to 2 in. tube
- 1 **DXE-UWA-END-KIT** - End Insulators, Package of 8
- 1 **DXE-8XDX100** - 100 Feet of RG-8/X coaxial cable with PL-259's on each end
- 1 **SYN-DBR-94-100** - 3/32 in. Diameter, Double-Braid Dacron/Polyester Rope, 100 ft. Roll

## From your local source:

- 15 ft 2 Inch Diameter Fiberglass pole. Military surplus 4' interlocking poles obtained locally
- 4 "J" hooks & mounting hardware, obtained locally
- 4 Tent Pegs, obtained locally
- 2 Ring Terminals for 14-16 ga wire (2 are in the kit, you need 4 total)



DXE-UWA8X-KIT



DXE-ANTW-150



DXE-ECL-24SS  
or DXE-ECL-2000-10P



DXE-UWA-END-KIT



SYN-DBR-94-100



DXE-8XDX100

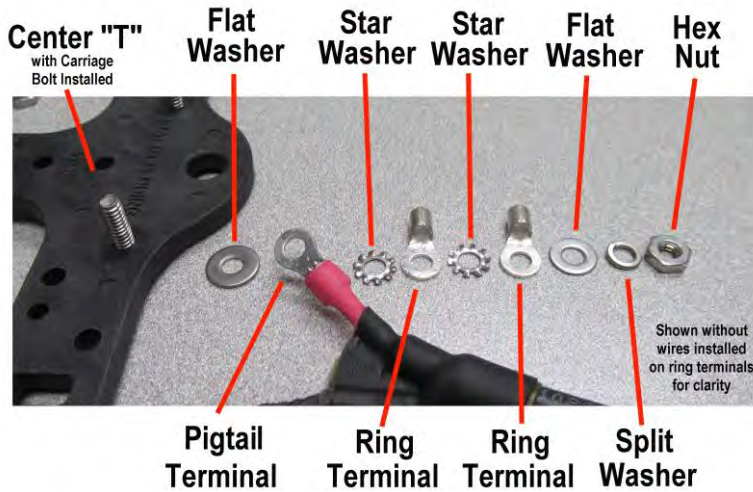
# Construction

Using the **DXE-ANTW-150** - #14 Insulated Antenna Wire, cut four wires. Two wires are 25 Ft each (40 meter side) and 2 wires are 38 Ft each (80 meter side). No further length adjustment will be needed.

Assemble the **DXE-UWA8X-KIT** - Universal Wire Antenna Kit for RG-8X per the instructions supplied. The antenna wires are connected to the Center "T" using the supplied ring terminals. Connect one 25 Ft. wire and one 38 Ft. wire to each leg of the Center "T".



Here is the proper hardware stack-up for the Center-T:



Using four **DXE-UWA-END-KIT** End Insulators, weave the antenna wire ends as shown in the **DXE-UWA8X-KIT** instructions.

Using the **SYN-DBR-94-100** - 3/32 in. Diameter, Double-Braid Dacron/Polyester Rope, 100 ft. Roll, cut four ropes. The rope lengths from the End Insulators to the Tent Pegs are: Two at 7 Ft. and two at 20 Ft. Allow extra rope length to tie to the End Insulators and the Tent Pegs. Keeping that in mind, cut the ropes: Two at 10 Ft. each and two at 23 Ft. each.

The knot shown for Dacron Polyester Rope will not slip and yet is easily adjustable.



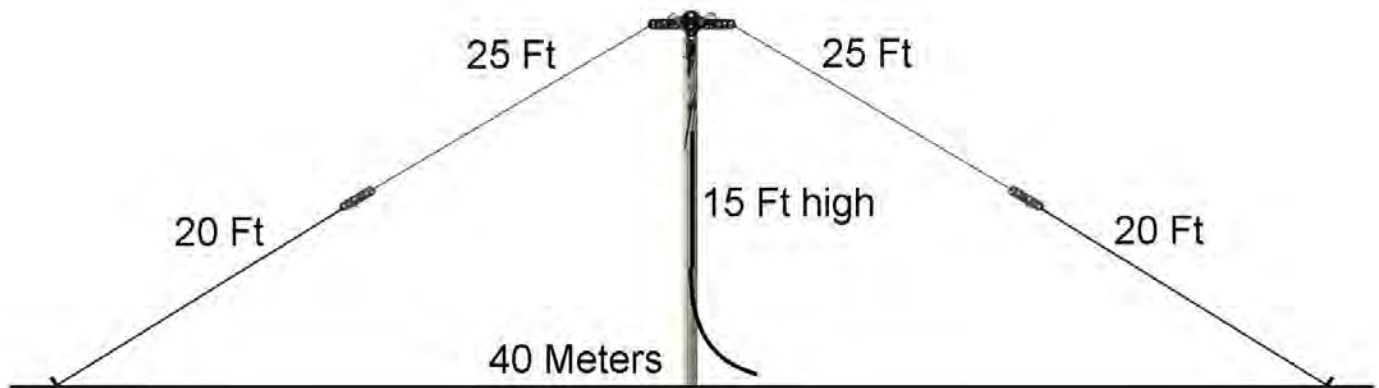
The Center "T" is held in place on the top mast using two **DXE-ECL-24SS** - Element Clamps as shown in the pictures shown on pages 7 and 8.

The J-Hooks mounted on the top fiberglass pole (shown on page 8) are optional and are used to wind the antenna wires on when not in use. You could also just coil the wire up and use small ties to hold the loops together.

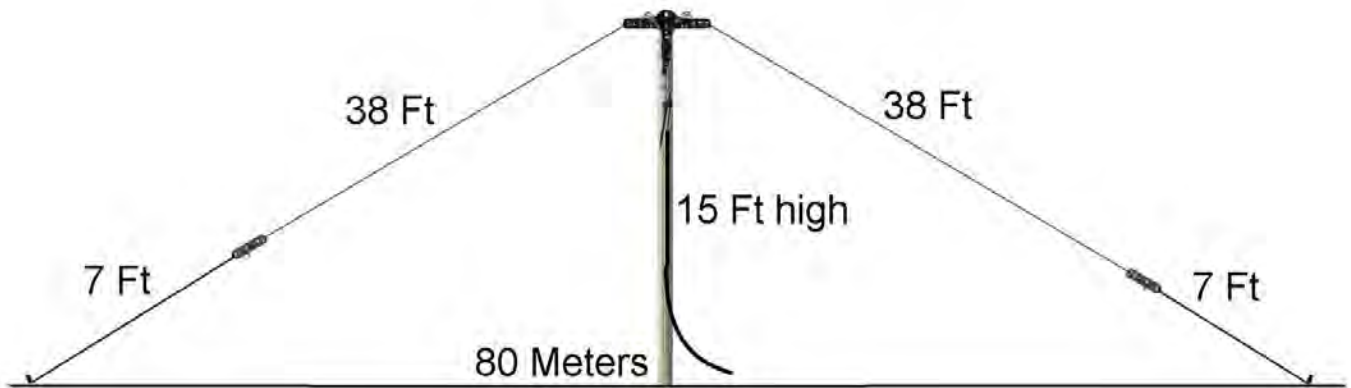


The overall length from the center "T" to each tent peg is 45 feet (diagonal measurement). This sets up each leg of the NVIS antenna to the proper angles.

When the antenna is set up, run the **DXE-8XDX100** RG-8/X coaxial cable to your tuner and connect the tuner to your transceiver. The tuner is necessary to provide the correct impedance match for proper operation with your transceiver. You are ready to get on the air using NVIS technology with a portable antenna that can be packed up and taken just about anywhere! Additional Tuning Information: Since the antenna is based on the military version, stay with the measurements shown. If you connect an antenna analyzer to this antenna as show, you will get erroneous readings due the lengths of the elements and their proximity to ground. Don't prune or add wire to the elements. It really works as-is.



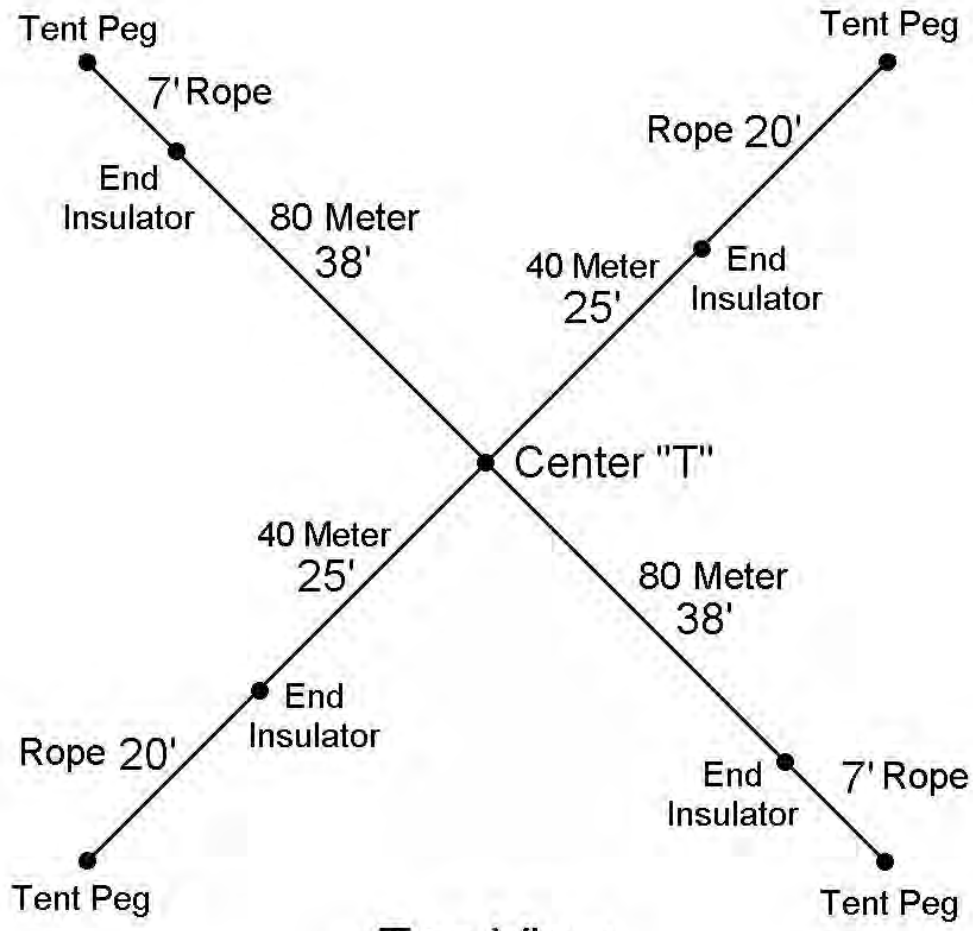
### Side Views



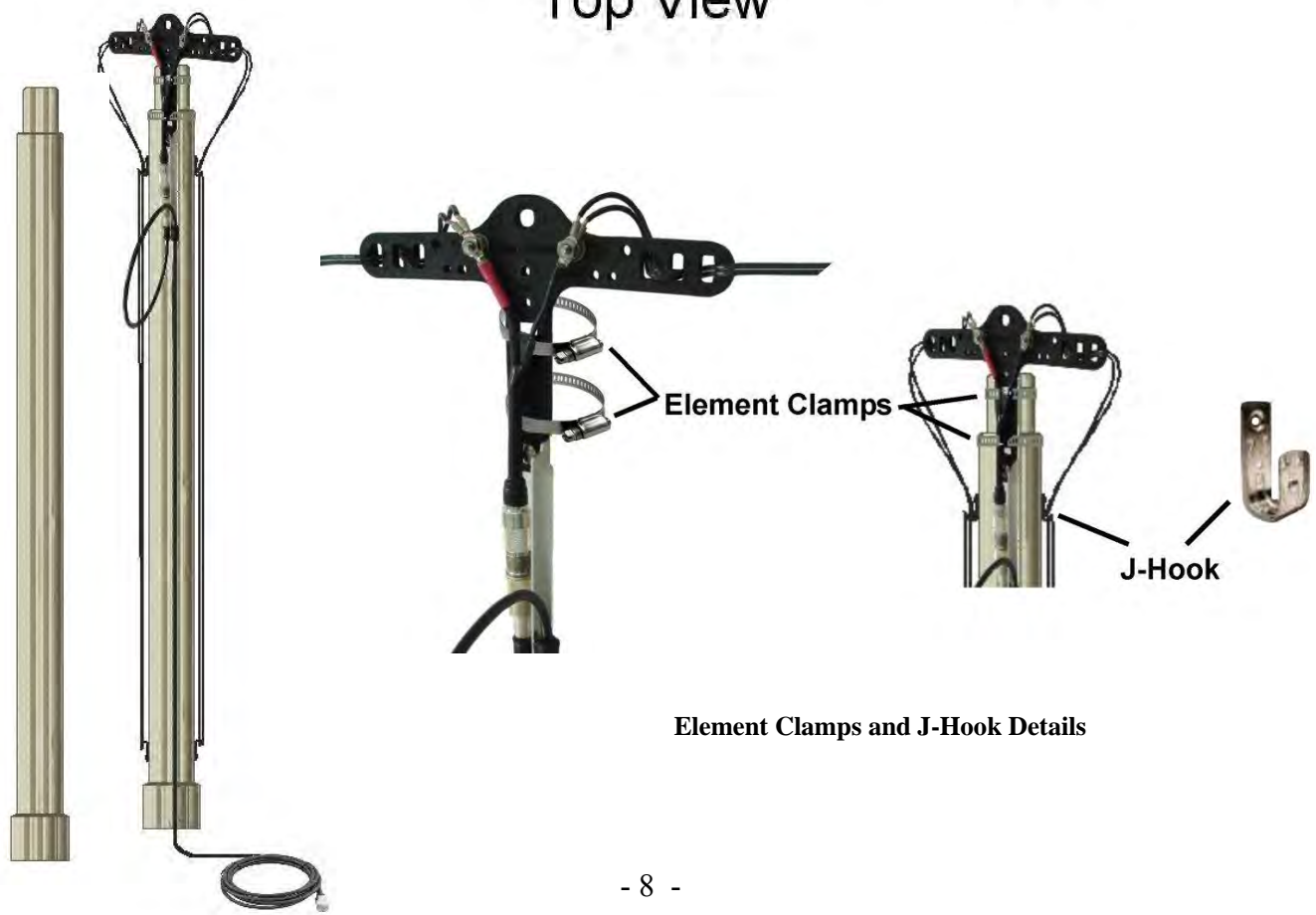
### Center "T"







Top View



Element Clamps and J-Hook Details

## DX Engineering Parts Used

### DXE-UWA8X-KIT Universal Wire Antenna Kit for RG-8/X

This model of our patented **EZ-BUILD®** versatile insulator kit is for building wire antennas of almost any design for low to medium power operation. It includes a new, completely unique coaxial cable connector and feedline strain relief system. This kit includes the patented light weight, high strength, UV-protected Center-T and End Insulators. They feature an exclusive serpentine wire grip for insulated DX Engineering Antenna Wire and our high strength, high power 300  $\Omega$  Ladder Line. The serpentine connection's grip is strong enough to permanently support the antenna wires without the need for looping or wrapping the wire ends. This allows fast and easy field adjustments of antenna length without soldering!

Stainless steel hardware is included. You can build wire antenna designs using any combination of wire or ladder line. Connection from your wire antenna to your coax cable is made with a pre-assembled coax cable and adapter that accepts a feedline with a PL-259 / UHF male connector. The feedline is secured with the included aluminum bracket, neoprene cushioned P-clamps and stainless steel hardware. This method supports the feedline without subjecting connectors to the strain of the coaxial cable's weight. The Center-T includes a centered top 3/8 inch hole for attachment of an antenna support rope, and the End Insulators accept up to 5/16 inch antenna support rope.

The DX Engineering Universal Wire Antenna Kits let you create any type of wire antenna including single band, multi-band, multi-frequency or folded dipole, doublet and inverted-vee, off-center fed, Windom, Zepp, long wires, rhombic, vee beam, and loop antenna. The **DXE-UWA8X-KIT** will handle low and medium power levels and tolerate low SWR levels.



The **DXE-UWA8X-KIT** includes:

- One patented Center-T Insulator featuring an exclusive no-loop, no solder, wire and 300  $\Omega$  ladder line grip which allows for rapid field adjustment of wire lengths – Center-T includes a centered top hole for attaching a support rope
- Two patented End Insulators featuring the no-loop, no solder grip design mentioned above
- Two stainless steel wire connection bolts, nuts and washers
- Four crimp ring terminals for the antenna and ladder line wire connections
- One pre-soldered and tested coax, connector and adapter assembly
- One aluminum cable strain relief bracket and mounting hardware
- Two strain relief P-clamps with neoprene cushions sized to grip only RG-8X without crushing the coaxial cable
- Additional hardware for mounting a DX Engineering Balun

### DXE-ANTW-150 - #14 Insulated Antenna Wire, 80M & Up, 150 Ft.

Use this wire to achieve top performance and long, trouble free operation. This antenna wire kit uses insulated wire that is UV resistant and pays out easily, unlike the wire that is commonly available at the big box stores which coils and kinks. It will last much longer in contact with the environment than bare wire.

- Heavy #14 AWG stranded copper antenna wire
- 150 feet, more than enough for a half wavelength 75/80 meter dipole
- UV-resistant insulation
- Reduces precipitation static
- Long, reliable life



### **DXE-ECL-24SS - (or DXE-ECL-2000-10) Element Clamp for 1-7/8 to 2 in. tube**

Typical elements are built using 0.058" wall tubing, which allows successive sizes to slide together with good contact. These clamps are used to hold the telescoping tubing in place at the length that you have chosen. Our clamps are Marine grade - meaning that they are made **entirely** of stainless steel as opposed to the normal hardware store variety.

- Marine grade clamp.
- High nickel alloy stainless steel meets the demands of severe corrosive environment.



### **DXE-8XDX100 - Coax Cable DXE RG-8/X, with PL-259 Connectors - 100 ft.**

Connectors: PL-259 Connectors at each end, Length: 100 ft.

Conductor RG Type: 8/X AWG: 16 Stranded: 19x29 Conductor Material: Bare Copper

Insulation Material: Gas injected FPE- Foam Polyethylene

Insulation Diameter: .155 in., Outer Shield Type: Braid Outer Shield Material: Bare Copper

Outer Shield % Coverage: 96% , Outer Jacket Material: PVC Type II Non-Contaminating

Overall Nominal Diameter: .242 in.



### **SYN-DBR-94-100 - 3/32 in. Diameter, Double-Braid Dacron/Polyester Rope, 100 ft. Roll**

Synthetic Textile Industries Double-braided Dacron/Polyester ropes are not weakened by decay or mildew and provide excellent resistance to abrasion. The color sealed black polyester yarn used in the braided jacket also protects the cord from damage due to ultra-violet light.

- 100' spool
- 3/32" diameter rope
- Double-braided Dacron/Polyester rope
- Excellent resistance to abrasion
- NOT weakened by decay or mildew
- UV-Resistant
- Rated for a load of 260 lbs.



### **DXE-UWA-END-KIT - End Insulators, Package of 8**

This kit includes eight of the patented light weight, high strength, UV-protected End Insulators used in the UWA KITS. They feature an exclusive serpentine wire grip for insulated DX Engineering Antenna Wire and our high strength, high power 300  $\Omega$  Ladder Line. The serpentine connection's grip is strong enough to permanently support the antenna wires without the need for looping or wrapping the wire ends. This allows fast and easy field adjustments of antenna length without soldering!



## Technical Support

If you have questions about DX Engineering products, contact DX Engineering at (330) 572-3200. You can also e-mail us at:

[dxengineering@dxengineering.com](mailto:dxengineering@dxengineering.com)

## Warranty

All products manufactured by DX Engineering are warranted to be free from defects in material and workmanship for a period of one (1) year from date of shipment. DX Engineering's sole obligation under these warranties shall be to issue credit, repair or replace any item or part thereof which is proved to be other than as warranted; no allowance shall be made for any labor charges of Buyer for replacement of parts, adjustment or repairs, or any other work, unless such charges are authorized in advance by DX Engineering. If DX Engineering's products are claimed to be defective in material or workmanship, DX Engineering shall, upon prompt notice thereof, issue shipping instructions for return to DX Engineering (transportation-charges prepaid by Buyer). Every such claim for breach of these warranties shall be deemed to be waived by Buyer unless made in writing. The above warranties shall not extend to any products or parts thereof which have been subjected to any misuse or neglect, damaged by accident, rendered defective by reason of improper installation, damaged from severe weather including floods, or abnormal environmental conditions such as prolonged exposure to corrosives or power surges, or by the performance of repairs or alterations outside of our plant, and shall not apply to any goods or parts thereof furnished by Buyer or acquired from others at Buyer's specifications. In addition, DX Engineering's warranties do not extend to other equipment and parts manufactured by others except to the extent of the original manufacturer's warranty to DX Engineering. The obligations under the foregoing warranties are limited to the precise terms thereof. These warranties provide exclusive remedies, expressly in lieu of all other remedies including claims for special or consequential damages. SELLER NEITHER MAKES NOR ASSUMES ANY OTHER WARRANTY WHATSOEVER, WHETHER EXPRESS, STATUTORY, OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS, AND NO PERSON IS AUTHORIZED TO ASSUME FOR DX ENGINEERING ANY OBLIGATION OR LIABILITY NOT STRICTLY IN ACCORDANCE WITH THE FOREGOING.

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