



***EF-240S and EF-240S/H***  
**40 Meter Linear Loaded 2 element Yagi**

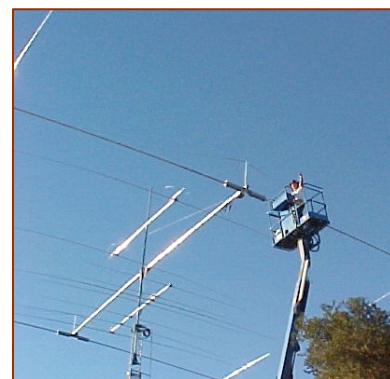
FREQUENCY COVERAGE: 6.850 - 7.500 MHz (adjustable)

**Force 12**

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The Elite Force ***EF-240S*** is 2 element 40 meter yagi antenna utilizing shortened 40 meter elements and is shown in the photo above a Sigma-280 Magnum 2 element 80/75 mtr Yagi. Each element is the ***EF-140S***, which is 37.8' long, or 56% of full size. The ***EF-140S*** element utilizes a single linear loading system that is physically located above the element in a "V" format. The elements use FORCE 12's linear loading design, which provides the highest feed point impedance and broadest bandwidth of any shortened antenna to date. The 2 element yagi is a driver and reflector design. Both elements are physically identical and their function is determined by how each is tuned. The reflector is tuned lower in frequency than the driver and the driver is tuned to the center frequency of desired operation. The reflector element has a jumper across the center feed point and the driver receives the feed line. As of July, 1998, the standard element design has been strengthened using an additional inner liner of .750" and .875" at the point of maximum element compression (this is the first tubing junction out from the center). This increased the rating for both to 95 mph. The ***EF-240S/H*** is for 120 mph winds and assembly detail is on the "H" drawing.



The antenna is shipped in sub-assemblies and each assembly section is appropriately identified. Each element is divided into two (2) halves: "A" and "B". Assembly requires only that the element side identifications are matched, such as "A1-A1; A2-A2; B1-B1", etc. to construct an element. All the rivet holes are pre-drilled and will align exactly when the proper sections are matched. Sometimes the elements are built in large lots and are controlled with a consecutive manufacturing number. This number is left on the elements to enable matching the halves together (i.e. 2A and 2B; 5A and 5B; 9A and 9B; etc.) Any pair makes a full element. The boom is in several sections and adjacent sections are marked "A-A", "B-B", etc. Matching up the sections completes the boom.

The expected 2:1 VSWR bandwidth of the ***EF-240S*** is more than 100 kHz at the antenna, typically being about 130 kHz. After a typical run of coax, the slight amount of loss in the coax will widen the VSWR response of the antenna. This is normal. The driver can be set for lowest VSWR by moving the tuning jumpers on each side of the element equal amounts until the desired frequency/low VSWR is obtained. The input impedance at the feed point is less than 50 ohms and is stepped up to 50 ohms by using a hairpin match mounted across the feed point. This hairpin is in the form of a "helical hairpin", or coil, as a typical hairpin would be physically too large. The match to 50 ohms is adjusted by making the spacing on

the coil wider or narrower. If the antenna is set for a VSWR of 2:1 at 7.000 MHz, the 2:1 point on the high side should be about 7.130 MHz. A tuner can be used with this antenna if desired. Since the antenna is balanced, a balun or RF choke should be used for the connection from the coax to the antenna. This will prevent current from flowing on the shield of the coax due to the balanced ("bal" in balun) antenna being fed by the unbalanced ("un" in balun) coax feed line.

The *EF-240S* may also be used on other bands with a tuner (and with reduced power), remembering that the loss in a non-resonant system (antenna plus line) will be the line loss with the higher VSWR at the load. This might be quite acceptable for operation on more bands. The reflected power due to the higher VSWR at the load is passed through the coax twice: once back to the tuner (or output circuit of the rig), where it is re-reflected back out to the antenna, through the coax the second time. The reflected power is not absorbed by the final amplifier of the transmitter! The *EF-240S* will not be efficient on 20 meters, as it is designed to be highly reactive on the even harmonics. This design feature enables interlacing of 40 meters with 20 meter antennas. It can be mounted parallel to 20 Meter elements within about four (4) feet without de-tuning them, which makes for a fine interlaced 20/40 antenna.

The mechanical design of the *EF-240S* utilizes pre-aligned element-to-boom brackets and riveted elements. The elements are positioned underneath the boom, where gravity and Sir Isaac Newton said they would like to reside. The center support for the linear loading spreader is welded to the top of the element-to-boom bracket.

All the elements are insulated from the brackets and boom and both the reflector and driver elements are split at the center with a solid fiberglass insulator. Connection to is through a pair of 10-24 stainless machine screws. **As previously mentioned, the reflector is jumpered at the center. Since the driver is a balanced element and coaxial line is unbalanced, a means to choke off antenna current from the outside of the coax should be used.** Two devices are fine: one is an RF choke, made by winding several turns of the coax in a circle close to the feed point; or, a 1:1 balun can be used.

Some of the hardware is stainless steel. It is type 304, not 18-8, which is only rust resistant. The plated hardware is used for the element-to-boom bracket installation, with stainless lock washers and nuts to enable removal. Stainless U-bolts are not necessary, except in extreme environments and a preferred method is to paint these parts. Stainless hardware is easy to gall, meaning to freeze the nut on the shaft, rendering the bolt useless. If all stainless is required, please contact the factory. The entire antenna can be painted to eliminate any glint in the sun, although all methods have been employed to limit glint already. For example, the tubing is all 6061-T6, non-polished, and the brackets and plates are tumbled.

The mounting system is the easiest to use ever. It is the Easy-On™ mount and is so unique and useful, it is a copyrighted design, with a patent in the works, too. Two plates are provided and they have identical bolt patterns. They can be mounted upside-down and backwards, as they will always work properly. One is attached vertically to the mast, with a bolt through the top, center hole, being held in place by the mast and protruding outward. The second plate is attached to the boom. When the antenna is raised, the boom plate is placed over the bolt and the antenna is immediately held in place by the bolt and after the lock washer and nut are on, the antenna is secure. This eliminates the cumbersome multiple hands requirements to attach U-bolts and saddles while trying to hold the lock washers, nuts and antenna - with the wind blowing!!

*On to the assembly.....*

Tools required:

- A. Wrenches or ratchets, used for attaching the elements to the boom and the boom to the mast.
  - 1. 7/16"
  - 2. 1/2"
  - 3. 9/16"
- B. A 3/8" nut driver, or small crescent wrench for the feed point 10-24 nuts.
- C. A 5/16" nut driver for the cable clamps on the linear loading.
- D. Screwdriver to back-up the 10-24 feed point machine screws.
- E. Hand riveter, also called a "POP™", or blind riveter. These are available from the company, a local hardware store, or possibly your dealer where this antenna was purchased. This is used to secure the element sections together. Use the smallest nozzle (tip) for the 1/8" rivets.
- F. A rope to hoist the antenna into position.
- G. Some patience and common sense - be careful, as antennas can come into contact with high voltage lines and they are lethal. Also, be careful installing, as towers and masts are also dangerous.  
Thanks

## ***Assembly Instructions:***

NOTES:

- 1) Although the entire antenna has already been pre-assembled, it might be a good idea to double-check the measurements, especially on the elements. Please let us know if there are any discrepancies.  
Thanks.
- 2) When using the hand riveter, please be sure the smallest nozzle is in the tool. Sometimes with a larger nozzle, the mandrel of the rivet can get crooked within the tool, which can result in breaking the mandrel before the rivet is "popped." The smaller nozzle also makes a smooth finish on the rivet head.
- 3) The "A" and "B" halves of the elements are arbitrarily marked, so they do not need to be matched for a particular side (i.e. all half-side "A"s on a certain side of the boom). The markings are simply for ease in assembly.

### **I. ELEMENT ASSEMBLY**

- \_\_\_\_00) **NOTE: this entire antenna has already been assembled at the factory. This is how the holes get drilled and how the sub-assemblies are made. This means that every piece will align properly, provided that they are being assembled in the right position.**
  - \_\_\_\_00a) **It should never be necessary to drill a hole for a rivet, or bolt.**
  - \_\_\_\_00b) **Each element is dis-assembled and separately bundled, so working with one element at a time is the best method. This will ensure that only the parts for a particular element are available for assembly at one time.**
  - \_\_\_\_00c) **Please check the measurements and the element positions to double check us at the factory. It is rare that a marking mistake is made, but it can happen.**

- \_\_\_\_0) Each element is tapered and the taper runs smaller towards the tip. Each section slides into

another and to ensure a nice fit, the larger one is crimped/swaged to reduce its size slightly. This means that one end of each section is crimped/swaged and the reduced size of one end can be clearly seen. Only the tip is not done in this manner, since it is the end of the element.

- \_\_\_\_\_0a) Please be sure that the non-crimped/swaged end goes into the crimped or swaged end of the larger piece.
  - \_\_\_\_\_0b) If the rivet holes do not align, please check to be sure the section is oriented properly and that the correct side (A or B) is on the correct side. It should not be necessary to drill any holes.
  - \_\_\_\_\_0c) Thanks.
- \_\_\_\_\_1) Select one element to use as the **reflector and mark the area close to the center "reflector"**.
- \_\_\_\_\_a) Lay out the element assembly sections.
  - \_\_\_\_\_b) Side A
  - \_\_\_\_\_c) Side B
- \_\_\_\_\_2) Apply Noalox compound to each of the sections that will slip into another. This can be a thin coat, spread evenly along and around the portion that is inserted into the larger tubing.
- \_\_\_\_\_3) Starting at the tip, slide the tip into the next larger section and align the rivet holes.
- \_\_\_\_\_a) **Note: the first joint has an inner liner (triple wall) and uses the longer rivets.**
  - \_\_\_\_\_b) Insert the supplied 1/8" rivets into all rivet holes. It is important to insert all the rivets before any are pulled; otherwise, there is a possibility that the other holes might not align properly. To lessen this possibility, the holes are drilled to the actual rivet size (1/8"), which makes for a tight alignment and snug hole. If at any time it becomes necessary to remove a rivet, use an 1/8" drill and use the hole at the center of the rivet as the hole guide. Even if the hole is enlarged, the closed-end rivets will fill in the hole when they are pulled.
  - \_\_\_\_\_c) Pull each rivet with the hand riveter. The mandrel of the rivet (the "shaft") is inserted into the riveter and the handles of the riveter are squeezed. Sometimes, a complete squeeze of the riveter will not "pop" the rivet and release the mandrel. If this occurs, release the pressure on the riveter and push it back down over the mandrel (which will now be sticking out farther).
  - \_\_\_\_\_d) Slip each section into the matching larger tubing, as in the prior step and secure with the rivets. By starting at the tip, managing the element is physically easier.
- \_\_\_\_\_4) The entire tip section is joined to the inward, "trunk", section via a fiberglass insulator. The insulator is already attached to the largest diameter tip section using a machined stud that is passed through the tip section and secured with a ny-loc nut. The insulator is also already attached to the smallest diameter section of the trunk section in a like manner.
- \_\_\_\_\_5) Double check that both sides "A" and "B" have been fully assembled.
- \_\_\_\_\_6) Remove the 10-24 machine screw from the center section that does not have the fiberglass insulator.
- \_\_\_\_\_7) Insert this section over the fiberglass insulator until it butts against the internal stop, or

until the holes line up (tubing and fiberglass insulator). One end of the hole in the tubing has been filed. This indicates the side that from which the machine screw is inserted; thereby ensuring proper alignment of the holes.

- \_\_\_\_\_ a) Re-insert the 10-24 machine screw through the center tubing, which will now pass through the inserted fiberglass insulator. Secure as on the other element half, with a split lock washer and nut. The lock washers and nuts are used to secure the feed line.
  
- \_\_\_\_\_ 8) The element is always installed with the rivets pointing down. This will prevent any water from sitting in the rivets, although there is no hole actually going through them.
  
- \_\_\_\_\_ 9) Mark the other element close to the center as "**driver.**"
  
- \_\_\_\_\_ 10) Assemble the driver just like the reflector in the steps above.
  
- \_\_\_\_\_ 11) Set the elements aside, noting which one is which (reflector and driver).

## II. BOOM ASSEMBLY

- \_\_\_\_\_ 1) Lay out the boom sections in the assembly sequence (A-A, B-B) and note their engraved alignment marks.
  
- \_\_\_\_\_ 2) Lubricate the portions that will slip into the splices.
  
- \_\_\_\_\_ 3) Slip the first section into the matching splice, align with the marks and secure with 1/4-20 bolts and ny-loc nuts.
  - \_\_\_\_\_ a) Drop the bolts in from the top. In case the nuts ever come off, the bolts will hold the boom.
  - \_\_\_\_\_ b) Tighten the nuts until snug. It is not necessary to crunch the boom.
  
- \_\_\_\_\_ 4) Slip the section from the above step into the next splice, B-B, and secure as before. This completes the boom assembly.
  
- \_\_\_\_\_ 5) Note there is a boom truss cable only for the "H", 120 mph model.
  
- \_\_\_\_\_ 6) Attach one of the Easy-On™ mounting plates to the boom using a pair of 2" U-bolts and saddles, using split lock washers and nuts.
  - \_\_\_\_\_ a) Position it flat against the boom, at about the center of the boom.
  - \_\_\_\_\_ b) Tighten the nuts enough to hold it in position.
  - \_\_\_\_\_ c) It might get moved later for better balance, for installation, or for actual mounting to the mast. This provides the most convenience.
  - \_\_\_\_\_ d) NOTE: that the other Easy-On™ mounting plate is attached similarly to the mast during installation.

## III. MOUNTING THE ELEMENTS TO THE BOOM

- \_\_\_\_\_ 1) The element mounting plates are on the underside of the boom. The elements are always installed on the underside of the mounting plate with the rivets pointing down. This will

prevent any water from sitting in the rivets, although there is no hole actually going through the rivets. The elements are insulated from the plates with standard PVC tubing. The PVC is shielded from direct sunlight by the element plate. Long term PVC testing has shown it to remain effective for more than 10 years and still going strong.

- \_\_\_\_2) Locate the element-to-boom bracket marked, "reflector", which is where the reflector will be mounted.
- \_\_\_\_3) The reflector element should already be assembled to full length, except for the linear loading.
- \_\_\_\_4) Locate the short jumper wire and secure it across the 10-24 machine screws at the feed point, placing it under a washer, lock washer and nut.
- \_\_\_\_5) Slide the reflector underneath the boom and center it under the mounting bracket.
- \_\_\_\_6) Using the appropriate U-bolts, slide the U-bolts from the underside, over the element, over the PVC insulators and through the mounting bracket.
  - \_\_\_\_a) Add split lock washers and nuts, but DO NOT TIGHTEN yet, thanks.
  - \_\_\_\_b) Be sure that the slots in the PVC insulators are down.
  - \_\_\_\_c) Be sure that the rivets are pointing down.
  - \_\_\_\_d) Be sure that the studs in the outer insulators are approximately horizontal.
  - \_\_\_\_e) Center the element on the bracket, with enough clearance between the PVC and feed point screws to enable easy access to the nuts.
  - \_\_\_\_f) Check so that the feed point screws are about a 45 degree angle to the boom.
  - \_\_\_\_g) Now tighten the nuts on the U-bolts enough so that the element will not rotate, then about a turn more.
- \_\_\_\_7) Locate the remaining element, which is the driver.
- \_\_\_\_8) Attach the driver to the boom like the reflector, except (of course) at the driver location.
  - \_\_\_\_a) Place the element so that the 10-24 machine screws at the feed point are pointing towards the end of the boom, not the center. This is not really critical, it simply makes installation of the matching coil and feed line easier (less congestion).
- \_\_\_\_9) Both elements are now attached to the boom.
- \_\_\_\_10) Double check that the reflector has the jumper wire across the center feed point screws.

#### **IV. LINEAR LOADING ATTACHMENT**

- \_\_\_\_1) Please familiarize yourself with the linear loading system by reviewing the various drawings.
  - \_\_\_\_a) The alignment of the studs is very important.
  - \_\_\_\_b) These studs hold the linear loading wire at the outer insulator.
  - \_\_\_\_c) The studs must be aligned as in the drawing to ensure the correct phase relationship in the loading system.

- \_\_\_\_\_d) If you stand at the center of an element and face towards one tip, if the first stud you see is on the trunk part of the element, then the first stud behind you should be on the tip side of the outer insulator.
  - \_\_\_\_\_e) Please refer to the drawings.
- \_\_\_\_\_2) **USE CAUTION WITH THIS WIRE. IT IS CALLED ALUM-O-WELD AND IS ALUMINUM-CLAD STEEL. THE STEEL CORE MAKES THE WIRE HAVE A MIND OF ITS OWN. (IT IS ALSO VERY STRONG.)**
- \_\_\_\_\_3) **USE EYE PROTECTION.**  
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- \_\_\_\_\_a) **A hint in using the wire is to re-curve it before using it. This will tend to make it straighter and not coiled. You should wear gloves and eye protection.**
- \_\_\_\_\_4) The linear loading for the reflector is attached first.
- \_\_\_\_\_5) Select one of the linear loading cables (they are all the same length).
- \_\_\_\_\_a) Check that the studs are inserted properly and change them if necessary.
  - \_\_\_\_\_b) Pass it through the aluminum stud closest to the tip by loosening the 1/4-20 hex bolt in the end of the stud.
  - \_\_\_\_\_c) Leaving about 1/2" of the wire towards the tip, tighten the 1/4-20 hex bolt down on the wire to lightly "crunch" it, thereby holding it securely.
  - \_\_\_\_\_d) Tighten down the nut towards the stud so that the lock washer is compressed.
  - \_\_\_\_\_c1) If the stud rotates, a 7/16" open end wrench can be used on the flat portion of the stud to re-align it and/or hold it in position.
  - \_\_\_\_\_e) Select the another cable and attach it in a like manner to the other end of the element.
  - \_\_\_\_\_f) The other cables are likewise attached to the stud on the inward side of the outer insulator.
  - \_\_\_\_\_g) Check that the nuts are tight and that the cables are running towards the center of the antenna.
- \_\_\_\_\_6) The center spreader is a composite design, which is a total of 48" (4 feet) long. It is designed so that it is strong, yet can be moved to one side to enable reaching the farthest tuning jumper point.
- \_\_\_\_\_a) Locate the spreader, which has fiberglass at both ends.
  - \_\_\_\_\_b) Slide the spreader through the center support tube that is welded to the element-to-boom mounting plate.
  - \_\_\_\_\_c) The securing pin through the support and spreader (also Alum-O-Weld wire) is added after tuning is completed.
- \_\_\_\_\_7) Working on one side ("A" or "B") at a time:
- \_\_\_\_\_a) Slip two (2) 1/8" cable clamps over the free end of both cables and keep them on the outboard side of the spreader (towards the element tip).
  - \_\_\_\_\_b) Slide one end of the linear loading cable through the hole at the end of the spreader (on the appropriate end of the spreader).
  - \_\_\_\_\_c) Bring the free end downward and back under the spreader and apply enough

tension to take up the slack in the cable.

- \_\_\_\_\_c1) The ALUM-O-WELD wire is quite stiff, so be careful.
- \_\_\_\_\_c2) It is not necessary to put a lot of tension on the wire.
- \_\_\_\_\_c3) Be careful not to distort the spreader with too much tension.
- \_\_\_\_\_d) Pass the free end through the cable clamp that is already on the cable, using the one closest to the spreader.
  - \_\_\_\_\_d1) It might be wise to not fully secure the cable clamps on the linear loading cable wire at this time. This will allow adjustments to make the element nice and symmetrical.
  - \_\_\_\_\_d2) The other clamp is used to secure the tuning jumper.
  - \_\_\_\_\_d3) Position the clamp towards the end of the wire, making the largest loop.
- \_\_\_\_\_e) **IMPORTANT:**
  - \_\_\_\_\_e1) The wire from one side does not cross over to the other side. The two wires on each side, plus the tuning jumper make a single loop for that side - and that side only.
  - \_\_\_\_\_e2) Crossing the wires across the spreader to the other side will not work!
- \_\_\_\_\_f) Position the cable clamp so that the body (not the "U") is on the cable going back out to the outer insulator and tighten the nuts on the cable clamp. It is not necessary to "crunch" these nuts. Tighten only enough so that the cable is visually compressed and physically secure.
- \_\_\_\_\_g) Follow this same procedure for the companion cable on this element half.  
\_\_\_\_\_NOTE: these elements should be installed with a slight droop still present (i.e. not straight). This is because to make the loading super tight creates compression on the element and can actually cause it to be less strong.
  
- \_\_\_\_\_8) Attach the linear loading wires in a similar manner on the other side.
  - \_\_\_\_\_a) Check for a nice, symmetrical look to the element.
  - \_\_\_\_\_b) Secure the cable clamps on the linear loading.
  
- \_\_\_\_\_9) Position and secure the REFLECTOR tuning jumpers as follows:
  - \_\_\_\_\_a) Note that the tuning jumper is made of solid material and is bent into a "V" formation.
    - The "V" goes UP.
    - The bent ends go OUT.
  - \_\_\_\_\_b) Measuring from the center spreader, 3-3.5" to the tuning jumper and cable clamp will center the antenna for operation at about 7.030. (This is an approximate measurement for proper REFLECTOR frequency.)
  - \_\_\_\_\_c) The proper REFLECTOR frequency for CW operation is about 6.930 MHz. This can be verified by:
    - \_\_\_\_\_c1) opening the feed point on the DRIVER element
    - \_\_\_\_\_c2) removing the jumper across the feed point screws on the REFLECTOR
    - \_\_\_\_\_c3) attaching a balun and coax to the feed point on the REFLECTOR element
    - \_\_\_\_\_c4) raise it to 20-25' and reading the frequency of lowest VSWR
    - \_\_\_\_\_c5) if a test unit like the MFJ is used, read only the VSWR lowest point, not anything on the right-hand meter
    - \_\_\_\_\_c6) after setting the REFLECTOR on frequency, remove the coax and balun, then replace the jumper across the feed point screws.
  - \_\_\_\_\_d) moving the tuning jumpers farther out to 5" will center higher, to about 7.130 MHz



- \_\_\_\_\_e) moving the tuning jumpers to 6" will center higher yet, to about 7.190 MHz
- \_\_\_\_\_10) Be sure the REFLECTOR tuning is right and the jumper is across the feed point screws.
- \_\_\_\_\_11) This completes the REFLECTOR assembly.
- \_\_\_\_\_12) Attach the linear loading wire to the driver, using the same procedure as for the reflector.
  - \_\_\_\_\_a) Check that the studs are inserted properly and change them if necessary.
  - \_\_\_\_\_b) **REMEMBER TO USE EYE PROTECTION.**
- \_\_\_\_\_13) Position and secure the DRIVER tuning jumper as follows:
  - \_\_\_\_\_a) Note that the tuning jumper is made of solid material and is bent into a "V" formation.
    - The "V" goes UP.
    - The bent ends go OUT.
  - \_\_\_\_\_b) Measuring from the center spreader, 12" to the tuning jumper and cable clamp will center the antenna at about 7.030. (This is an approximate measurement for 7.030.)
  - \_\_\_\_\_c) 14" will center higher, to about 7.130 MHz
  - \_\_\_\_\_d) 15" will center higher yet, to about 7.190 MHz
  - \_\_\_\_\_e) The actual setting will vary somewhat, due to actual location and tension in the loading wires.
- \_\_\_\_\_14) Attach the DRIVER tuning jumper on the other side as above.
- \_\_\_\_\_15) The antenna is now ready for mounting.

#### IV. ATTACHING THE FEEDLINE and MOUNTING TO THE MAST

- \_\_\_\_\_1) **This antenna will usually require one or two tuning adjustments. This is because it is high Q and fairly narrow banded; however, the high Q means it is very efficient.**
- \_\_\_\_\_2) **If the adjustments can be made and the antenna raised to perhaps 15', it will not move up in frequency very much from that height (should be not more than 10-15 kHz).**
- \_\_\_\_\_3) The mounting instructions are provided first, then the tuning. Please use them in the sequence most suited to your installation.
- \_\_\_\_\_4) There are two (2) Easy-On™ mounting plates and they are identical. One attaches to the mast and the other attaches to the boom. They are held together in final installation by several 5/16" hex bolts going through both plates.
  - \_\_\_\_\_a) The Easy-On™ mounting plate that attaches to the boom has already been installed, with the nuts slightly tightened.
  - \_\_\_\_\_b) The Easy-On™ mounting plate that attaches to the mast is attached with one (1) of the 5/16" hex bolts (**with a lock washer under the head**) inserted from the mast side of the plate **before** the plate is secured with a pair of 2" U-bolts and saddles.
    - \_\_\_\_\_b1) This makes the bolt protrude outward from the top, center hole of the mast-mounted plate. The mast holds the bolt in place and it will not fall out.

- \_\_\_\_\_ b2) A hole in the Easy-On™ mounting plate on the boom will align with this bolt and the antenna is slipped onto the bolt, thereby quickly relieving the weight of the antenna from the installer.
  - \_\_\_\_\_ b3) A lock washer and nut on the top, center bolt will secure the antenna while the corner bolts are added.
  - \_\_\_\_\_ c) Mount the Easy-On™ mounting plate on the mast as described above and note the correct position of the single 5/16" x 1" bolt through the top, center hole in the plate.
- \_\_\_\_\_ 5) This antenna was designed for use with either a split coax and RF choke feed line, or a 1:1 balun.
- \_\_\_\_\_ a) If a balun is used, such as a *FORCE 12 B-1 or B-IS*, attach the leads to the screws as above and plug the feed line into the other end of the balun.
  - \_\_\_\_\_ a1) **NOTE: trim the balun leads to 2 - 2 1/2" before putting on the lugs. The balun lead length adds to the driver element length, so not trimming the leads will cause the feed points to be resonate low of the band(s).**
  - \_\_\_\_\_ b) If coax is used directly, split about 3" of the coax and solder the round terminals to the coax. Wind the coax into an RF choke by making 8 turns of about 10" diameter and tape or otherwise bind the coil together so that it cannot come apart.
  - \_\_\_\_\_ c) Secure with flat washer, split lock and nut.
  - \_\_\_\_\_ d) Dress the coax and feed line assembly neatly to the boom, towards the mast.
- \_\_\_\_\_ 6) BEFORE raising the antenna into position, review what is going to happen and then proceed carefully.
- \_\_\_\_\_ a) It is recommended that a simple harness attached to both sides of the mounting plate be used to lift the antenna into position. This harness will keep the antenna from rocking and will make it easier to balance. The pull rope is then attached to the center/balance point of the harness.
  - \_\_\_\_\_ b) The boom can be positioned for best balance at this time. Simply loosen the nuts and position as necessary.
  - \_\_\_\_\_ c) NOTE: it is not necessary to crunch the nuts on the U-bolts holding the boom to the extent of deforming the boom material; just enough to hold it from rotating.
- \_\_\_\_\_ 7) BEFORE raising the antenna into position, be ready with the lock washer and nut to thread onto the top, center bolt.
- \_\_\_\_\_ a) Have the remaining 5/16" bolts, lock washers and nuts ready to place through the corner holes.
  - \_\_\_\_\_ b) NOTE: there are four (4) 5/16" bolts included. Although one in the top, center hole, plus one in each lower corner adds up only to three (3), the fourth is included just in case the top, center bolt was not installed. This will enable the plates to be attached in all four (4) corners and still be secure.
- \_\_\_\_\_ 8) Raise the antenna into position and slip the Easy-On™ mounting plate on the boom over the top, center 5/16" bolt on the Easy-On™ mounting plate attached to the mast. Place a lock washer and nut on this bolt and the antenna will be initially secured to the mast and the weight will be removed from the installer.
- \_\_\_\_\_ a) Place the two (2) remaining lower corner bolts through both plates from the

mast side and leave the nuts somewhat loose to enable alignment of the other bolts.

- \_\_\_\_\_ b) The bolts will now form a triangle pattern.
  - \_\_\_\_\_ c) Place the fourth bolt through one of the top corner holes and secure with a lock washer and nut.
  - \_\_\_\_\_ d) Double check that the antenna is parallel to the ground (if it is off balance, it will tilt) and tighten all 5/16" bolts to secure the two plates together.
- \_\_\_\_\_ 9) The boom can be positioned as necessary for balance and orientation by loosening the U-bolts holding it to the plate.
- \_\_\_\_\_ a) Double check antenna balance and alignment.
- \_\_\_\_\_ 10) If this is an "H" model, there is one (1) truss cable on this boom.
- \_\_\_\_\_ a) The cable is pre-assembled and already attached to a pair of eye-bolts.
  - \_\_\_\_\_ b) Place the eye-bolts from the top of the boom through the appropriate holes and start (do not tighten them yet) the Ny-loc nuts on the eye-bolts.
  - \_\_\_\_\_ c) Check to be sure that the eye-bolts are parallel to the boom.
  - \_\_\_\_\_ d) Check to be sure that the cable is on the top side of all the elements.
  - \_\_\_\_\_ e) Tighten the Ny-loc nuts enough so that the eye-bolts are secure. Using a screw driver through the eye will hold it in position while the nut is being tightened.
  - \_\_\_\_\_ f) The cable is run to the center mast position and will attach to the mast using a 2" U-bolt and saddle.
  - \_\_\_\_\_ g) The approximate attachment point is 3' above the boom.
- \_\_\_\_\_ 11) Neatly dress the feed lines to the mast, making sure there is sufficient coax to coil around the mast if a rotator is used.
- \_\_\_\_\_ 12) Check the VSWR on other antennas in the area (i.e. on the mast) to be sure this antenna has not de-tuned them. If the VSWR has not changed, the interaction is minimal, but the front-to-back ratio of the other antenna(s) might have been lessened.

## V. TUNING

- \_\_\_\_\_ 1) Place the helical hairpin match over the 10-24 bolts, so that it is pointing away from the center of the antenna. Check to ensure that the coil turns are not touching each other (not shorting).
- \_\_\_\_\_ 2) Attach the feed line to the two 10-24 bolts at the center, with the lock washer and nut. The supplied round terminals should be used to make a good connection to the screws.
- \_\_\_\_\_ a) If a balun is used, such as a **Force 12 B-1 or B-1S**, attach the leads to the screws as above and plug the feed line into the other end of the balun.
  - \_\_\_\_\_ b) If coax is used directly, split about 3" of the coax and solder the round terminals to the coax. Slip the terminals over the screws and secure with the ny-loc nuts. Wind the coax into an RF choke by making 8 turns of about 10" diameter and tape or otherwise bind the coil together so that it cannot come apart.
  - \_\_\_\_\_ c) Secure the coax feed line to the mast, making sure there is sufficient coax to coil around the mast if a rotator is used.

- \_\_\_\_\_3) Using a VSWR meter, read the VSWR. If it is not less than 1.3:1 in the band, adjust the hairpin by spreading or pushing together the coil for the lowest VSWR in the band.
  - \_\_\_\_\_3a) If the 1:1 point is higher than desired, move the jumpers on both sides of the driver element inward towards the center and test it again. If lower than desired, move the jumpers outward. A readjustment of the hairpin might be required.
  - \_\_\_\_\_3b) If adjusted at about 15' above ground, the antenna will shift less than 20 kHz upward as it is raised.
  - \_\_\_\_\_3c) The VSWR will also change slightly, due to the impedance changing as the antenna is raised (this is not unique to this antenna - just a fact!). The hairpin can be re-adjusted once or twice as necessary to compensate, noting which direction it needs to go (turns wider or closer together).
  
- \_\_\_\_\_4) Check the VSWR on other antennas in the area (i.e. on the mast) to be sure this antenna has not de-tuned them. If the VSWR has not changed, the interaction is minimal, but the front-to-back ratio of the other antenna(s) might have been lessened. This antenna can be mounted parallel to the other booms for the least interaction potential. It has been specifically designed for high reactance with other bands; however, coupling can still occur.

**VI. FINAL CHECKOUT**

- \_\_\_\_\_1) Apply power and have fun.

***Notice.....***

***PLEASE BE CAREFUL AND DO NOT LET THIS ANTENNA COME INTO CONTACT WITH POWER LINES OR OTHER DANGERS. YOU CAN BE INJURED OR KILLED BY IMPROPER HANDLING OF THIS ANTENNA.***

***Thank you for selecting our product. We hope you enjoy using it.***

**Force 12 Warranty, Limitation of Liability**

Force 12 products are warranted for a period of one year from date of purchase. Warranty covers defects in manufacturing and workmanship. Force 12 has the discretion of honoring the warranty if the product appears to have been abused, used in a manner that exceeds the specifications of the unit, or a use for which the product was not designed. This warranty does not cover transportation, installation, punitive, or other costs that may be incurred from warranty repair, or installation. Force 12 must be notified and warranty repair authorized (only by Force 12 who issues an RMA) before the company will accept any product returns. Please advise the date of purchase, model number, serial number (if applicable) and a brief description of the problem. 30% restocking fee on products returned unused with RMA issued by Force 12 at the sole discretion of Force 12. The customer, installer and user of these products individually and collectively acknowledge that these products can cause injury or death and individually and collectively accept full responsibility and liability for any and all personal and property damage (direct, indirect and punitive) caused during installation and/or use of these products and hold Force 12 harmless for such damage. (warranty notice date 10/15/2004)

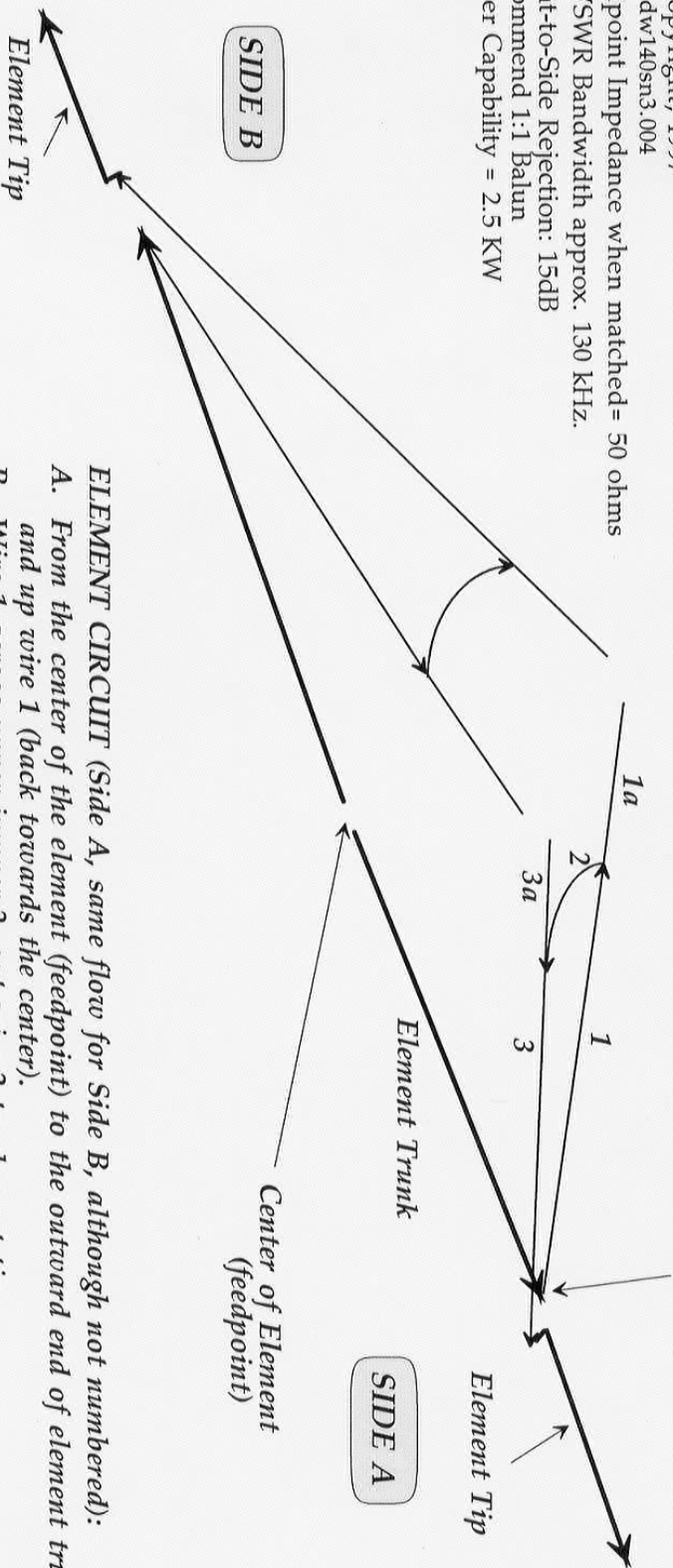
Feedpoint Impedance when matched = 50 ohms  
2:1 VSWR Bandwidth approx. 130 KHz.  
Front-to-Side Rejection: 15dB  
Recommend 1:1 Balun  
Power Capability = 2.5 KW

## LINEAR LOADED ELEMENT DESIGN

### 40 Meter, EF-140S Model..... Circuit Visual Flow

( single linear loading V-shaped loop )

Outward end of wire 1



#### ELEMENT CIRCUIT (Side A, same flow for Side B, although not numbered):

- From the center of the element (feedpoint) to the outward end of element trunk and up wire 1 (back towards the center).
- Wire 1 across upper jumper 2, out wire 2, to element tip
- Sections 1a and 3a of wires 1 and 3 are the capacitive portions of the loading system.
- Initial settings for approximately 7.050 MHz are:  
Jumper from Center Insulator = 14"
- Tuning will vary with height above ground and proximity to other conductive objects, such as other antennas and trees. A good height for initial adjustment is about 15' above ground. The antenna will shift up slightly when raised from this height, but the upward shift should not be more than 15 KHz at 70'.

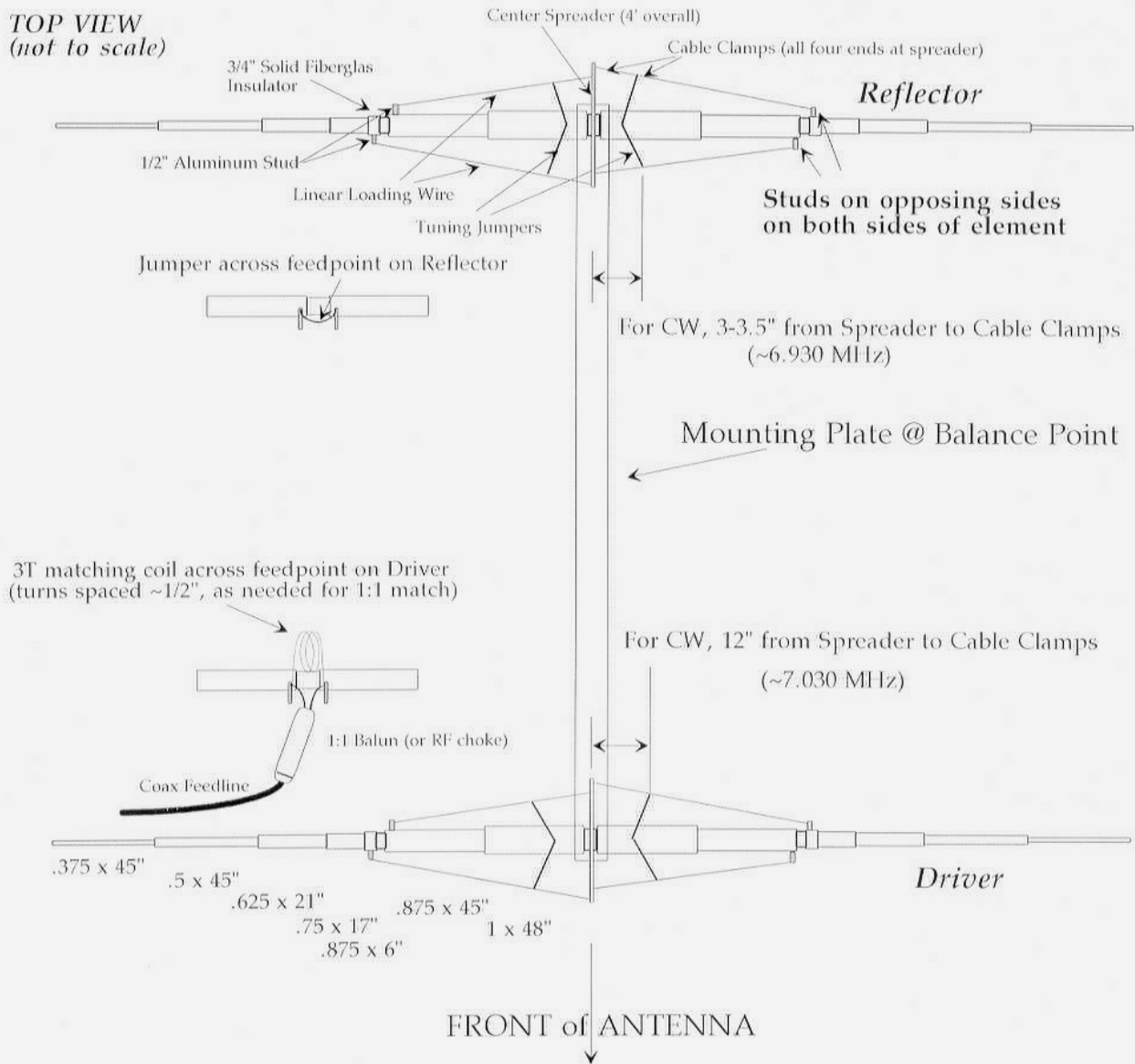
**FORCE 12**

**Elite Force EF-240S**

2 element 40 Meter Linear Loaded Antenna (~38' long elements)

FREQUENCY COVERAGE: Tunable 6.900 - 7.600 MHz

TOP VIEW  
(not to scale)



- WINDLOAD    Approx. 3.6 Square Feet
- WEIGHT        Approx. 27 Pounds
- MAST TORQUE @ 70 mph = <100 inch pounds
- TURNING RADIUS    21.4 Feet
- POWER RATING    5KW
- WIND SURVIVAL    80 mph
- FEED SYSTEM: Hairpin (coil) to 50 ohms, through 1:1 balun or RF choke

Copyright, Force 12, 1997  
dw240sn2.004

## Elite Force EF-140S

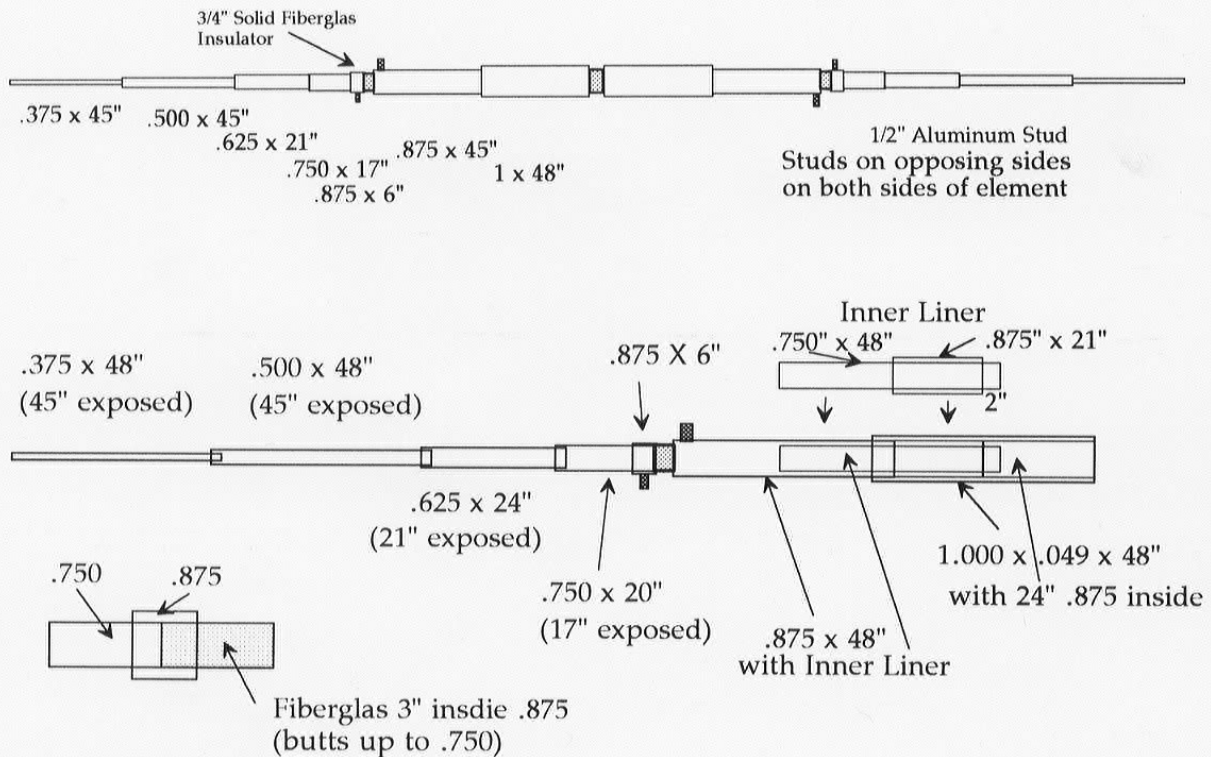
New, as of July 20, 1998; now rated at 100 mph

(this replaces both EF-140S and Ef-140S/D), two are used on EF-240S & EF-240S/D)

### Production & Assembly Drawing

TOP VIEW  
(not to scale)

48" PACKAGING



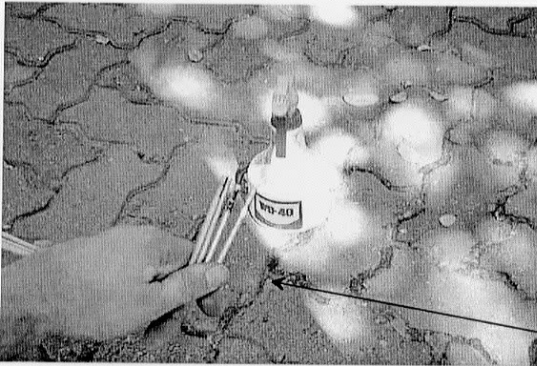
#### CUT LIST

- .375 x 48 x 2
- .500 x 48 x 2
- .625 x 24 x 2
- .750 x 20 x 2 (for tip)
- .750 x 48 x 2 (liner for .875 & 1" in trunk)
- .875 x 21 x 2 (liner for .875 & 1" in trunk)
- .875 x 6 x 2
- .875 x 48 x 2
- .875 x 24 x 2 (liner for 1.000)
- 1.000 x 48 x 2

*Sample photos for assembly of EF-140S, 40 mtr element(s) on:  
C-4SXL, C-4XL, C-4, C-4S, , EF-140S, EF-240S, EF-320X/240S.  
GENERAL INFORMATION, Page 1*



*Alignment of the slot in the PVC insulator on a typical driver element. The slot is positioned with the slot in the PVC and the gap between the U-bolt and the element mounting bracket for maximum clearance.*



*Cleaning black tape residue:  
A) can be removed by using the original tape to re-stick to the residue, or*

*B) use an oil like WD-40:*

*1) let WD-40 set for a couple minutes*



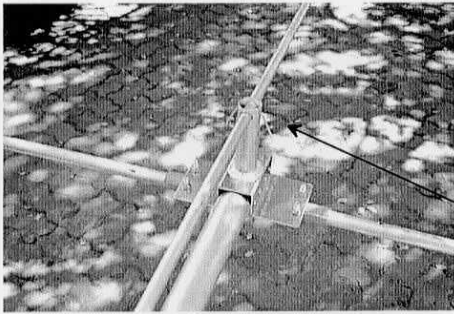
*2) wipe off tape residue*

*pix40s1.001*



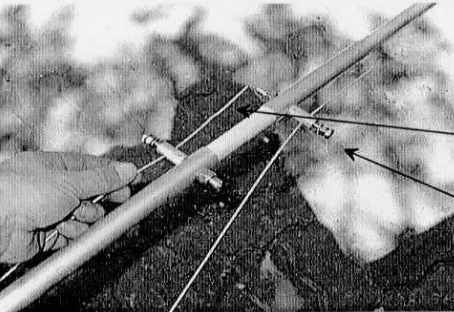
Sample photos for assembly of EF-140S, 40 mtr element(s) on:  
C-4SXL, C-4XL, C-4, C-4S, , EF-140S, EF-240S, EF-320X/240S.

**GENERAL INFORMATION, Page 2**



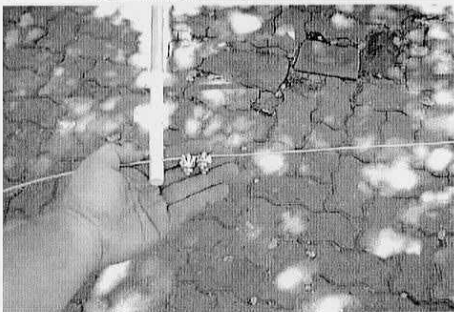
The center spreader and support post for the 40 mtr element(s).

NOTE the short piece of Alum-O-Weld wire through the post and spreader.

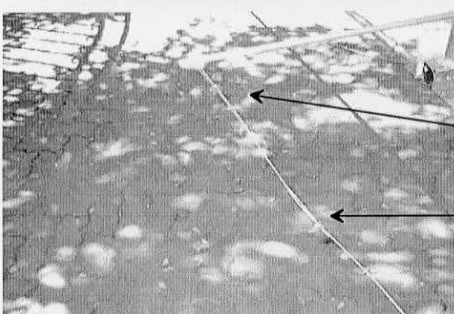


The Alum-O-Weld linear loading wire has been straightened out. It is passed through a stud. There is about 5" (12cm) of wire through the stud.

The 1/4-20 hex bolt is finger tight (do not use a wrench now).



Two (2) cable clamps are placed on the linear loading wire, THEN the wire is passed through the center spreader. This is so you will not have to disassemble the clamps later.



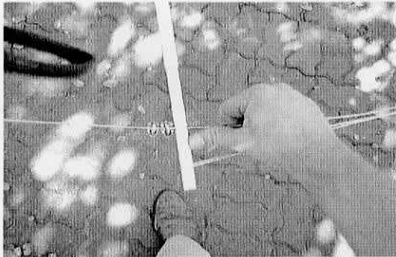
The cable clamps have been lightly tightened on the linear loading wire (just tight enough to hold the wire).

NOTE: one clamp is close to the center spreader and one clamp is close to the free end. The free end can be trimmed LATER.

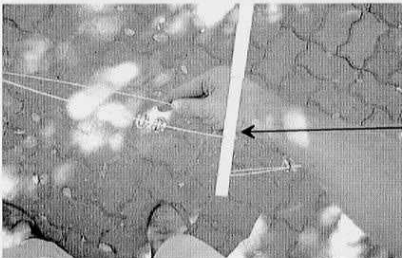
*pix40s1.001*

Sample photos for assembly of EF-140S, 40 mtr element(s) on:  
C-4SXL, C-4XL, C-4, C-4S, , EF-140S, EF-240S, EF-320X/240S.

## GENERAL INFORMATION, Page 3

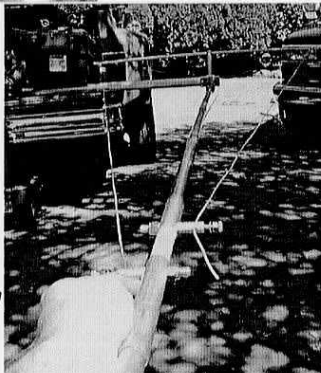


Use your thumb to tension the linear loading wire. The wire should have some tension on it so that the element is approximately straight. Do not "gull wing" the element upwards. The wires should be equalized so that the element is straight. You can look from the end to be sure it is straight.



Add the second wire to the center spreader.

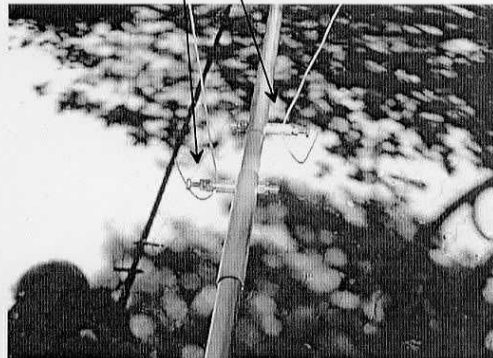
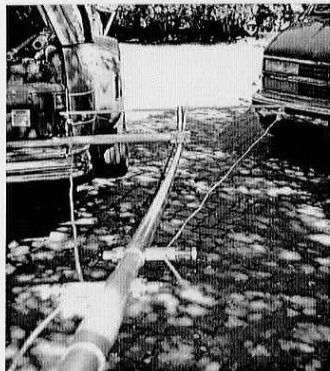
Look from the tip towards the center. Use the 5" extra wire to make very small adjustments in the wire. This will make the element straight.



After the element is straight and equal on both sides, tighten the 1/4-20 bolt and nut. This will secure the linear loading wires. I NOTE: it is NOT necessary to overtighten the bolts onto the wire. Tighten about 1/6 turn past snug.

Raise the tip of the element to make adjustments easier. Raising the tip will make slack in the wires.

Lift up ↑

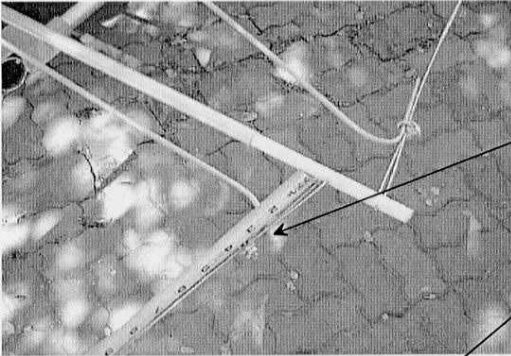


*pix40s1.001*

# Force 12

Sample photos for assembly of EF-140S, 40 mtr element(s) on:  
C-4SXL, C-4XL, C-4, C-4S, , EF-140S, EF-240S, EF-320X/240S.

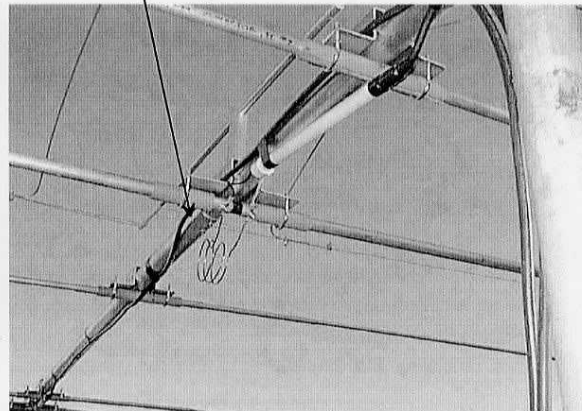
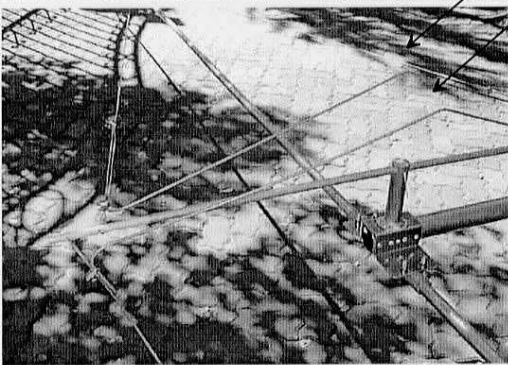
## GENERAL INFORMATION, Page 4



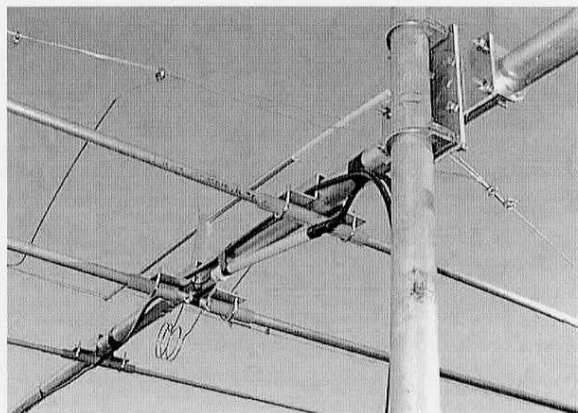
Measuring to clamp. Shown is 3" on the reflector element for C-4SXL, C-4XL, 240S.

Make tuning jumpers like this.  
Be sure they are parallel to each other.

Hairpin matching coil and B-1 balun  
on 40 mtr driver element.  
( C-4SXL shown )

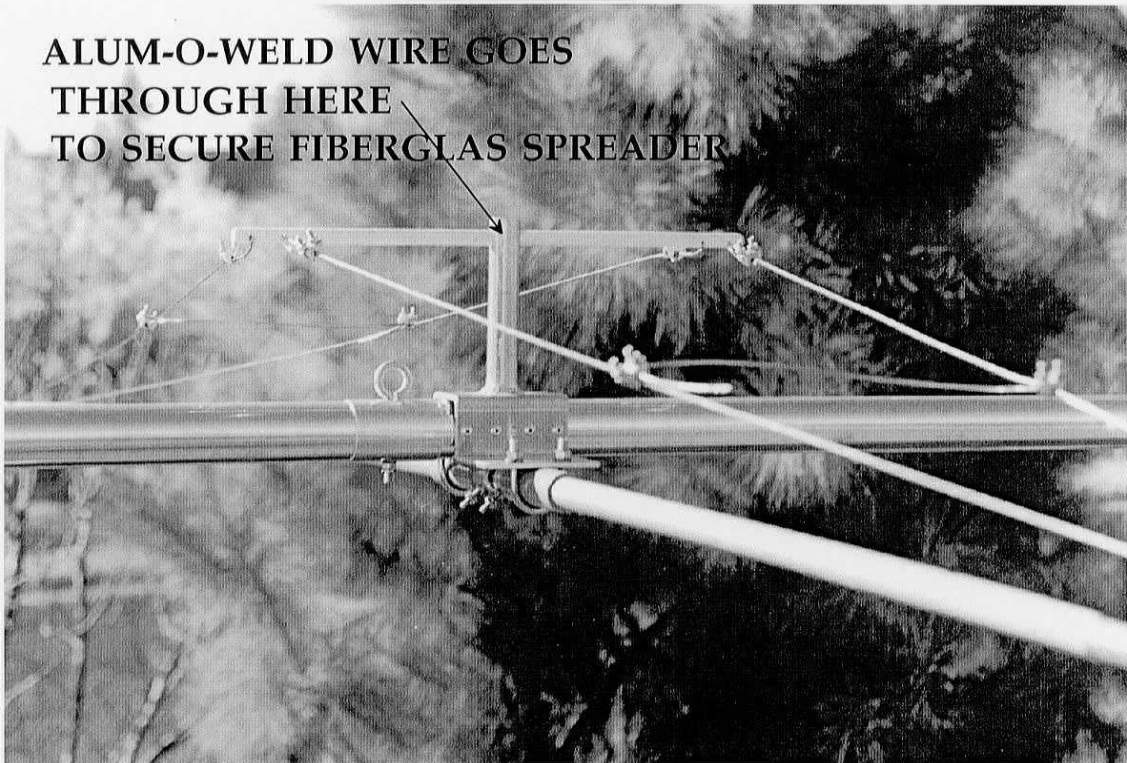


NOTE: on 2el 40 (C-4SXL, C-4XL, 240S)  
remember to jumper across the  
reflector element.



pix40s1.001

**ALUM-O-WELD WIRE GOES  
THROUGH HERE  
TO SECURE FIBERGLAS SPREADER**



*Sample of linear loading  
for*

*EF-140, 240, 340 (40 mtr) and EF-130, 230 (30 mtr).*

*EF-140S ( D and XP) have 4' aluminum/fiberglass spreader*

*and semi-rigid tuning jumpers*

**INCLUDING SECURING OF FIBERGLASS SPREADER  
TO VERTICAL SUPPORT WITH SHORT JUMPER.**

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ex40302.002



**TYPICAL ELEMENT BUNDLE, ALL ELEMENTS**  
(Model XR-5 shown)

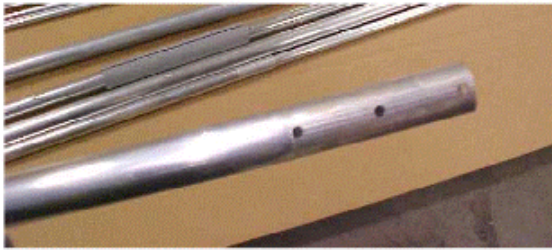


**INDIVIDUAL ELEMENT BUNDLES**  
(Model XR-5 shown)

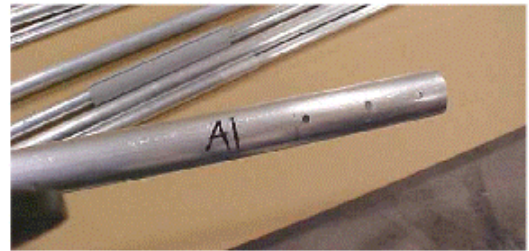


**“A” and “B” MARKINGS ON ELEMENT PIECES**  
“A1” & “B1” identify they are part of element #1.

### Element Assembly Example



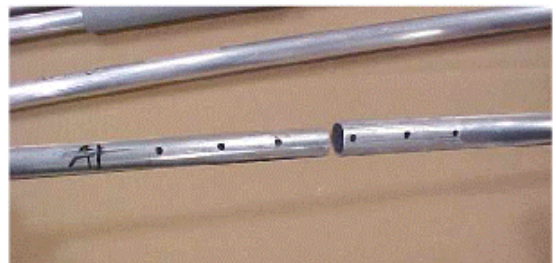
Swaged Element End  
(swager marking lines and rivet hole is close to end of piece)



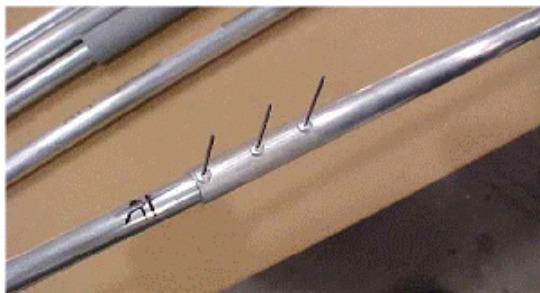
Non-swaged Element End  
(no swager marks and rivet hole is not close to end of piece)



1) Apply Noalox with brush



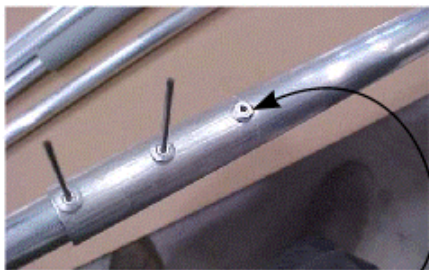
2) Insert tube into matching piece



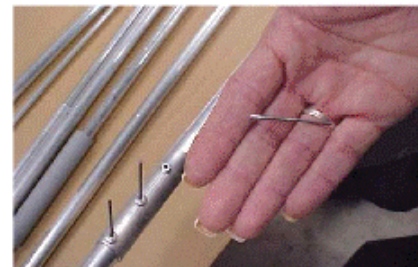
3) Insert all rivets before riveting



4) Slide rivet tool over mandrel and pull ("pop") the rivet



5) Pulled rivet is on right



6) Mandrel removed from rivet tool



RIVET TOOL NOZZLE  
<--Wrong one on left - hole is too large  
Correct on right - small hole fits mandrel -->  
(rivet shown dropping into nozzle)



## Element Assembly Example

### Removing a Properly Installed Rivet



RIVET TOOL  
NOZZLE

<--Wrong one on left - hole is too large  
Correct on right - small hole fits mandrel -->  
(rivet shown dropping into nozzle)



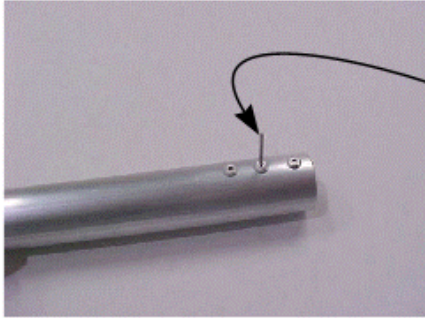
#### To Remove a Rivet (that has been properly installed)

- 1) Use 1/8" drill bit
- 2) Run drill slowly until rivet head comes off
- 3) Remove rivet head from drill tip
- 4) Drill through hole

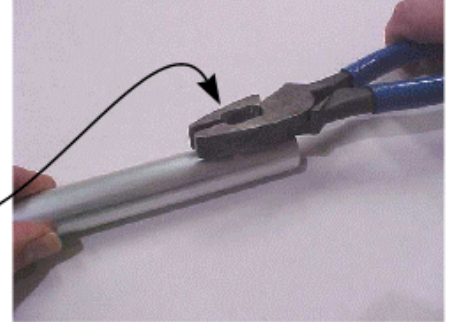


*Element Assembly Example*

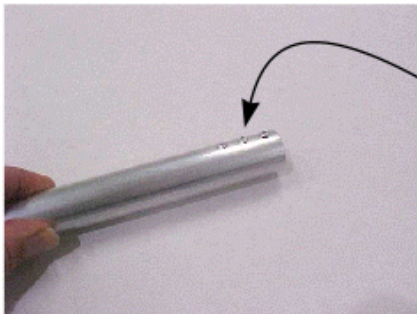
**Removing a Rivet with a Broken Mandrel**



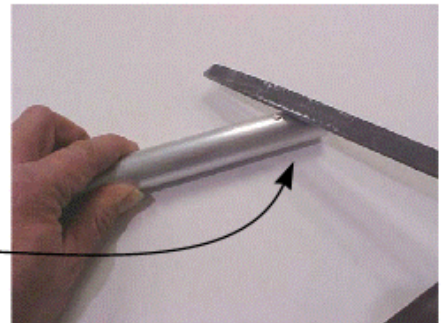
\_\_\_ 1) Broken mandrel



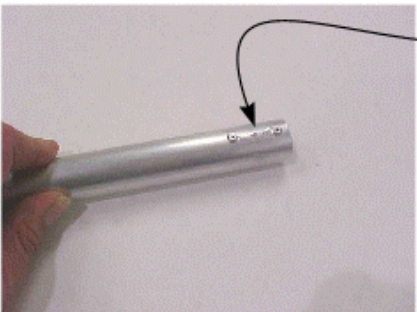
\_\_\_ 2) Cut mandrel close to rivet head



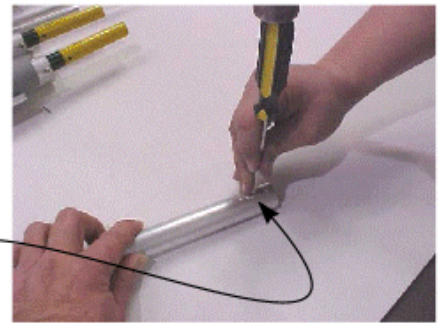
\_\_\_ 3) Mandrel is now cut



\_\_\_ 4) File mandrel AND rivet head flush with tubing

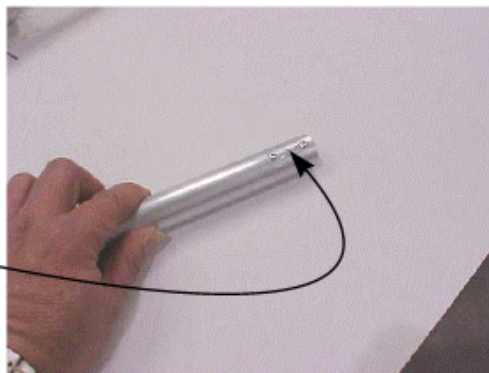


\_\_\_ 5) Rivet head and mandrel filed off flush with tubing



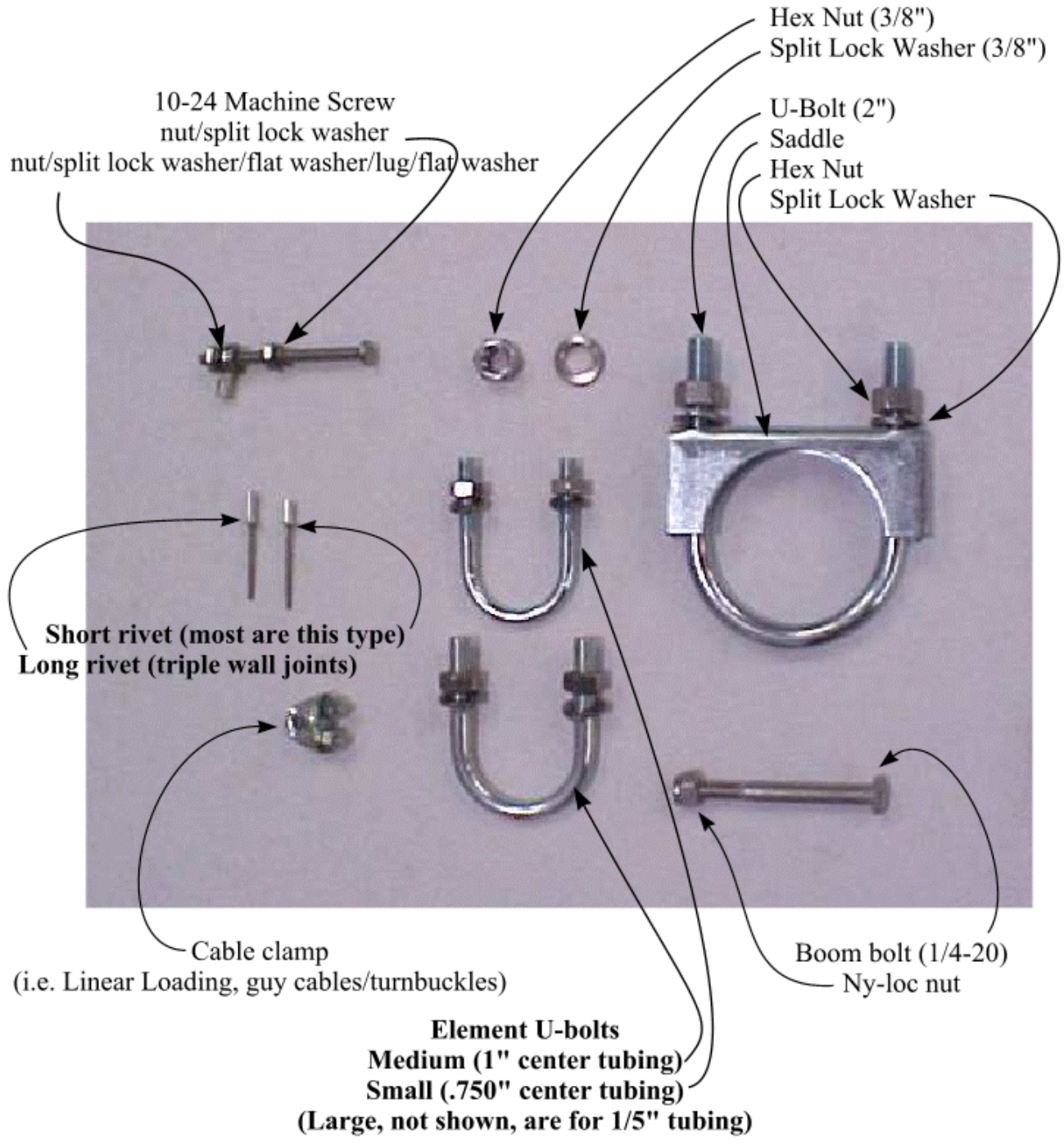
\_\_\_ 6) Punch rivet through with pointed tool (and hammer)

\_\_\_ 7) Hole is now clear for new rivet.



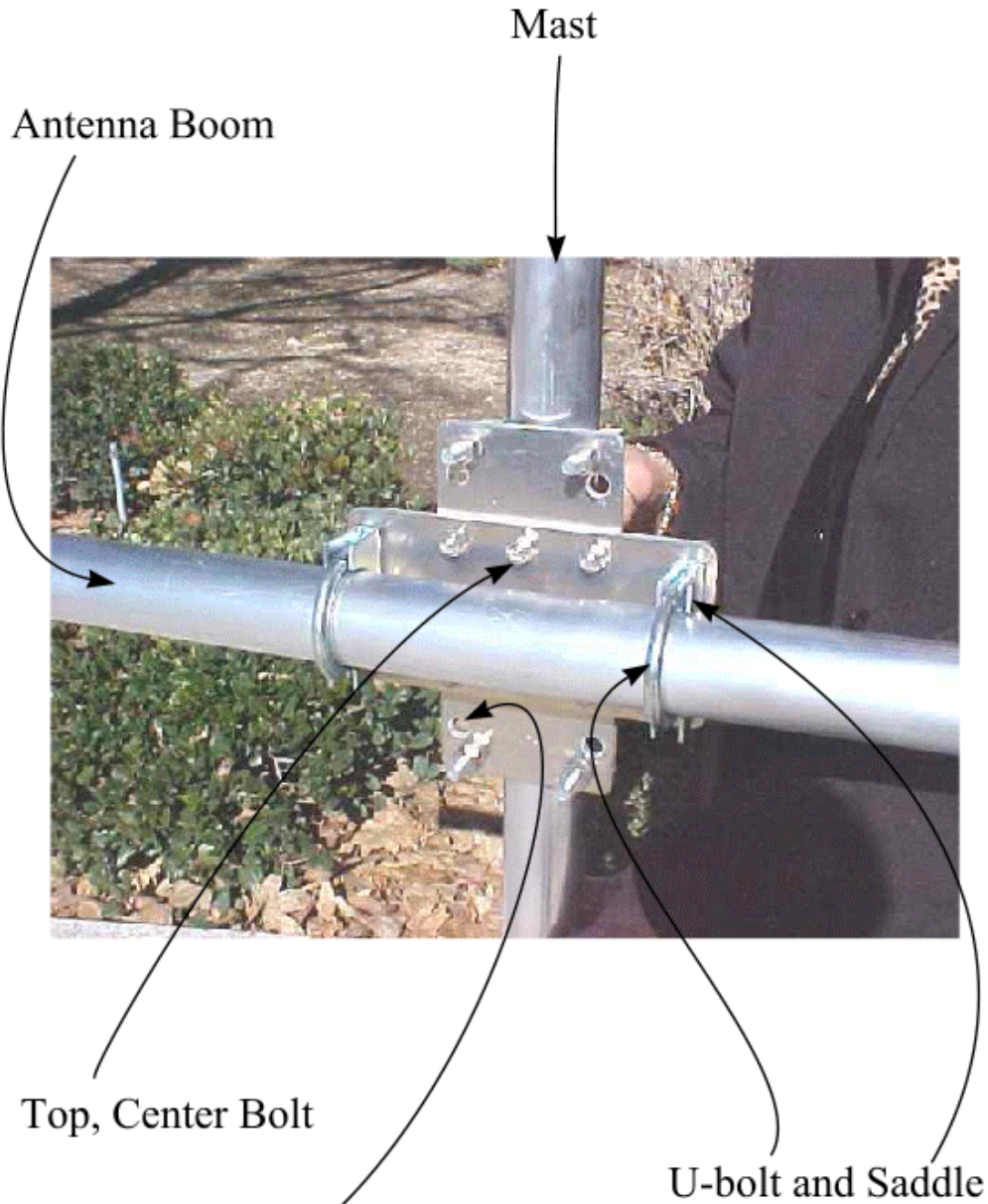


## Element Assembly Example Typical Parts



**Force 12**

## Photo of Easy-On™ Mount

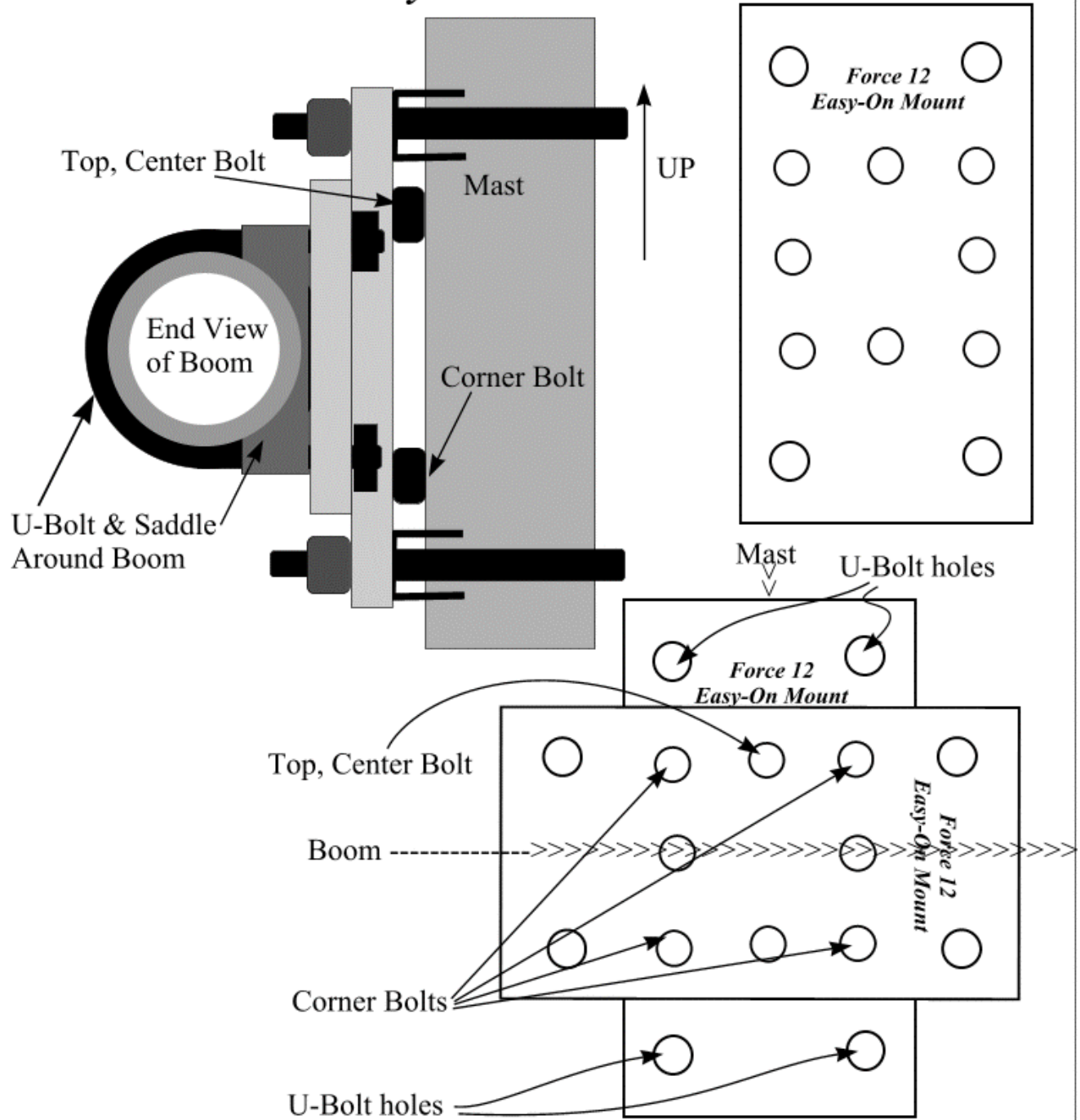


(Note: in this example, extra holes have been drilled for 2 1/2" U-bolts / 2 1/2" mast)

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DW-EASY-ON-PIX-1

**Force 12**

# Easy-On™ Mount



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DW-EASY-ON-DWG-1

**NOTES.....**

.....LAST PAGE.....