

Cushcraft

Amateur Radio Antennas

HV-4E Vertical Antenna



CAUTION: Read all instructions before operating equipment.

Assembly and Instruction Manual

Cushcraft

Amateur Radio Antennas

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Version 0

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WARNING: Improper installation and assembly can be hazardous! Read these instructions thoroughly before attempting to assemble, install, or operate this product! High power transmitting devices produce voltages that can cause severe burns or other injuries.

Introduction

The HV-4E Vertical Antenna is an economical 18 ft low profile antenna designed to improve operating efficiency and bandwidth on 40M. On 40M the antenna is a center loaded vertical and on 20-10M it is a top loaded vertical.

The power rating of this antenna varies from band to band. The PEP ratings are primarily determined by the voltage breakdown of the components, while the CW and RTTY/DIGITAL ratings are generally determined by the components heating. Exceeding the rated powers can cause excess coil heating.

Power Rating

The following chart lists the power rating and the 2:1 VSWR bandwidth of this antenna:

Band	Power			Aprox. Bandwidth
	CW	SSB	RTTY/ DIGITAL	
40m	500	1200	500	150KHz
20m	400	1000	400	420KHz
15m	800	1500	800	1300KHz
10m	600	1500	600	570KHz

PREPARATION

This antenna although it is not heavy, is large and cumbersome for one person to handle.

It has lots of pointy rods that protrude in every direction from the center of the antenna. Safety glasses are recommended during the assembly and tuning. Assemble the antenna away from other people. Do not allow children in the assembly area. Only the people involved in the construction should be near.

WARNING

KEEP THIS ANTENNA AWAY FROM POWER LINES

Never mount or move any antenna where it can come into contact with power lines. If this antenna comes into contact with power lines, it can KILL you. Never mount any antenna where if it fell it could come into contact with power lines.

Assembly can be done by one person but when the antenna is to be mounted or moved, plan to have a friend to help. It is not wise to attempt to install any antenna without help. You will need some type of support on each end of the antenna while you are installing the spokes into the rings. The antenna can not rest on the ground after the spokes are installed. Assembly and tuning of the antenna will take time so allow several hours for this. Don't rush. The more time you put into the antenna, the better the results will be.

CHOOSING A LOCATION FOR THE ANTENNA

The best performance on receiving and transmitting will be obtained by mounting the antenna in a clear location above or away from buildings, towers, feed-lines, utility wires, and other antennas. While your own ingenuity and particular circumstances will determine the final mounting method, we will pass along a few ideas for both permanent and portable installation.

WARNING: Always mount this antenna so that it is out of the reach of adults as well as children. The capacitance elements (spokes) can cause injury and or severe RF burns.

- **Never** place this antenna in a location that will permit people to encounter the loading spokes or any other part of the antenna.
- **Never** place this antenna where a mechanical failure might allow the antenna to contact power lines or other utility wires.
- **Always** ground the feed-line at the point where it enters a building to a good earth ground for lightning protection.
- **Follow** the guidelines for antenna installations as recommended by the US consumer product safety commission.

INSTALLATION

The HV-4E was designed as an efficient low profile antenna. The antenna installation **MUST** be protected with non-metallic fencing to provide personal safety and to prevent antenna damage. The antenna can be installed using the supplied mounting bracket and a suitable ground radial system.

IMPORTANT: A suitable ground plane must be installed with this antenna.

PORTABLE SETUP

The antenna may be disassembled to the extent necessary for transporting to a temporary location. Before the antenna is disassembled, some type of marks should be placed on the mast of the antenna to ensure it will be the same height as before. ***Some retuning may be required after moving the antenna.***

The MFJ-1901 MFJ Portable Ground-Coupled Antenna Base is ideal for portable use.

WARNING: If the antenna falls it will be damaged and may cause serious injury. Whatever type of installation you choose, remember that the antenna should be installed where it can ***never*** be contacted by people or animals.

MFJ Optional Accessories (not included)

HV-4TB Tilt Base

MFJ-1901 MFJ Portable Ground-Coupled Antenna Base

GKR-6160 or MFJ-1932 Ground Radial Kit

GR-1 or MFJ-1934 Ground Rod

TOOLS AND TIME REQUIRED FOR ASSEMBLY

The estimated assembly time for this antenna is 1 hour. Antenna assembly requires the following hand tools:

- [] 5/16" nut driver
- [] 7/16" open end wrench
- [] large wire cutters (to cut aluminum spokes)
- [] small pliers
- [] #2 Phillips screwdriver
- [] suitable eye protection

In addition, you will need two stable supports (i.e. saw horses or trash cans) to aid in assembly.

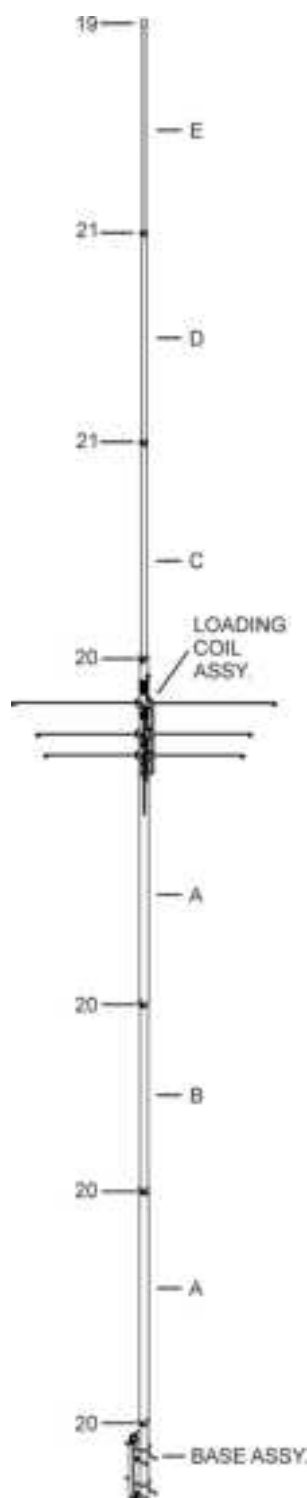
For installation you will need some additional items not supplied with the antenna installation kit.

- [] Quality low-loss 50-Ohm coax with a PL-259 to go from the antenna to the transmitter.
- [] Either an SWR meter or Antenna Analyzer (MFJ-259, 269)

SAFETY PRECAUTIONS:

WARNING: You can be killed if the antenna, feedline, or the equipment used to install the antenna accidentally contacts any utility lines. Never install an antenna near power lines!

1. Be careful while carrying the antenna. It is heavy enough to cause you to lose your balance if it is handled too casually or if the capacitance spokes become entangled in obstructions.
2. Mount the antenna in a way so that it is out of reach. The ends of the capacitance spokes can cause eye injury, serious RF burns or both.
3. Make sure that a mast, if used, is sturdy enough to support the weight and the wind load.



INCLUDED PARTS, KITS, AND ASSEMBLIES

Kits and Assemblies

HV-4E	Main Package Masts
50-HV4E-LC	Loading Coil Assembly
17-HV4E-LC	Loading Coil Hardware Kit
17-HV4E-SP	Loading Coil Spoke Kit
17-HV4E-MT	Mounting Hardware Kit
17-HV4E-MP	Antenna Mounting Plate Assembly

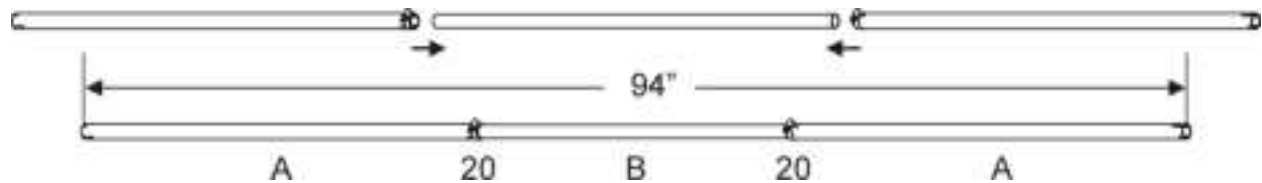
HV-4E Antenna List by Individual Parts

ID	QTY	Item No.	Description	In Kit or Assembly
R1	4	810-HV4E-8	8" Bent Radial	17-HV4E-SP
R2	4	810-HV4E-10	10" Bent Radial	17-HV4E-SP
R3	4	810-HV4E-14	14" Bent Radial	17-HV4E-SP
1	1	10-HV4E-LC	Coil Form 20" L x 1" OD drilled	50-HV4E-LC
2	1	737-1796-1	Jumper Bracket 1	50-HV4E-LC
3	1	737-1796-2	Jumper Bracket 2	50-HV4E-LC
4	1	737-1796-3	Jumper Bracket 3	50-HV4E-LC
5	24	656-0375S	6-32x0.375 SS Screw	17-HV4E-LC
6	35	705-0632S-K	6-32 SS KEP Nuts	17-HV4E-LC & 50-HV4E-LC
7	11	656-1500S	6-32x1.5 SS screw	17-HV4E-LC & 50-HV4E-LC
8	1	711-0627S	#6 Internal Tooth SS Lock Washer	17-HV4E-LC
9	6	745-3109	4 Spoke Radial Clamp Bracket	50-HV4E-LC
10	1	735-HV4E-BA	HV-4E Antenna Mounting Plate	17-HV4E-MP
11	1	811-HV4E	Fiberglass Base Section 16" long	Main Package
12	4	010401	U-Bolt	17-HV4E-MT
13	8	010104	Flat Washers	17-HV4E-MT
14	8	010084	Split Ring Lock Washers	17-HV4E-MT
15	8	010085	1/4-20 SS Nut	17-HV4E-MT
16	1	610-2001T	Coax Connector	17-HV4E-MP
17	2	654-0500S	4-40x1/2 SS Screw	17-HV4E-MP
18	2	705-0440S-K	4-40 KEP NUT	17-HV4E-MP
19	1	050053	1/2 Plastic End Cap	17-HV4E-LC
20	5	30411	Hose Clamps 1.25 #12	17-HV4E-MT
21	2	30409	Hose Clamps 0.875 #6	17-HV4E-MT
A	2	810-HV4E-A	Mast Section A 36" long	Main Package
B	1	810-HV4E-B	Mast Section B 36" long	Main Package
C	1	810-HV4E-C	Mast Section C 36" long	Main Package
D	1	810-HV4E-D	Mast Section D 36" long	Main Package
E	1	810-HV4E-E	Mast Section E 36" long	Main Package
	8	720-3067	#6 Solder Lug	50-HV4E-LC
	24 ft	874-1611	16 AWG GP/MR-200 Magnet Wire	50-HV4E-LC

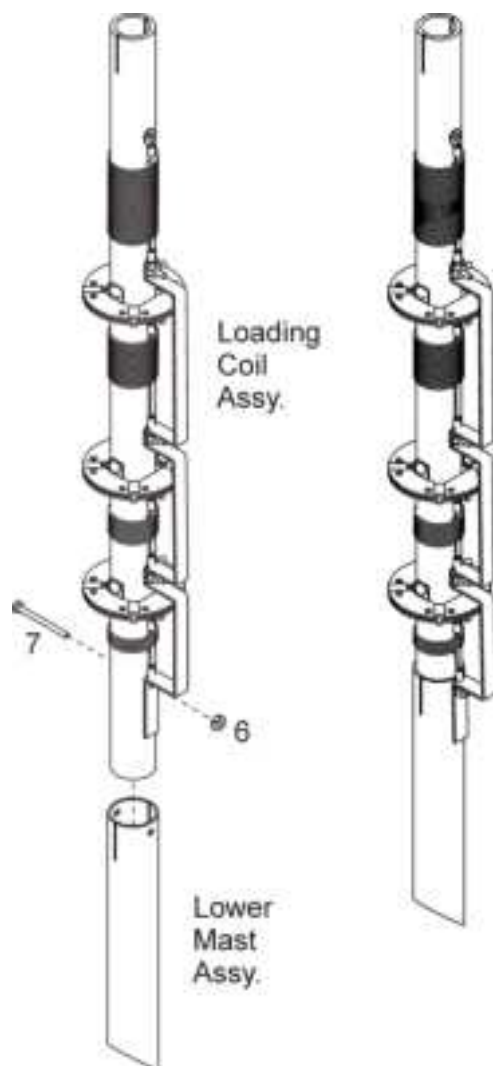
ASSEMBLY

Lower Mast Assembly

Using the two mast section A and the mast section B and two 1.25" hose clamps push the section B into one of the section A about 3 inches and tighten down the hose clamp. Slide the other section A onto the other end of the section B and tighten down the hose clamp. Adjust the length to where the bottom mast is 94" long.

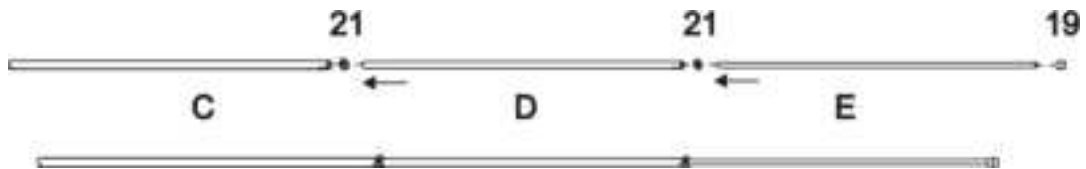


Lower Mast Attachment



Attach the lower mast assembly to the loading coil assembly using 6-32x1.5 SS screw (7) and 6-32 KEP nut (6). Slide the mast assembly over the fiberglass tube and align the hole in the aluminum tube with the fiberglass tube. Slide the screw through the holes and attach the nut. The solder lug will be between the aluminum tube and the jumper bracket. Tighten the nut and screw.

Upper Mast Assembly



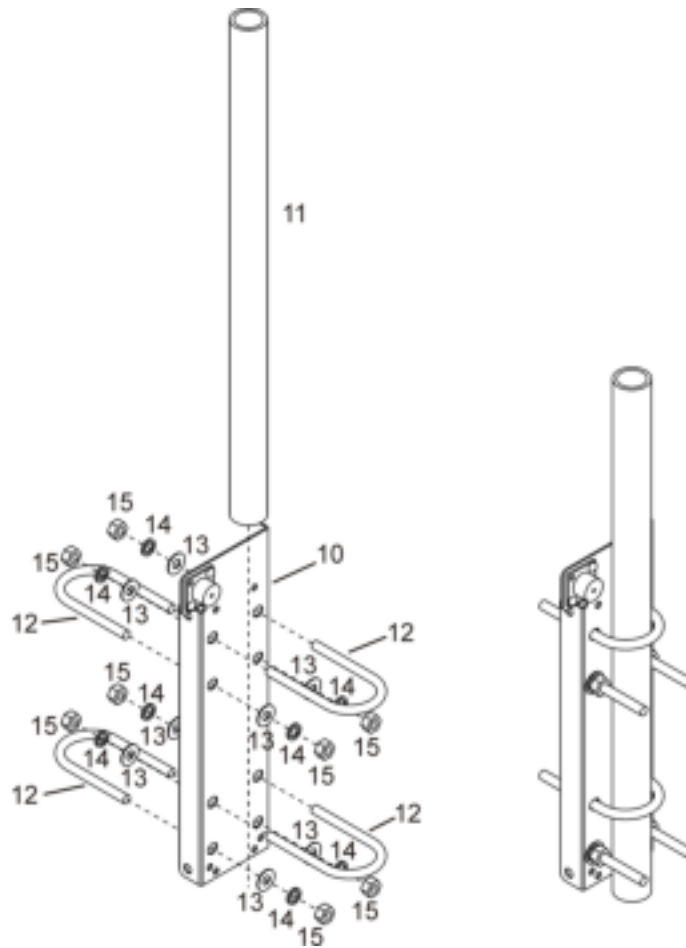
Slip section D non-slotted end into section C slotted end about 2 inches and clamp with the 0.875" hose clamp (21). Slip section E into section D slotted end about 2 inches and clamp with the 0.875" hose clamp (21). Slip the end cap (19) over the section C end. The final length will be adjusted when tuning the 40M band.

Upper Mast Attachment



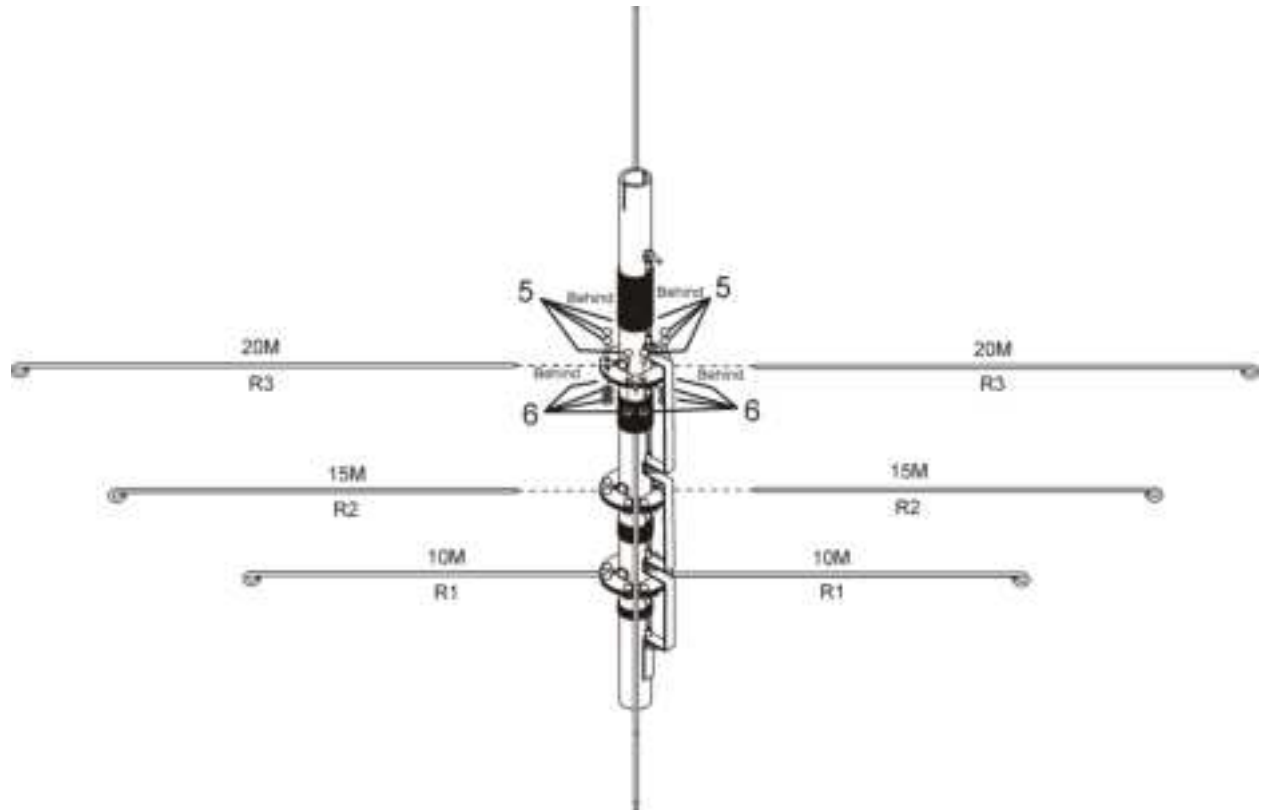
Slip the upper mast assembly and the 1.25" hose clamp (20) into the loading coil assembly and align the holes then slide the 6-32x1.5 SS screw (7) and #6 lockwasher (8) through the holes and the solder lug. Attach the 6-34 KEP nut (6) to the screw and tighten down. Tighten the hose clamp.

Base Assembly

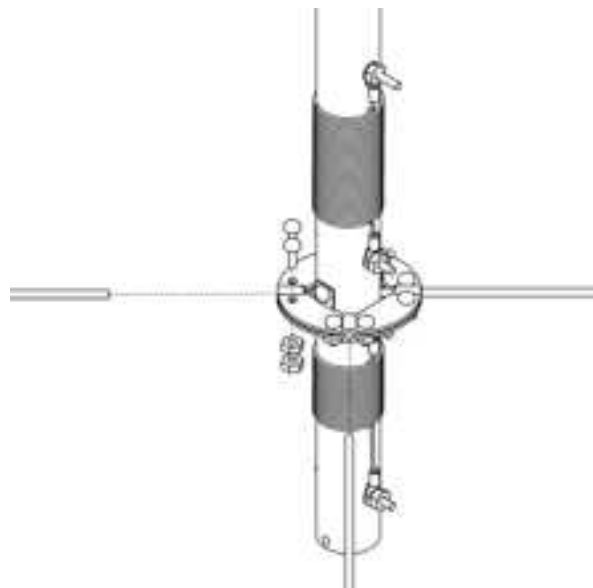


Assemble the base using the Base Plate (10), four U-Bolts (12), eight $\frac{1}{4}$ " flat washers (13), eight $\frac{1}{4}$ " lock washers (14), and eight $\frac{1}{4}$ -20 nuts. Loosely attach the U-Bolts then slide the fiberglass base insulator (11) into the U-Bolts as shown in the picture and tighten up the U-Bolts holding the fiberglass base insulator.

Radial Spoke Assembly

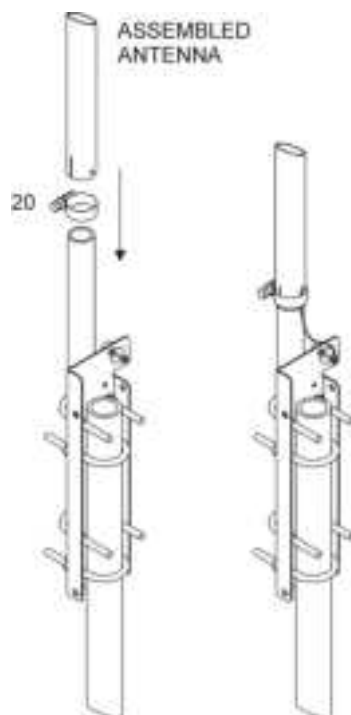
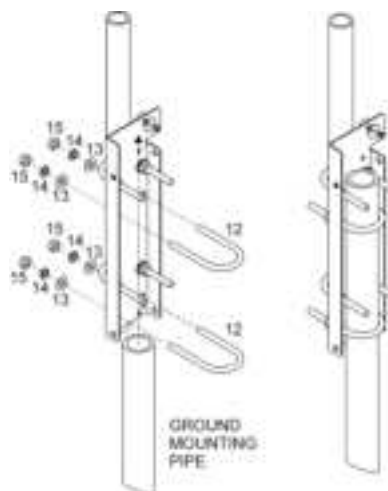


Each radial spoke level requires eight 6-32x.375 SS screws (5) and eight 6-32 KEP nuts (6) for a total of 24 of each. For initial assembly the R1 and R2 radial spokes are 14 inches long and the R3 radial spokes are 18 inches long. They will be trimmed to the correct length in the tuning phase of the assembly. For each level attach the eight screws and nuts loosely. Push the correct radial spokes for each level into the radial spoke clamps. Tighten the screws and nuts some so they do not fall off while tuning.



Base Mounting

The base mount is designed to clamp to a pipe of 1" to 1-1/2" OD. A galvanized water pipe 1" nominal (OD of 1.335") is ideal for mounting the antenna base. The exact way of mounting the pipe is up to you but it is suggested that a 4 ft piece of 1" galvanized pipe is driven 2-3 ft deep vertically into the ground. Clamp the base plate to the galvanized pipe with the U-Bolts on the side opposite to the fiberglass tube.



Slide the assembled antenna and the 1.25" hose clamp (20) onto the fiberglass tube. Place the wire from the coax connector under the hose clamp between the clamp and the antenna mast. Raise the antenna mast up so it is about 1 inch above the mounting base plate then tighten the hose clamp to hold the antenna and wire in place on the base. Make sure the wire or the mast section does not touch the base plate.

RF GROUNDING

The antenna requires multiple ground radials to properly operate. A single ground rod or the ground mounting pipe is not adequate and the antenna will not tune up. The MFJ-1932 or GKR-6160 ground radial kits will work adequately with this antenna. Attach one end of the ground radials to the base plate ground holes using 6-32 or 8-32 screws and nuts. Spread the radials out just under the ground. For more information on antenna ground systems see references such as the ARRL Antenna Book and many internet sources. Do not place the radials where people can trip on them or lawnmowers can catch them on the blade.

ANTENNA TUNING

Tuning of the antenna requires some patience with the trimming of the radial spokes for each band. Checking the results can be done with an SWR meter but it is strongly suggested to use an antenna analyzer because the initial tuning will be outside of the amateur bands and using an analyzer will make tracking changes much easier. Exact lengths of the spoke radials will vary depending on the ground system, mounting location, and items near by the antenna.

When tuning, do not stand close to the antenna. Stand about 10-20 ft away from the antenna so your body will not detune the antenna.

FREQUENCY AND SWR ADJUSTMENT

This antenna covers wider frequency ranges on the higher bands, and narrower segments on the lower frequency bands. The 40 meter band has the narrowest range of operation (approximately 150 KHz) and is the most sensitive to adjustments.

The entire antenna must be accessible during initial tuning and testing. If the MFJ-1901 *Ground Coupled™* Portable Antenna Base is used, attach the antenna to the base and place it in a location away from buildings or other objects that could affect the measurements. If the portable antenna base is not used, it is best to install the antenna on the final mounting pipe or a short, temporary mast or pipe.

IMPORTANT: A suitable Ground radial system must be connected to the antenna mounting bracket if the Ground Coupled Portable™ Antenna Base is not used.

The SWR can be measured by using a transmitter and SWR bridge or an SWR Analyzer. The measuring device should be connected to the antenna with a length of high quality 50-Ohm coaxial cable. If using a transceiver and SWR meter, set the transceiver to the lowest possible power to take measurements.

Please read the following hints:

- **The normal resonant frequency of this antenna is at or below the bottom of each amateur band.** This allows the user to "trim" a small amount off the *inside end* of the capacitance spokes to raise the resonant frequency. Conversely, adding a longer capacitance spoke will lower the resonant frequency of a loading assembly. Spare spokes are included in case you need to lower the resonant frequency of the antenna.
- **If the suspected resonant frequency is lower than your equipment can detect**, for example below 14 MHz, take one 20 meter spoke entirely off the antenna. Measure the resonant frequency again. If the resonant frequency still cannot be found, check another band. If none of these tests results in a good SWR on any frequency, substitute a 50-Ohm load for the antenna to test the feed line. If the SWR checks good, the antenna assembly will have to be checked for proper assembly, shorts, or openings at the feed point of the antenna.
- **If the antenna operates normally higher than the band after one spoke is removed**, install all the spokes and trim each spoke in 1/4 inch increments. The spokes for each band should be cut to the same length.
- **Once the resonant frequency is found**, use the chart located under the section Tuning The Antenna section of this manual to estimate the amount of the spoke length to cut so that the antenna will resonate at your favorite section of the band.

CAUTION: Always start tuning on 40 meters and adjust each band progressively higher in frequency. Adjustment of a lower frequency band will always have the most effect on the next higher frequency band. The tendency of the interaction is that if you move one band higher ALL the other bands move higher, but only very slightly. It is always best to "shoot for" the lowest end of the range you intend to use, and "trim in" by adjusting the bottom loading assembly after the antenna is in it's final location. ALWAYS work from the lowest frequency band up.

Tuning the Antenna

1. Measure and record the frequency where the lowest SWR occurs on for each band. The lowest SWR should be at or below the bottom end of each HF band. The SWR should be below 2:1 at resonance on each band.

2. The following is a typical chart for initial measurements of a new antenna before tuning:

40 M	1.3:1	about	6.97 MHz	for 98" upper mast
20 M	1.2:1	about	13.7 MHz	for 14" spoke
15 M	1.2:1	about	20.65 MHz	for 10" spoke
10 M	1.4:1	about	27.1MHz	for 8" spoke

If the resonant frequency is lower than what your equipment detected, take one spoke off to raise the resonant frequency. Measure the resonant frequency and calculate the approximate resonant frequency as if the spoke was in place using the chart on the below.

CAUTION: Never trim the outer (rounded) end of the spokes. The sharp end that remains can be a safety hazard and the power handling of the antenna will be greatly reduced on some bands.

IMPORTANT: Due to the sensitivity of the resonant frequency on this antenna, small increments, such as 1/4 inch, should be considered when cutting the spokes to find resonant frequency.

Begin tuning by adjusting the 40 meter upper mast. Continue adjusting until the antenna resonates approximately 15 KHz below the desired operating frequency.

Use the chart below to **approximate** the amount of spoke to be trimmed. Trimming only one spoke from the top or bottom results in half the frequency change.

40 M:	1" reduction of upper mast equals	approximately	32 KHz
20 M:	1" trimmed off each of the spokes equals	approximately	323 KHz
15 M:	1" trimmed off each of the spokes equals	approximately	525 KHz
10 M:	1" trimmed off each of the spokes equals	approximately	437 KHz

3. Now tune progressively higher frequency bands by trimming the spokes. Do not cut off the spokes from the rounded end. Keep each set of capacitance spokes equal in size. **20 meters must be the second** HF band adjusted, **15 the third**, and **10 meters last**. After adjusting 10 meters go back and check the other bands. Tighten all spoke screws. Remember the frequency of the adjacent frequency bands will shift slightly as the next band is tuned.

Note the ground wire lengths may shift the resonant frequency as well as the best SWR.

SAFETY GROUNDING CONSIDERATIONS

SAFETY GROUNDING MUST be provided to protect equipment, property, and persons from the hazards of lightning strikes and other weather related electrical discharges. In addition the coaxial cable feeding the antenna should have the shield grounded to eliminate the risk of any indoor equipment failure that would allow hazardous voltages to appear indoors creating a shock hazard.

Follow local electrical codes and NFPA grounding and bonding requirements for all grounding. A single ground rod is not sufficient.

MAINTENANCE

Your antenna is constructed of heavy-duty non-corrosive materials and should withstand normal climates for many years. The use of some type of coaxial connector moisture protection is recommended at the bottom coax connection, especially in coastal areas where salty mist is commonplace.

NOTES:

LIMITED WARRANTY

Cushcraft Amateur Radio Antennas, 308 Industrial Park Rd., Starkville, MS 39759, warrants to the original consumer purchaser for one year from date of purchase that each Cushcraft antenna is free of defects in materials or workmanship. If, in the judgment of Cushcraft, any such antenna is defective, then Cushcraft Amateur Radio Antennas will, at its option, repair or replace the antenna at its expense within thirty days of the date the antenna is returned (at purchasers expense) to Cushcraft or one of its authorized representatives. This warranty is in lieu of all other expressed warranties, any implied warranty is limited in duration to one year. Cushcraft Amateur Radio Antennas shall not be liable for any incidental or consequential damages that may result from a defect. Some states do not allow limitations on how long an implied warranty lasts or exclusions or limitations of incidental or consequential damages, so the above limitation and exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights that vary from state to state. This warranty does not extend to any products that have been subject to misuse, neglect, accident or improper installation. Any repairs or alterations outside of the Cushcraft factory will nullify this warranty.

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