Force 12

Classic 4-Band, the C-4S

40-20-15-10 Mtrs

(2 feed lines: 40 & 20-15-10)

also operates on 17 and 12 meters using your rig's tuner

Force 12, Inc.
P.O. Box 1349 Paso Robles, CA 93447
Technical Support 1.805.227.1680 FAX 1.805.227.1684 Order Line 1.800.248.1985

Thank you for selecting the combination Force 12 ***C-4S*** 4-band Yagi antenna. Core ***C-3S*** antenna is enhanced by the addition of the ***EF-140S*** dipole for 40 meters.

The assembly instructions are the individual manuals for each of the Yagi antennas (the ***C-4S*** and ***EF-140S***). Both manuals follow this introduction. Several drawings of the antenna follow this page.

The assembly procedure is to assemble the ***C-3S*** core antenna first, then assemble the ***EF-140S*** 40 meter element. Add the 40 meter element to the boom and assembly is complete. Use the individual manuals for all assembly instructions (i.e. element assembly, etc.).

Thank you!

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.

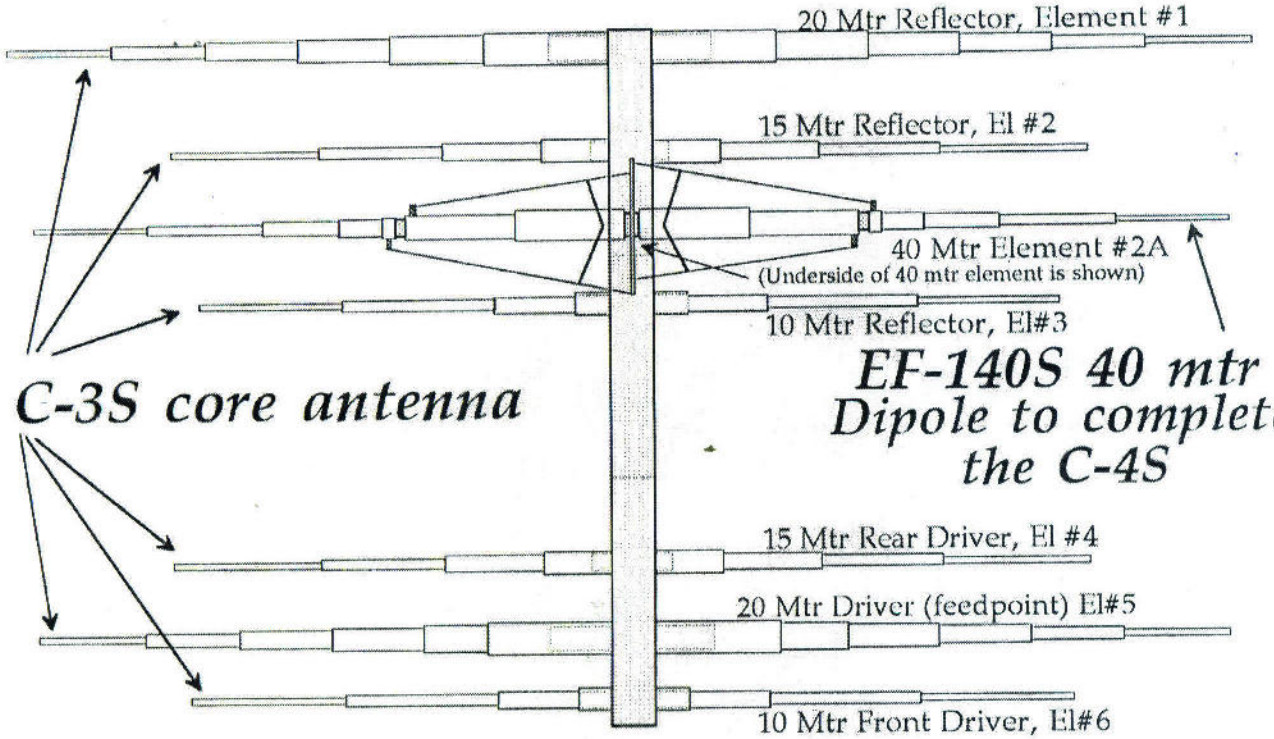
Thank you for selecting our product. We hope you enjoy using it.

STRIKE FORCE Classic 4-Band, C-4S

7 Element 40, 20, 15 and 10 Meter Yagi-style Antenna

FREQUENCY COVERAGE 6.900-7.500; 13.950-14.400; 21.000-21.450; 28.000-29.700 MHz (>1MHz 2:1)

"C-4S"



15 Mtr Rear Driver tips have 2 adjustments available: 1 up and 1 down
each hole in/out adjusts center frequency approx 125 kHz (std center freq is ~21.225)

10 Mtr Front Driver tips have 4 adjustments available: 2 up and 2 down
each hole in/out adjusts center frequency approx 250 kHz (std center freq is ~28.800)

FRONT of ANTENNA

BOOM is 12' x 2" OD

WINDLOAD 5.66 Square Feet Maximum at 15 degrees from boom center
MAST TORQUE: <200 inch pounds at 70 mph
WEIGHT Approximately 35 Pounds
TURNING RADIUS 19.8 Feet
POWER RATING 3KW
WIND SURVIVAL 80 mph
FEED SYSTEM: Single 50 ohm coax through RF choke or 1:1 balun
Hairpin match on 40 mtrs through RF choke or 1:1 balun

dwc4s2.001

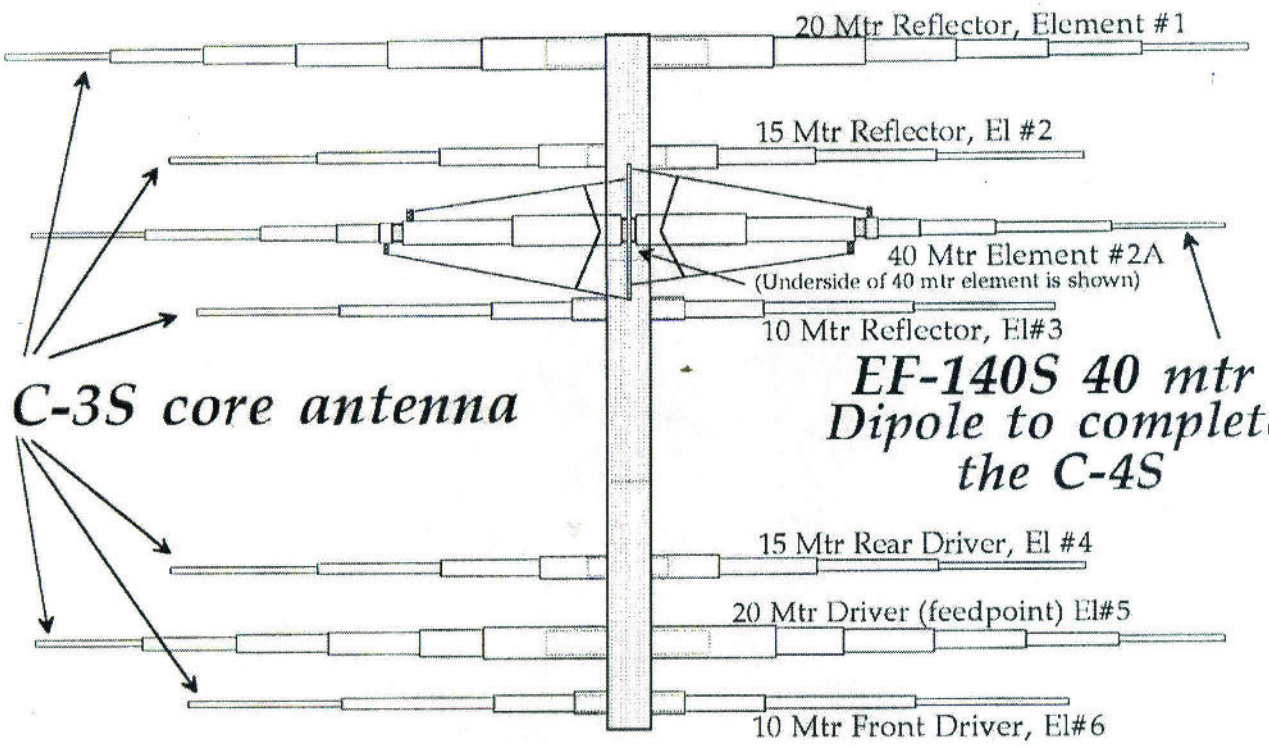
Force 12

STRIKE FORCE Classic 4-Band, C-4S

7 Element 40, 20, 15 and 10 Meter Yagi-style Antenna

FREQUENCY COVERAGE 6.900-7.500; 13.950-14.400; 21.000-21.450; 28.000-29.700 MHz (>1MHz 2:1)

"C-4S"



15 Mtr Rear Driver tips have 2 adjustments available: 1 up and 1 down
each hole in/out adjusts center frequency approx 125 kHz (std center freq is ~21.225)

10 Mtr Front Driver tips have 4 adjustments available: 2 up and 2 down
each hole in/out adjusts center frequency approx 250 kHz (std center freq is ~28.800)

FRONT of ANTENNA

There are two (2) feedpoints for the C-4S:

1) *20 mtr driver, element #5, can be fed with an RF choke or 1:1 balun.*
2) *40 mtr dipole, element #2A, can be fed with a large RF choke; however, a 1:1 balun is recommended.*

dwc4s3.001

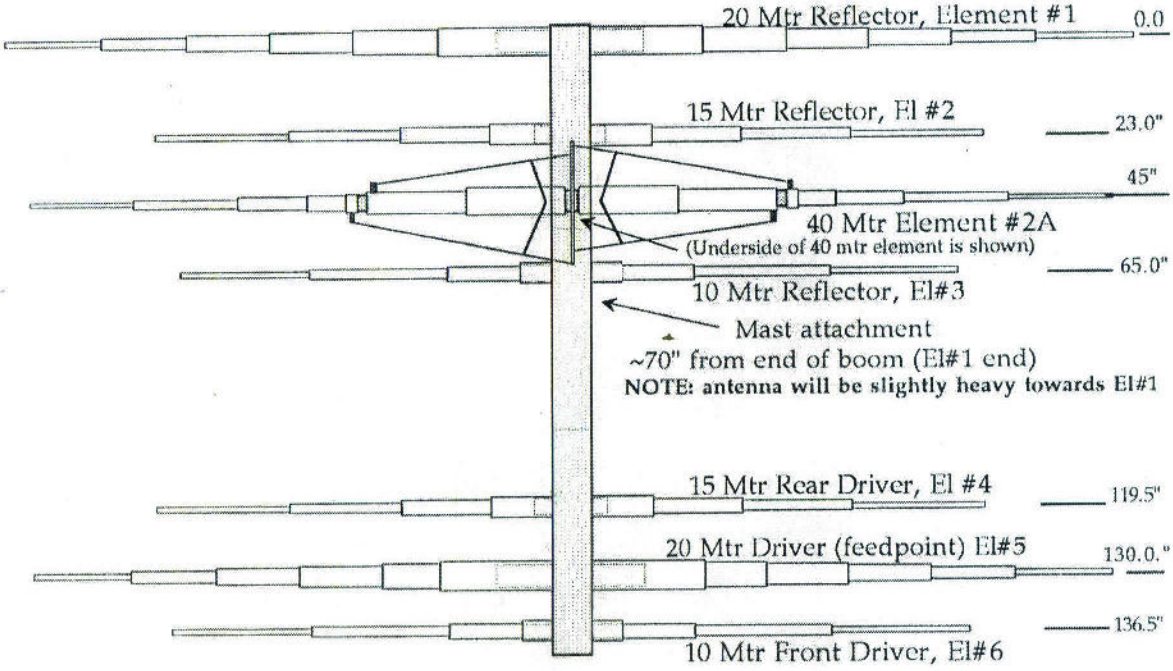
Force 12

STRIKE FORCE Classic 4-Band, C-4S

7 Element 40, 20, 15 and 10 Meter Yagi-style Antenna

FREQUENCY COVERAGE 6.900-7.500; 13.950-14.400; 21.000-21.450; 28.000-29.700 MHz (>1MHz 2:1)

"C-4S"



15 Mtr Rear Driver tips have 2 adjustments available: 1 up and 1 down
each hole in/out adjusts center frequency approx 125 kHz (std center freq is ~21.225)

10 Mtr Front Driver tips have 4 adjustments available: 2 up and 2 down
each hole in/out adjusts center frequency approx 250 kHz (std center freq is ~28.800)

FRONT of ANTENNA

BOOM is 12' x 2" OD

WINDLOAD 5.66 Square Feet Maximum at 15 degrees from boom center
MAST TORQUE: <200 inch pounds at 70 mph
WEIGHT Approximately 35 Pounds
TURNING RADIUS 19.8 Feet
POWER RATING 3KW
WIND SURVIVAL 80 mph
FEED SYSTEM: Single 50 ohm coax through RF choke or 1:1 balun
Hairpin match on 40 mtrs through RF choke or 1:1 balun

dwc4s1.001

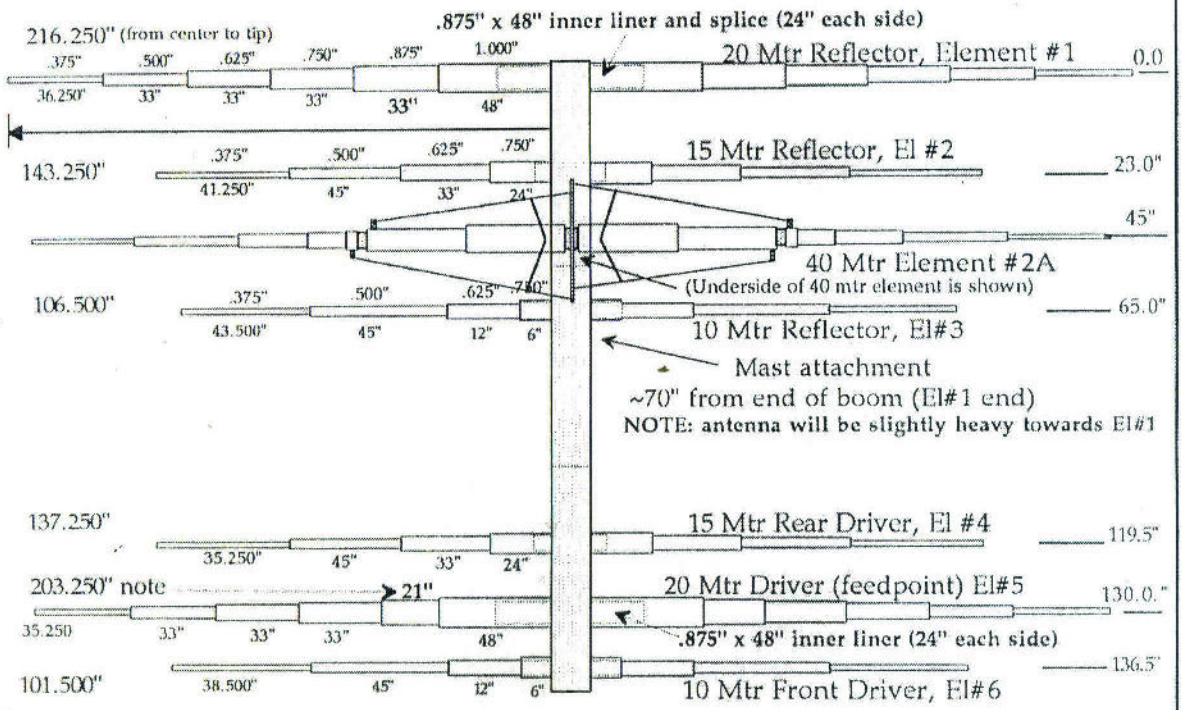
Force 12

STRIKE FORCE Classic 4-Band, C-4S

7 Element 40, 20, 15 and 10 Meter Yagi-style Antenna

FREQUENCY COVERAGE 6.900-7.500; 13.950-14.400; 21.000-21.450; 28.000-29.700 MHz (>1MHz 2:1)

"C-4S"



15 Mtr Rear Driver tips have 2 adjustments available: 1 up and 1 down
each hole in/out adjusts center frequency approx 125 kHz (std center freq is ~21.225)

10 Mtr Front Driver tips have 4 adjustments available: 2 up and 2 down
each hole in/out adjusts center frequency approx 250 kHz (std center freq is ~28.800)

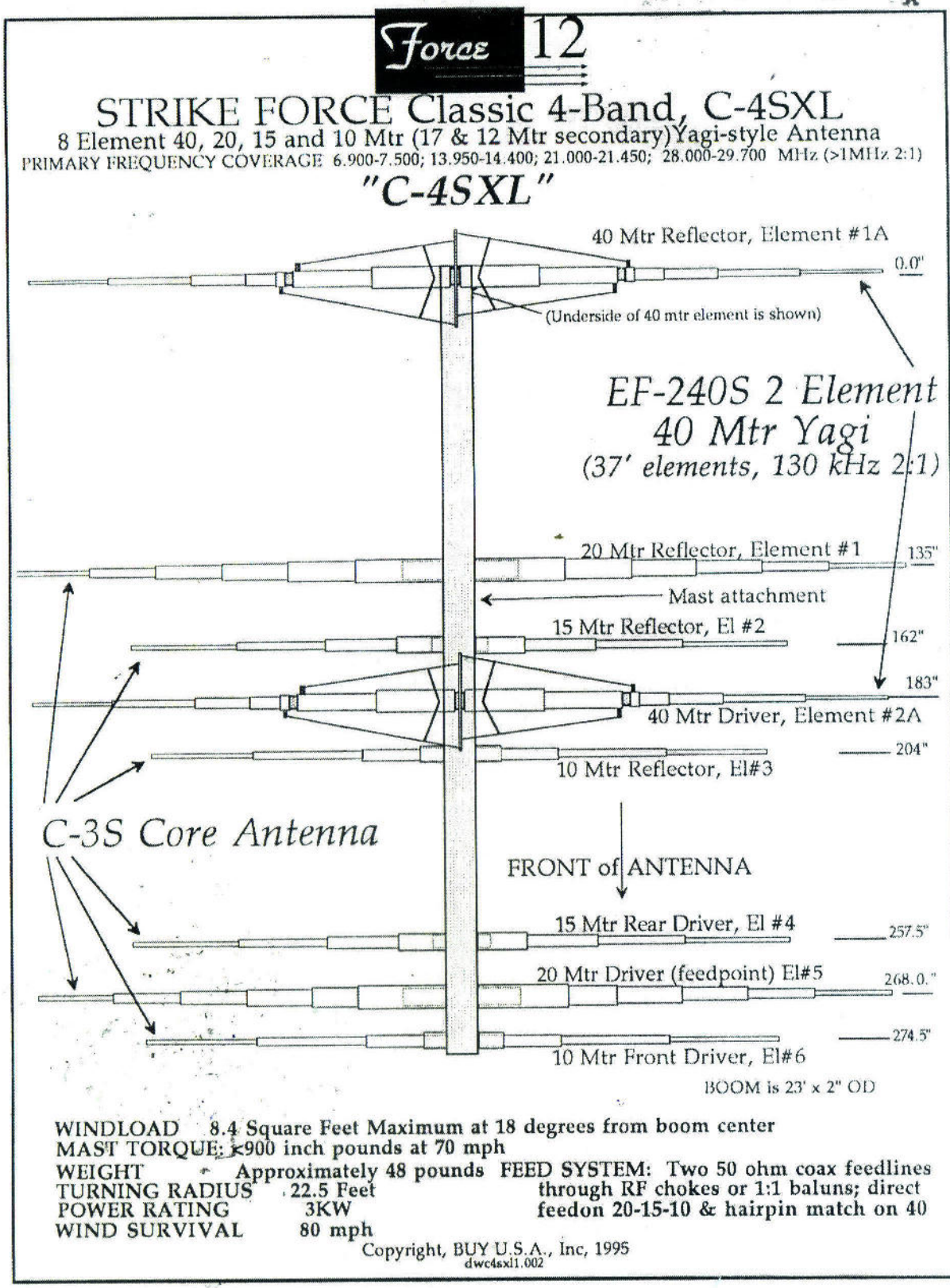
FRONT of ANTENNA

BOOM is 12' x 2" OD

WINDLOAD 5.66 Square Feet Maximum at 15 degrees from boom center
MAST TORQUE: <200 inch pounds at 70 mph
WEIGHT Approximately 35 Pounds
TURNING RADIUS 19.8 Feet
POWER RATING 3KW
WIND SURVIVAL 80 mph

FEED SYSTEM: Single 50 ohm coax through RF choke or 1:1 balun
Hairpin match on 40 mtrs through RF choke or 1:1 balun

dwc4s.001


Force 12
STRIKE FORCE Classic 4-Band, C-4SXL
8 Element 40, 20, 15 and 10 Mtr (17 & 12 Mtr secondary)Yagi-style Antenna
PRIMARY FREQUENCY COVERAGE 6.900-7.500; 13.950-14.400; 21.000-21.450; 28.000-29.700 MHz (>1MHz 2:1)
"C-4SXL"
40 Mtr Reflector, Element #1A
0.0"
(Underside of 40 mtr element is shown)
EF-240S 2 Element
40 Mtr Yagi
(37' elements, 130 kHz 2:1)
20 Mtr Reflector, Element #1
135"
Mast attachment
15 Mtr Reflector, El #2
162"
183"
40 Mtr Driver, Element #2A
204"
10 Mtr Reflector, El#3
C-3S Core Antenna
FRONT of ANTENNA
15 Mtr Rear Driver, El #4
257.5"
20 Mtr Driver (feedpoint) El#5
268.0"
274.5"
10 Mtr Front Driver, El#6
BOOM is 23' x 2" OD
WINDLOAD 8.4 Square Feet Maximum at 18 degrees from boom center
MAST TORQUE: 900 inch pounds at 70 mph
WEIGHT Approximately 48 pounds
TURNING RADIUS 22.5 Feet
POWER RATING 3KW
WIND SURVIVAL 80 mph
FEED SYSTEM: Two 50 ohm coax feedlines through RF chokes or 1:1 baluns; direct feedon 20-15-10 & hairpin match on 40
Copyright, BUY U.S.A., Inc, 1995
dwc4sxl1.002

Element examples, Riveting examples
Common to most antennas

Force 12, Inc.
P.O. Box 1349 Paso Robles, CA 93447
Technical Support 1.805.227.1680 FAX 1.805.227.1684 Order Line 1.800.248.1985

Thank you for selecting the Force 12 antenna. These photos and examples are common to most all Force 12 antennas. Elements are bundled separately and each piece is marked with an element number and an "A" or a "B". In some antennas, all the elements are bundled together to make unpacking easy. Work on one element at a time – for example, assemble element #1 first, then work on element #2, etc. This will prevent pieces of the elements from becoming mixed up.

The riveted element construction is a trade-mark of Force 12 and has proven to be an excellent. With more than 10,000 antennas in the field over 10 years, there have been few problems. In some extreme areas, like on a slope or adjacent to the ocean or a lake, the winds can be uplifting and / or rotational. This adds a significant amount of stress to the joints. If you are in such an area, the element joints can be strengthened using 120 degree riveting, which will survive just about any environment. This technique is superior to all other joint connection types (i.e. compression clamps, machine screws, sheet metal screws) In case you did not notify the company before purchasing about being in a severe weather area like this, please contact the company for additional rivets. It is best to do this before the antenna is up!

The Easy-On™ mounting system is another Force 12 first. It makes installing the antenna simple and safer than other devices. The Easy-On™ mounting comes in two (2) sizes: standard and Magnum. The installation techniques are the same.

Notice.....

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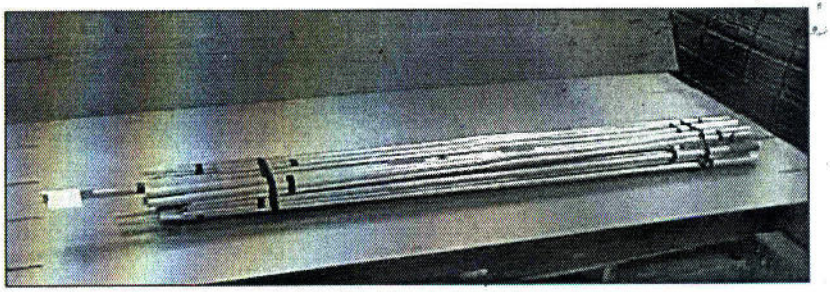
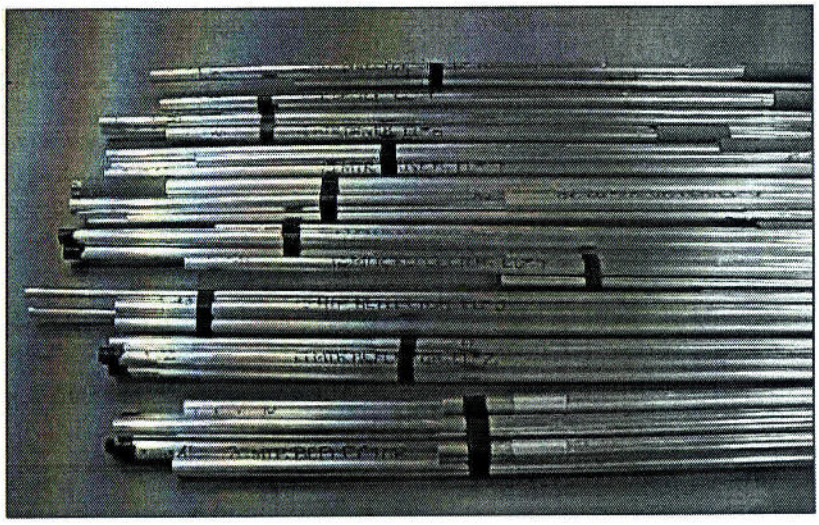
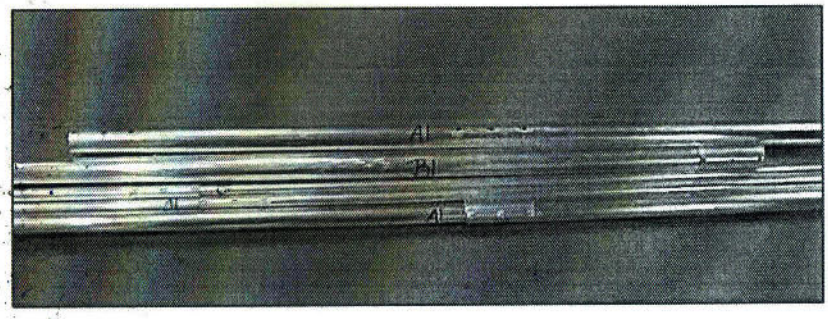
Thank you for selecting our product. We hope you enjoy using it.



(Model XR-5 shown)

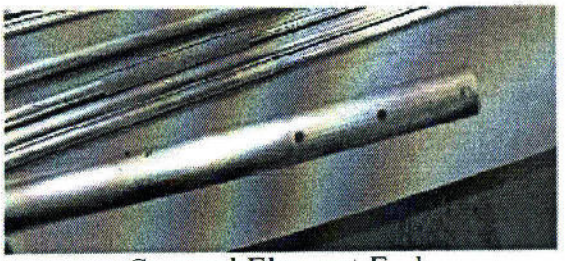


INDIVIDUAL ELEMENT BUNDLES
(Model XR-5 shown)

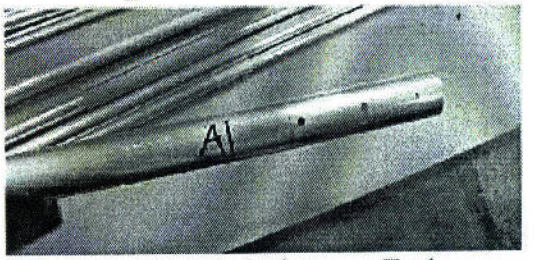


"A" and "B" MARKINGS ON ELEMENT PIECES
"A1" & "B1" identify they are part of element #1.

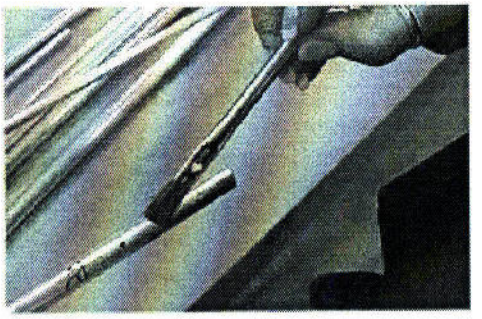
Element Assembly Example



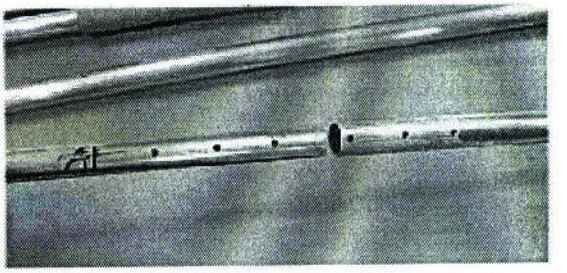
Swaged Element End
(swager marking lines and rivet hole is close to end of piece)



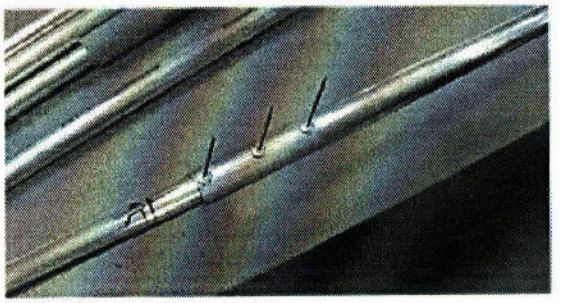
Non-swaged Element End
(no swager marks and rivet hole is not close to end of piece)



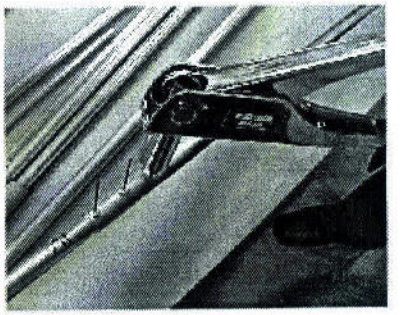
1) Apply Noalox with brush



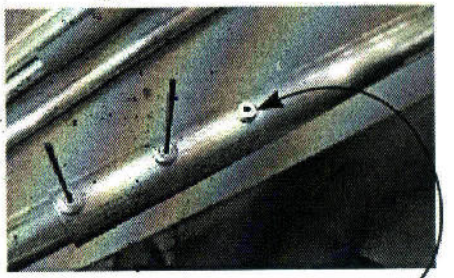
2)Insert tube into matching piece



3) Insert all rivets before riveting

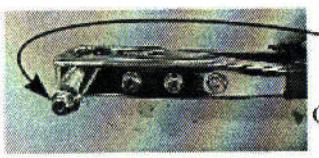


4) Slide rivet tool over mandrel and pull ("pop") the rivet

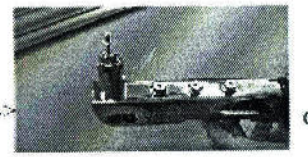


5) Pulled rivet is on right

6) Mandrel removed from rivet tool



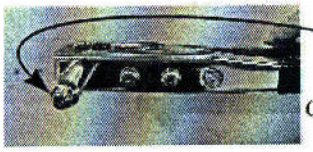
RIVET TOOL
NOZZLE
<--Wrong one on left - hole is too large
Correct on right - small hole fits mandrel -->
(rivet shown dropping into nozzle)



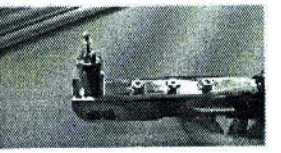
Force 12

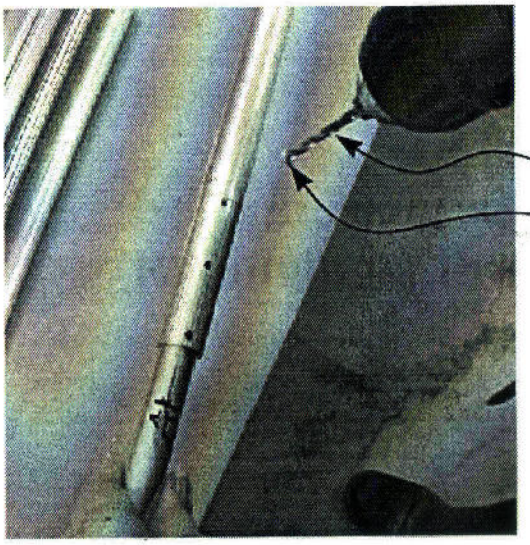
Element Assembly Example

Removing a Properly Installed Rivet



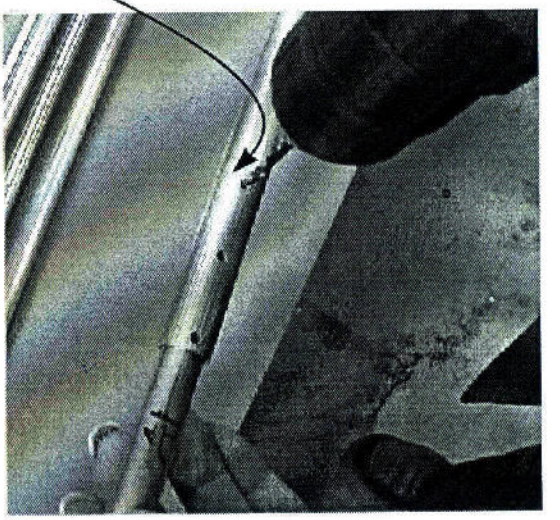
RIVET TOOL
NOZZLE
<--Wrong one on left - hole is too large
Correct on right - small hole fits mandrel -->
(rivet shown dropping into nozzle)





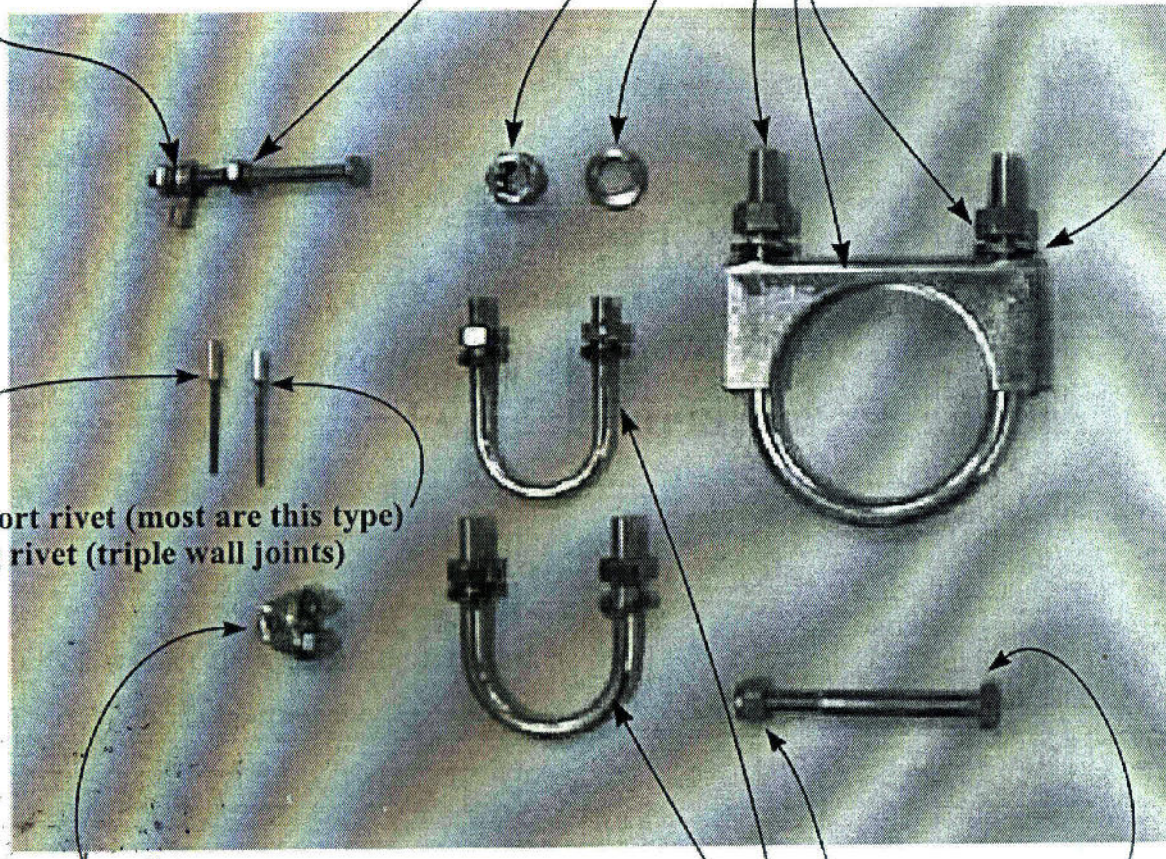
To Remove a Rivet
(that has been properly installed)

___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



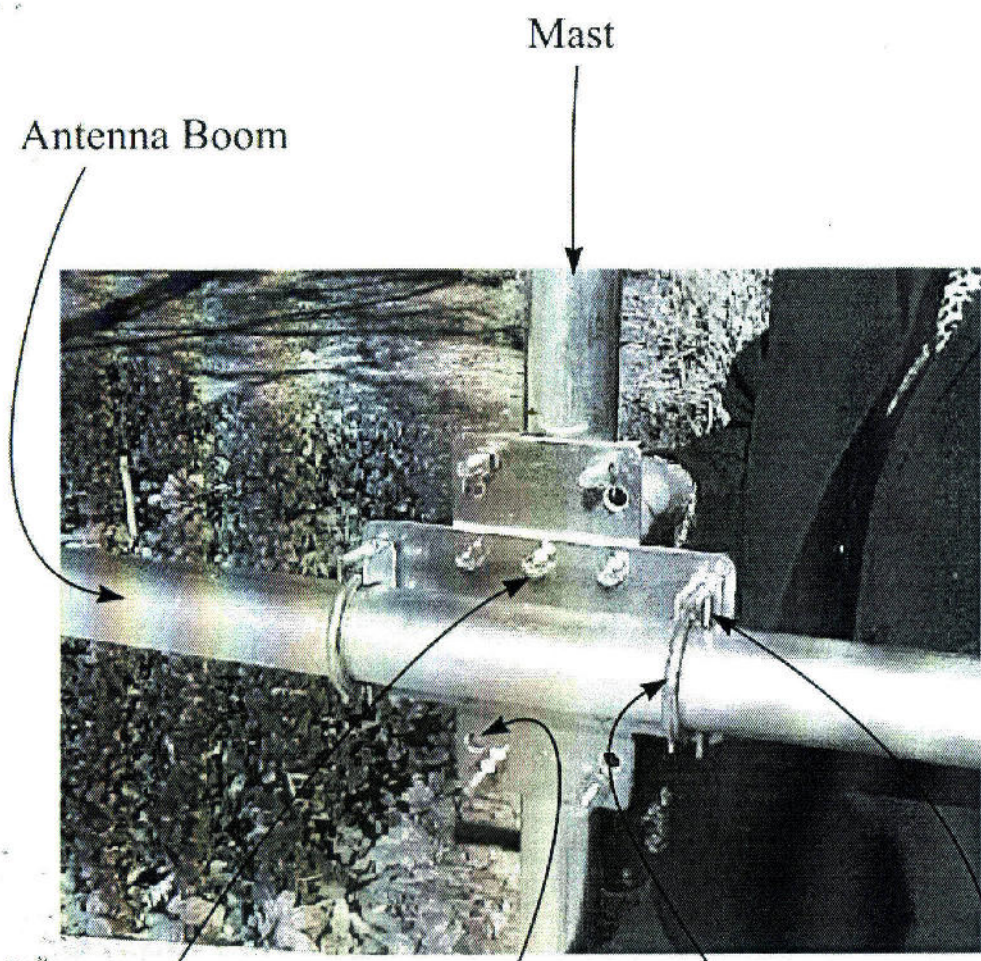
Force 12

Element Assembly Example
Typical Parts

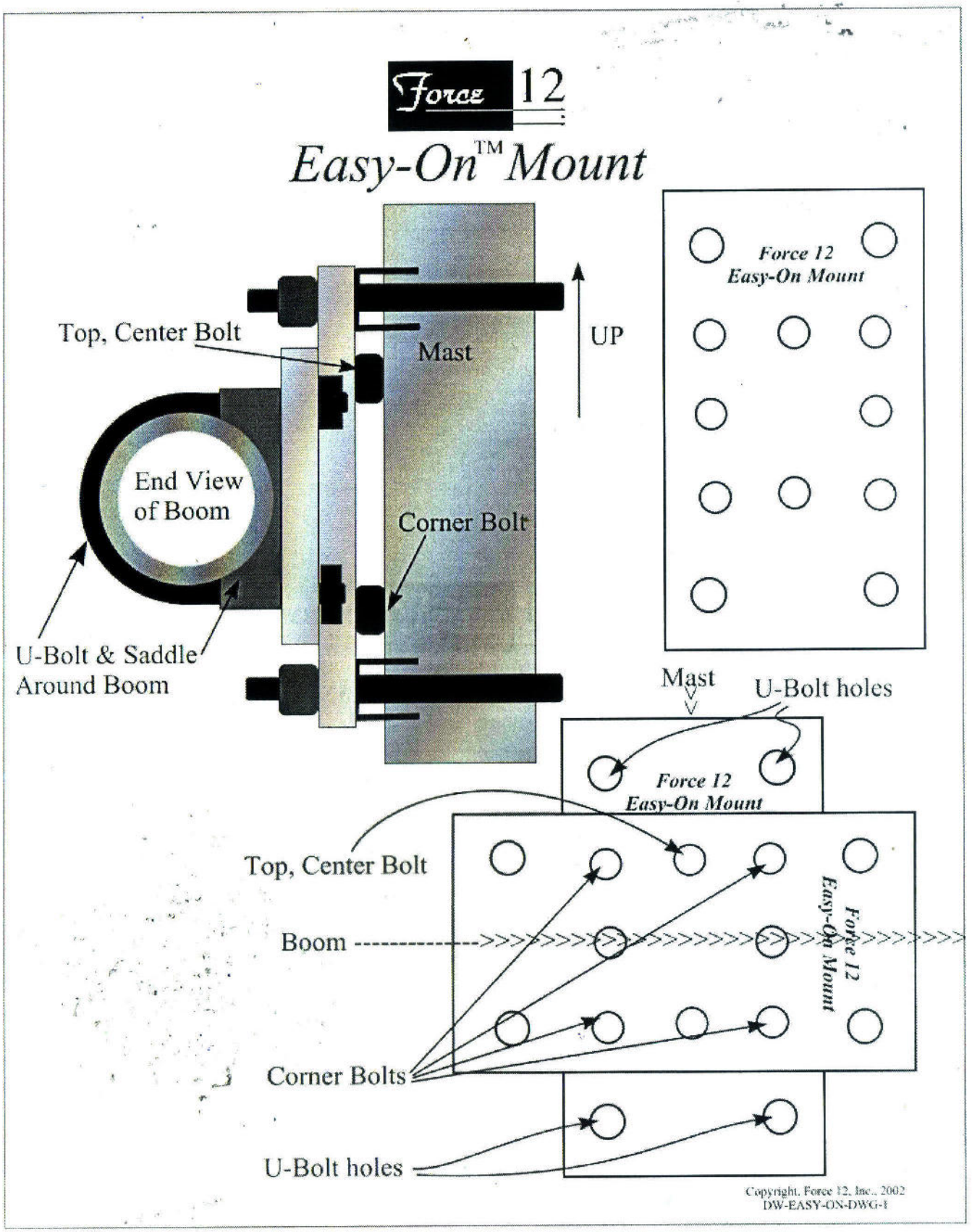


Force 12

Photo of Easy-On™ Mount

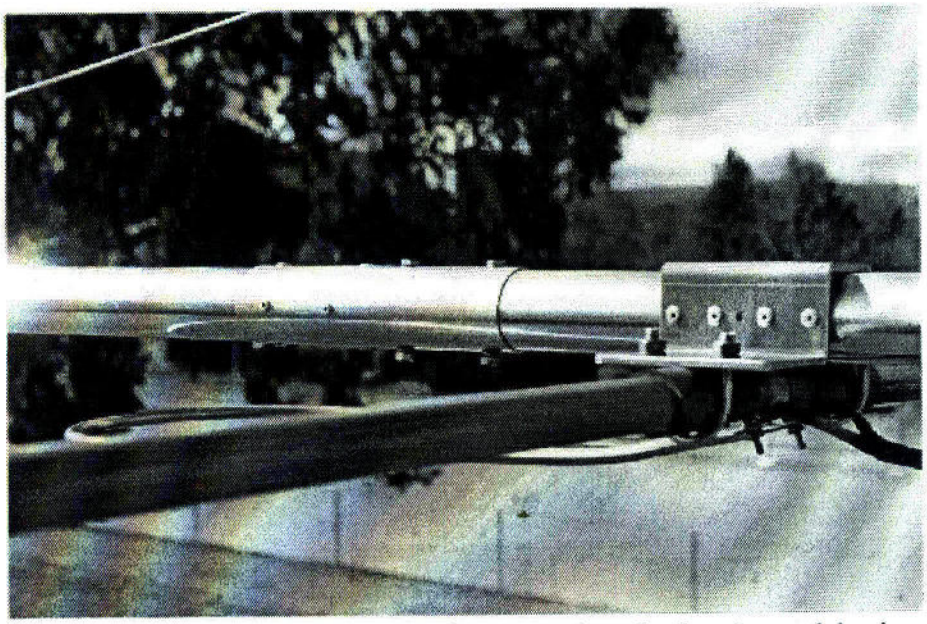


(Note: in this example, extra holes have been drilled for 2 1/2" U-bolts / 2 1/2" mast)

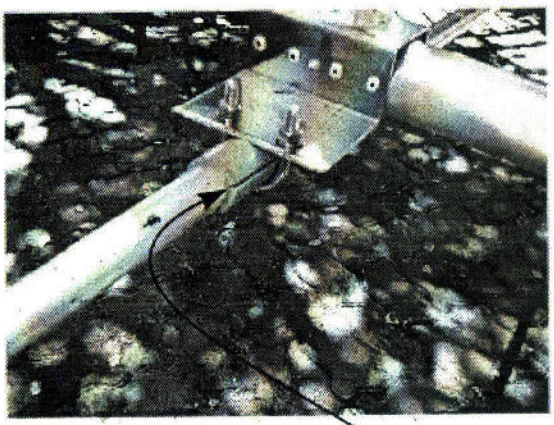

Force 12
Easy-On™ Mount
Top, Center Bolt
Mast
UP
End View of Boom
Corner Bolt
U-Bolt & Saddle Around Boom
Force 12 Easy-On Mount
Mast
U-Bolt holes
Force 12 Easy-On Mount
Top, Center Bolt
Boom
Force 12 Easy-On Mount
Corner Bolts
U-Bolt holes
Copyright, Force 12, Inc., 2002
DW-EASY-ON-DWG-1

Force 12

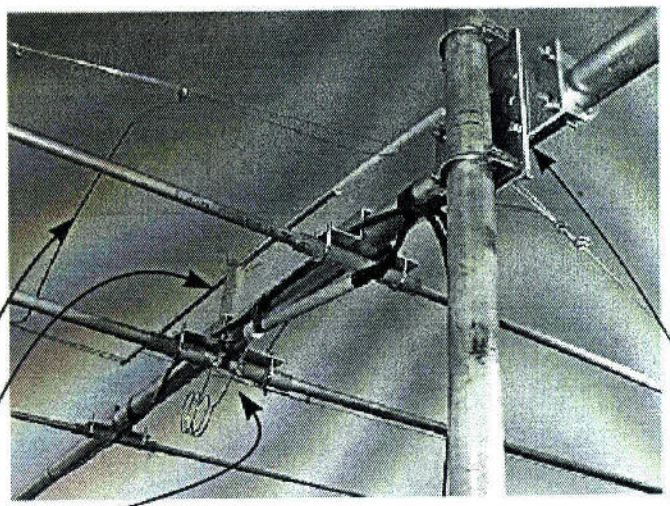
Element to Boom Examples



Driver element, coax attachment (no balun) and hairpin.
Note that the element bracket is not deformed by overtightening of the U-bolts.



PVC slot alignment
on driver elements



Various views (C-4SXL)
Split driver, hairpin & Force 12 B-1 balun
Easy-On Mount™
Center 40 mtr spreader and tuning jumpers

Force 12

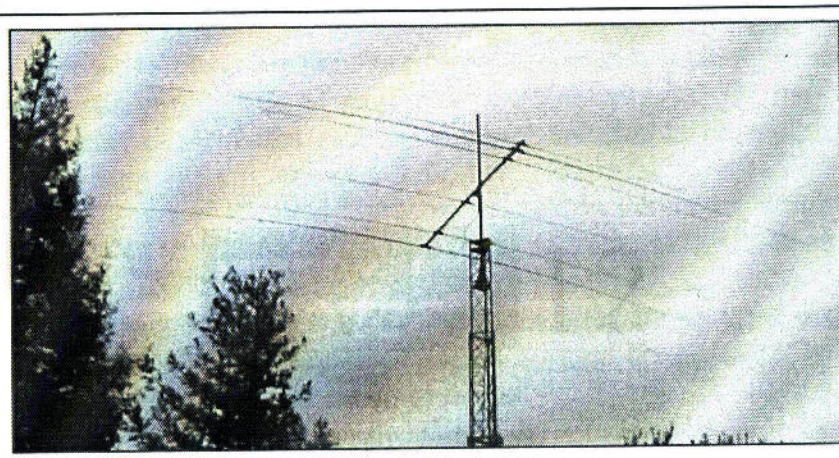
Strike Force Classic 3-Band

C-3S, C-3S/D, C-3S/H, C3S/HH

20, 15 and 10 Meter (plus 17 & 12) Multi-monoband Yagi Antenna

FREQUENCY COVERAGE: 13.950-14.400; 21.000-21.450; 1.1 MHz of 10 Meters (VSWR <2.1:1)

Force 12, Inc.
P.O. Box 1349 Paso Robles, CA 93447
Technical Support 1.805.227.1680 FAX 1.805.227.1684 Order Line 1.800.248.1985



Thank you for selecting the Force 12 ***C-3S*** series antenna. These instructions are common for all four (4) survival models, the ***C-3S*** (80 mph), ***C-3S/D*** (100 mph), ***C-3S/H*** (120 mph) and the ***C-3S/HH*** (140 mph). The ***C-3S*** is the finest three band high performance Yagi-style antenna ever developed and offered in the smallest physical footprint, with its 12' boom. It is also standard in 4' segments, making it ideal for portable use, such as DXpeditions, Field Day, etc. There are no areas for high maintenance or potential loss, such as coils, traps and phasing systems. The antenna is strong, lightweight and computer designed not only for the basic electrical performance, but also computer designed for mechanical strength, durability and low profile. This manual is common for all four ***C-3S*** models.

The ***C-3S*** is a triple monoband Yagi antenna designed for direct operation in the 20, 15 and 10 meter amateur bands. It will also operate on the 17 and 12 meter bands with a VSWR that can be matched by the tuners in most rigs, or by an external tuner. The term, "***C-3S***" is from "Classic 3-Band", which means the antenna is designed for the bands classically, or traditionally, covered by a "triband" antenna. These bands are the 20, 15 and 10 meter bands previously mentioned. The advent of the new 30, 17 and 12 meter bands authorized by W.A.R.C. has added the latter two (17 and 12 meter) bands into the same spectrum space as the classic tribander. There now can be several "tribanders" within this five band range, so this antenna is termed the Classic 3-Band, or "***C-3S***". The ***C-3S*** is a shorter version of the 18' boom version model, the "***C-3***" that re-wrote the book on triband Yagi performance. The trade-off between the ***C-3S*** and ***C-3*** is that the ***C-3S*** covers about 1-1.1MHz of the 10 mtr band vs. the entire band for the ***C-3*** and the VSWR on 12 mtrs for the ***C-3S*** is also higher than the ***C-3***. Otherwise, the performance on 20-15-10 and 17 is very close between the two "classics."

The design of the ***C-3S*** is an dramatic improvement in multiband Yagi antennas over the typical methods used in past years and decades. The usual methods of covering multiple bands utilize traps in the elements, log-periodic cells, dual phased drivers, parallel-feed drivers or various combinations of these methods. The primary shortcomings of these methods are losses in the traps, complex mechanical structures with log and phased elements and other compromises to provide a 50 ohm feedpoint impedance for the 50 ohm coax feed line.

Several design features of the ***C-3S*** will be described in the following paragraph. Knowing it is possible that not everyone who has acquired the ***C-3S*** is necessarily familiar with Yagi antennas, or beam-type (directional) antennas, it is suggested that a good book, such as the A.R.R.L. Antenna Book be utilized for further information. Of course, one can always proceed directly and assemble the ***C-3S***!

The ***C-3S*** is a combination of three individual beam antennas: 20, 15 and 10. The usual method for combining several monoband beams is to stack them vertically on a common mast support; however, this will not result in the best performance mainly because the antennas cannot be separated sufficiently to prevent interaction and a consequent loss of gain. The antennas affected are the higher frequency ones, namely the 15 and 10 meter ones in this case. A superior solution is to stack them horizontally in a sequential manner, so that each one will enhance the other. This is the essence of the ***C-3S*** design. It was proven on several other designs and is called "forward stagger" in the patent write-up. The most complex section in the ***C-3S*** is the design providing for a single feed line to excite the three antennas.

The 20, 15 and 10 meter beams are two element Yagi designs. They are set up with the parasitic element as a reflector. Referring to the ***C-3S*** drawing, the forward stagger arrangement will be evident. The 15 reflector is positioned ahead of the 20 meter reflector so that the 20 reflector does not interfere with the 15 reflector operation. The 10 meter reflector is positioned in a similar manner in front of the 15 meter reflector. The single feed line is made possible through the use of an "open sleeve" driver system. The basic open sleeve design is nothing too new, but to use it in this manner required some extra design work.

The 20 meter driver element is the one to which the coax is attached and the 20 meter Yagi is designed for approximately 50 ohms at the feed point. The spacing and length of the 15 meter rear driver are adjusted to achieve 50 ohms on 15 meters and the 2:1 VSWR bandwidth covers the band. The 10 meter front driver is designed in like manner. This is a new development in open sleeve implementation and is included in one of the company's filed patents. The 15 and 10 meter drivers are excited parasitically. Since the spacing is part of the feedpoint system, the VSWR will be noticed to fluctuate during windy conditions on 10 and somewhat on 15 meters. This is normal. The usual VSWR fluctuation has been noticed to be about +/- a tenth (.1).

The VSWR curves for the ***C-3S*** allow full coverage on 20 and 15 meters and 1-1.1MHz on 10 meters. Part of the specification is that at least 100' of coax is assumed to be in use, which is a typical installation. If the VSWR is measured directly at the feed point, the 2:1 points on 15 will not span the entire band and 10 meters will also be narrower than 1-1.1MHz; however, making use of a particular phenomenon with coaxial cable, the VSWR response is flattened out slightly and the ***C-3S*** covers all the bands with 2:1 or less across the 20 and 15 meter bands. The VSWR curves are not symmetrical, nor should they be expected to be so. For example, the lowest point on 10 meters is usually about 28.800 MHz. The curve increases slower on the low side and faster on the high side. Small adjustments are provided so that the VSWR curves on 15 and 10 meters can be slewed either upward or down in frequency. Doing so will not alter the forward gain or front-to-back ratio of the antenna on these bands. As a short note, a low or high VSWR does not necessarily mean that an antenna works or not. A fine book addressing this is Reflections,

published by the A.R.R.L. The ***C-3S*** antenna is highly efficient and does not contain any traps, which typically produce loss in the antenna. The ***C-3S*** will also operate well on 17 and 12 meters, although the directional patterns will not be great, as there are no elements included to enhance the patterns for these bands. Overall, the ***C-3S*** is an efficient, multi-band antenna!

The mechanical design of the ***C-3S*** 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 riveted elements can be installed temporarily for expeditions by using a stainless rivet without the mandrel. Simply put the rivet in the hole, wrap a piece of black tape around it and it is ready to go. Disassembly involves taking the tape off and removing the rivet! Simple. The elements and boom are designed to present a low profile and withstand 80 mph winds (the boom is actually designed in excess of 100 mph). ***C-3S*** antennas can be stacked to provide more potential to the station.

All the elements are insulated from the brackets and boom and the driver element is split at the center with a solid fiberglass insulator. Connection to the driver is through a pair of 10-24 stainless machine screws. **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 feedpoint 10-24 nuts.

C. Screwdriver to back up the 10-24 feedpoint machine screws.

D. 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.

E. A rope to hoist the antenna into position.

F. 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

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The antenna is shipped in sub-assemblies and each assembly section is appropriately identified. There are six (6) elements and each one is divided into two (2) halves: "A" and "B". The assembly sections are then numbered consecutively from the inside out to the tip with the element number first, such as: 1A and 1B, 2A and 2B, 3A and 3B, etc., since there is never the same size tubing twice on a side! Matching up the tapering sizes for each element side is all that is required. Element #1 is the 20 meter reflector. The ***C-3S*** drawing will assist in this process. Assembly requires only that the identifications are matched. All the rivet holes are pre-drilled and will align exactly when the proper sections are matched. The driver element is split at the center and fed with 50 ohm coax through either a 1:1 balun, or an RF choke (i.e. 8 turns, 10" diameter circle). The boom is in three (3) sections and is marked A-A, B-B and C-C. Matching these sections and inserting the 1/4-20 bolts will complete the boom assembly. The aluminum mill markings are left on the tubing. If it is desired to remove them, most solvents will wipe them away. Any markings made at the Force 12 factory will quickly fade.

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.

4) The PVC element insulators may or may not be already installed on each element. There are two sizes (in diameter) of PVC and they are easy to relate to each element. Slide the appropriate size over the element and center it on the largest tubing in the element (which will be the center piece). The longer pieces go on the non-driver elements. The drivers use two short pieces and they go on both sides of the center insulator, just outside of the 10-24 machine screws.

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 disassembled 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/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) Lay out the element assembly sections for element #1 (the 20 meter reflector).**

_____a) Side A

_____b) Side B

_____c) Note: the ***C-3S/HH*** uses bolts for two (2) joints on this element (see drawing).

_____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) 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.

_____b) 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).

_____c) 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) Double check that both sides "A" and "B" have been fully assembled.

_____**5) Lay out the element assembly sections for element #2 (the 15 meter reflector).**

_____a) Side A

_____b) Side B

_____6) 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.

_____7) Starting at the tip, slide the tip into the next larger section and align the rivet holes.
- _____a) Insert the supplied 1/8" rivets into all rivet holes.
- _____b) Pull each rivet with the hand riveter.
- _____c) Slip each section into the matching larger tubing, as in the prior step and secure with the rivets.

_____8) Double check that both sides "A" and "B" have been fully assembled.

_____**9) Lay out the element assembly sections for element #3 (the 10 meter reflector).**
- _____a) Side A
- _____b) Side B

_____10) 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.

_____11) Starting at the tip, slide the tip into the next larger section and align the rivet holes.
- _____a) Insert the supplied 1/8" rivets into all rivet holes.
- _____b) Pull each rivet with the hand riveter.
- _____c) Slip each section into the matching larger tubing, as in the prior step and secure with the rivets.

_____12) Double check that both sides "A" and "B" have been fully assembled.

_____**13) Lay out the element assembly sections for element #4 (the 15 meter rear driver).**
- _____a) Side A
- _____b) Side B

_____14) 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.

_____15) Starting at the tip, slide the tip into the next larger section and align the rivet holes.
- _____a) Insert the supplied 1/8" rivets into all rivet holes.
- _____b) Pull each rivet with the hand riveter.
- _____c) Slip each section into the matching larger tubing, as in the prior step and secure with the rivets.
- _____d) NOTE: the initial proper rivet holes for the tip have one hole outside the .500" section. Double check the drawing to ensure the proper holes are used. The outside hole and inside hole are used for making slight VSWR slewing adjustments if needed to shift the curve up or down.

_____16) Double check that both sides "A" and "B" have been fully assembled.

_____17) **Lay out the element assembly sections for element #5 (the 20 meter driver).**

_____a) Side A

_____b) Side B

_____c) Note: the ***C-3S/HH*** uses bolts for two (2) joints on this element (see drawing).

_____18) 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.

_____19) Starting at the tip, slide the tip into the next larger section and align the rivet holes.

_____a) Insert the supplied 1/8" rivets into all rivet holes.

_____b) Pull each rivet with the hand riveter.

_____c) Slip each section into the matching larger tubing, as in the prior step and secure with the rivets.

_____20) Double check that both sides "A" and "B" have been fully assembled.

_____21) If the center section is not already assembled:

_____a) Remove the 10-24 machine screw from the center section that does not have the fiberglass insulator.

_____b) Insert this section over the fiberglass insulator until it butts against the internal stop. This will align the hole in the tubing and the insulator. One end of the hole in the tubing has been filed. This indicates the side from which the machine screw is inserted; thereby ensuring proper alignment of the holes. Note that there is also an alignment mark.

_____c) 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 flat washer and another split lock and nut secure feed line.

_____22) **Lay out the element assembly sections for element #6 (the 10 meter front driver).**

_____a) Side A

_____b) Side B

_____23) 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.

_____24) Starting at the tip, slide the tip into the next larger section and align the rivet holes.

_____a) Insert the supplied 1/8" rivets into all rivet holes.

_____b) Pull each rivet with the hand riveter.

_____c) Slip each section into the matching larger tubing, as in the prior step and secure with the rivets.

_____d) NOTE: the initial proper rivet holes for the tip have one hole outside the .500" section. Double check the drawing to ensure the proper holes are used. The outside hole and inside hole are used for making slight VSWR adjustments if needed to shift

the curve up or down.

_____25) Double check that both sides "A" and "B" have been fully assembled.

II. BOOM ASSEMBLY

_____1) Lay out the three (3) boom sections in the assembly sequence (A-A, B-B) and note their engraved alignment marks. Note also that one end of two sections are swaged (reduced).

_____a) Note: the ***C-3S/HH*** has a thick-wall center boom section that is swaged on both ends. The outer sections slide over the center section and are bolted through (see drawing). The element brackets are also through-bolted, besides being riveted in place.

_____2) Lubricate the portions that will slip into the next section. These are the swaged ends.

_____3) Slip the first section into the matching location, 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 only 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 that there is no truss cable for this boom.

_____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 only 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.

_____e) Note: the ***C-3S/HH*** uses the large Magnum Easy-On™ mounting plate that has four (4) U-bolts and saddles for the boom and four (4) for the mast..

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 tests of 10 years show that the PVC is an excellent material and there was no need for replacement. The primary purpose is mechanical, except on the driver elements.

_____2) Two methods are suggested for element mounting:

_____a) Placing the element on the underside of the plate and then sliding the U-bolts over the PVC, up through the plate.

_____b) Inserting the U-bolts through the plates first (with washers and nuts very loose) and then sliding the element through the pair of U-bolts.

_____c) Note that this element mounting method makes it easy to mount elements on the boom while the antenna is on the tower, as might be required in some installations.

_____3) Select the mounting method that best meets your installation needs.

_____4) The element mounting plates are already aligned at the factory, so element alignment is quite simple. The way an element can get slightly out of alignment is if the U-bolts are not equally tightened (can be noted by more threads showing on one side than the other).

_____a) The elements should be visually checked to be as parallel as possible, especially in the driver area (15 and 10 Mtr drivers). There is a slight amount of alignment possible with the clearance between the PVC insulator and the U-bolts.

_____5) NOTE: there are two (2) sizes of U-bolts to hold the elements to the boom.

_____a) The larger ones are for the 20 meter elements.

_____b) The smaller ones are for the 15 and 10 meter elements.

_____6) Use the following procedure with all but the driver element (20 meter driver, element #4):

_____a) With the nuts still loose on each plate, align the element so that:

_____a1) the rivets are pointing downward.

_____a2) the slot in the PVC insulators are downward.

_____a3) the PVC is centered on the element mounting plate, with the U-bolts over the PVC (not touching the aluminum element).

_____b) Now the nuts can be tightened. It is only necessary to tighten them until the element does not rotate with hand pressure, then about a half-turn more.

_____c) Double check that the split lock washers under the nuts are compressed.

_____7) Use the following procedure with the 20 meter driver (element #5):

_____a) With the nuts still loose on each plate, align the element so that:

_____a1) the rivets are pointing downward.

_____a2) the slot in the PVC insulators are downward.

_____a3) the PVC is centered on the element mounting plate, with the U-bolts over the PVC (not touching the aluminum element).

_____b) The 10-24 machine screws are at about a 45 degree angle (so that attachment can be made easily). Double check that the screws are pointing in the best direction for feed line/balun attachment (usually towards the mast).

_____c) Now the nuts can be tightened. It is only necessary to tighten them until the element does not rotate with hand pressure, then about a half-turn more.

_____d) Double check that the split lock washers under the nuts are compressed.

IV. ATTACHING THE FEED LINE and MOUNTING TO THE MAST

_____1) There are two (2) Easy-On™ mounting plates and they are identical. One attaches to the mat 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.

_____2) This antenna was designed for use with either a split coax and RF choke feed line, or a 1:1 balun. Some baluns, such as the large W2DU, have the effect of adding length to the driver element. If it is noticed that the VSWR curve on 20 mtrs is low in frequency and a balun is being used, it might be necessary to shorted the driver tips by drilling out the rivets, pushing in the element, drilling new holes through the tip and inserting new rivets. The VSWR curve for 15 and 10 can be adjusted independently of 20 mtrs.

_____a) If a balun is used, such as a ***FORCE 12 B-1***, 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 feedpoints 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.

_____3) 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.

_____4) 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.

_____5) 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.

_____6) 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.

_____7) Neatly dress the feed lines to the mast, making sure there is sufficient coax to coil around the mast if a rotator is used.

_____8) 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.

VI. FINAL VSWR CHECK

_____1) If the VSWR curves are low for all the bands, please check to be sure the leads on the balun (if used) were trimmed to 2 - 2 1/2" before attachment to the lugs and the antenna. These leads add length to the driver element(s).

_____2) In the event that either 15 or 10 meters VSWR curves are not where desired, they can be shifted slightly by using the provided adjustment holes.

_____3) It was noted during assembly of the 15 mtr rear driver and the 10 mtr front drivers that there are additional holes that can be used for riveting the tips to the .500" sections. The proper initial settings are to have one hole exposed.

_____4) Double check that the tips are correct.

_____5) NOTE that the U-bolts and saddles holding the boom to the mounting plate can be loosened to allow the elements to be rotated downward and possibly reached from the ground.

_____a) Note also that the tips can be held temporarily in place using tape.

_____6) If the VSWR curve is lower than desired, the frequency of the appropriate band must be raised. This is done by shortening the tips for that band.

_____7) If the VSWR curve is higher than desired, the frequency of the appropriate band must be

lowered. This is done by lengthening the tips for that band.

_____8) If 15 mtrs is low (needs to be raised), drill out the rivets in the tip with an 1/8" drill and slide the tip in so that the hole farthest out on the tip is now aligned with the outside hole in the .500" section. The tip will now have been shortened about .750" and the frequency will be raised. Re-rivet the tip. Do the same to the other 15 mtr rear driver tip.

_____a) If 15 is high (needs to be lowered), use the same procedure, but pull the tip outward until the next holes align.

_____b) Moving one hole in or out will shift the frequency of lowest VSWR about 125 kHz.

_____9) 10 mtrs can be slewed in a similar manner.

_____a) Moving one hole in or out will shift the frequency of lowest VSWR about 250 kHz.

_____10) The above should enable positioning the VSWR curve as desired.

_____11) 20 mtrs should not need any adjustment.

_____12) If a short feed line is used, the VSWR response might not be as broad as specified. The additional length of coax "flattens" out the response. This should not be confused with the situation when changing the coax length changes the actual VSWR reading. This indicates that there is current flowing on the outside of the coax and the RF choke or 1:1 balun are not working properly.

_____13) Operation on 17 mtrs is possible using a tuner. The tuners in most transceivers will usually match the ***C-3S*** on 17 mtrs. Operation on 12 mtrs is also possible, although the antenna is much more reactive and the tuner might not be able to match it properly.

VI. FINAL CHECKOUT

_____1) Apply power and have fun.

Notice.....

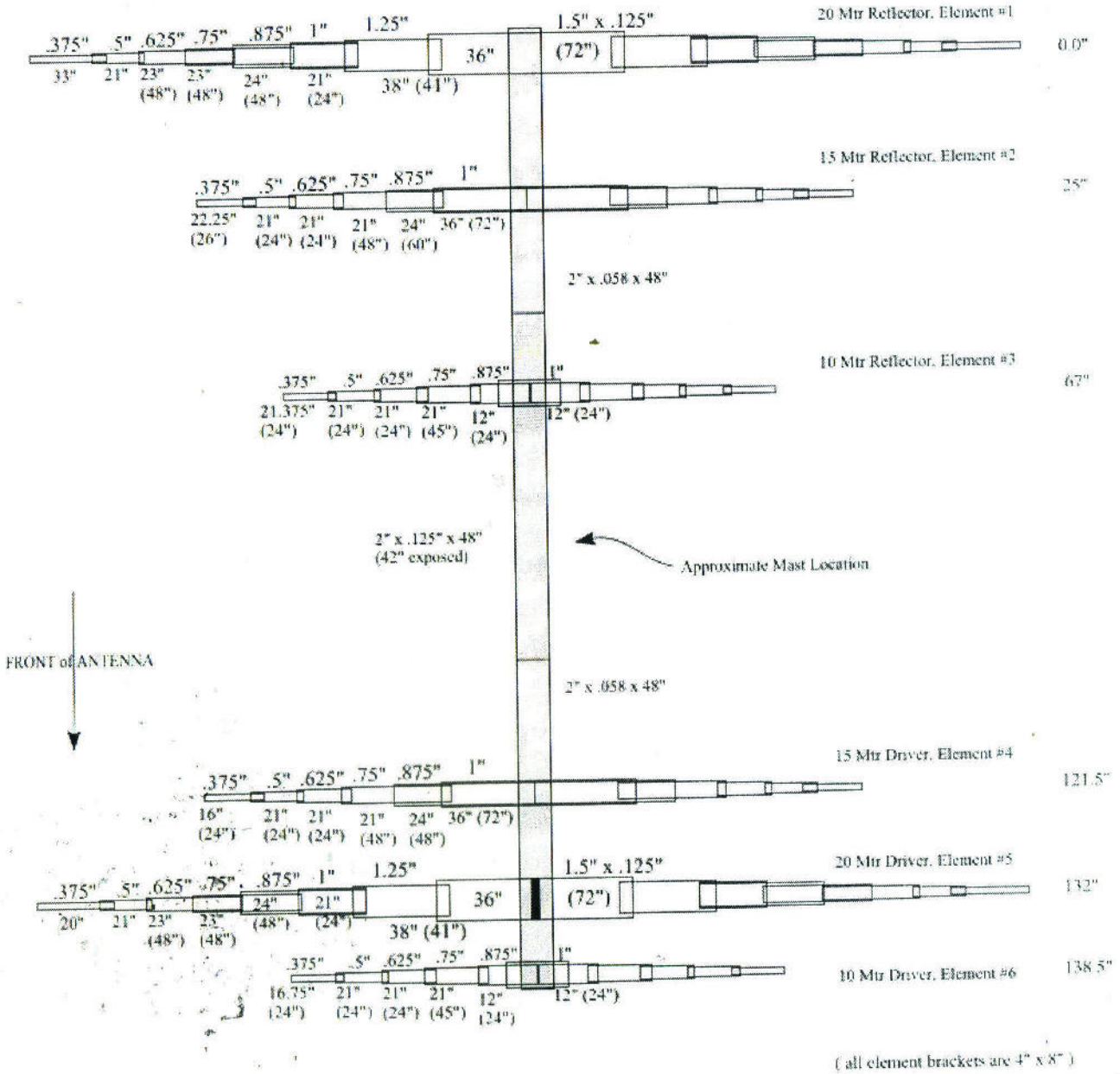
PLEASE BE CAREFUL AND DO NOT LET THIS ANTENNA COME INTO CONTACT WITH POWER LINES OR OTHER DANGERS. YOU CAN BE INJURED OR KILLED BY IMPROPER HANDLING OF THIS ANTENNA.

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

Force 12

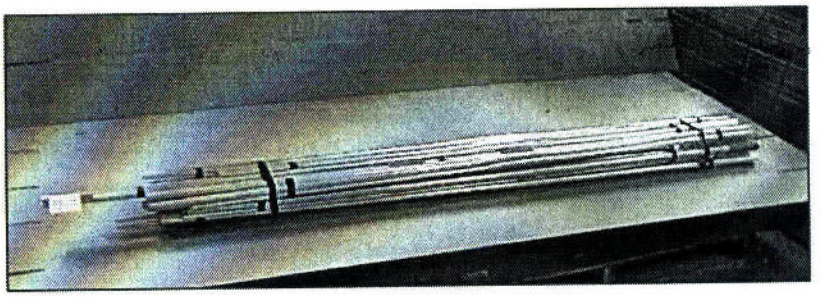
C-3S / HH

20-15-10 (17 & 12) Multi-Monobander
(140 mph)

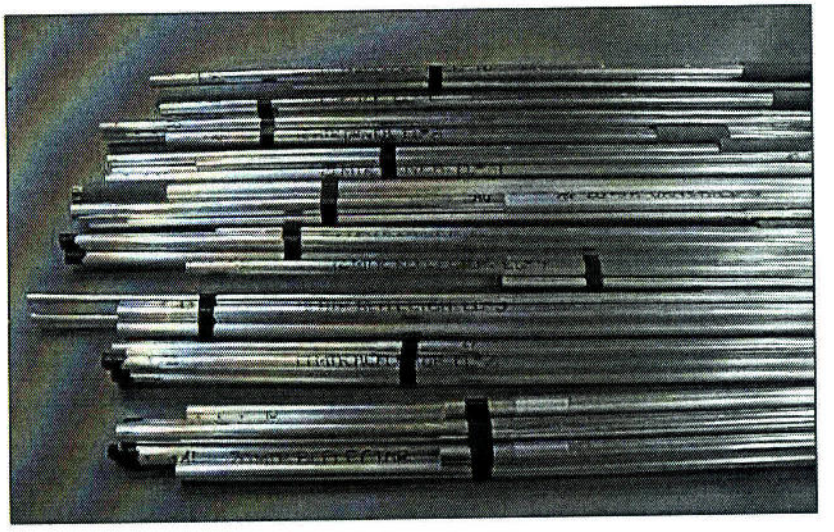


Windload: 7 sqft
Weight: 72 pounds
Power Rating: 5KW
Boom Length : 11' 9"
Turning Radius: 19.2'
Wind Survival 140 mph

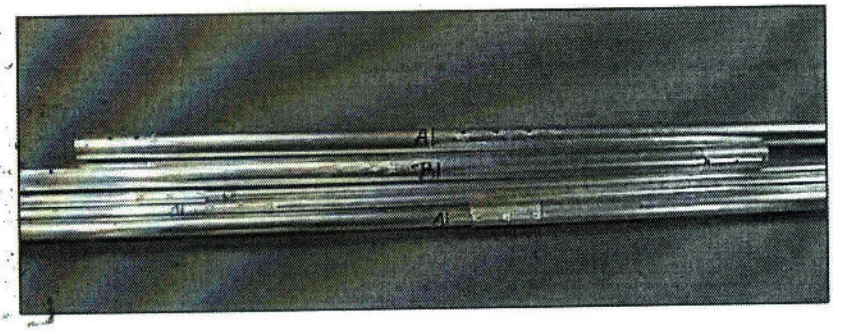
Feed system: 1 feedline, 50 ohms with 1:1 balun or RF choke



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



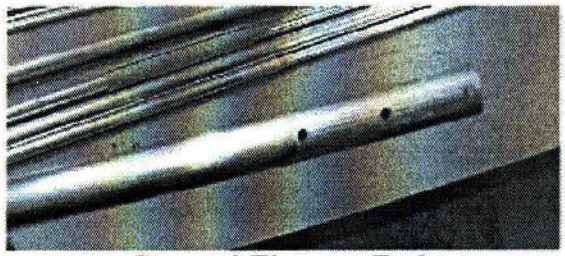
INDIVIDUAL ELEMENT BUNDLES
(Model XR-5 shown)



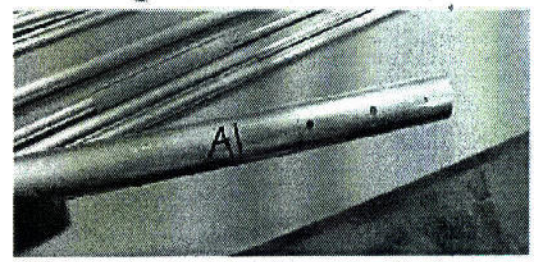
"A" and "B" MARKINGS ON ELEMENT PIECES
"A1" & "B1" identify they are part of element #1.

Force 12

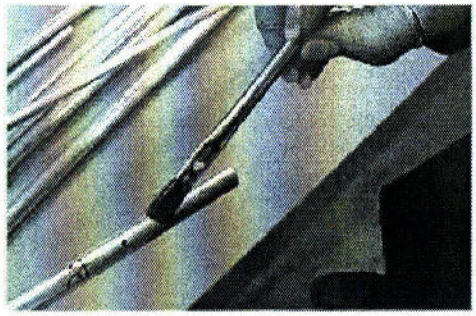
Element Assembly Example



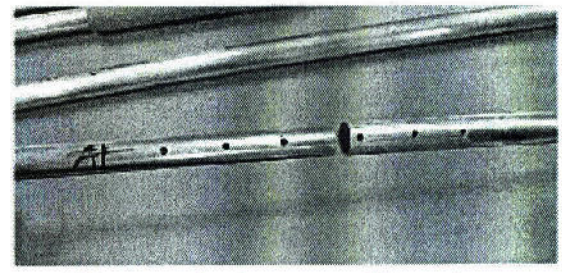
Swaged Element End
(swager marking lines and rivet hole is close to end of piece)



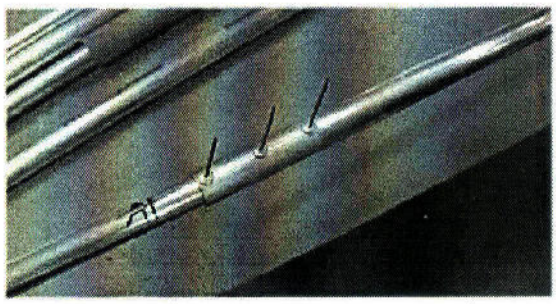
Non-swaged Element End
(no swager marks and rivet hole is not close to end of piece)



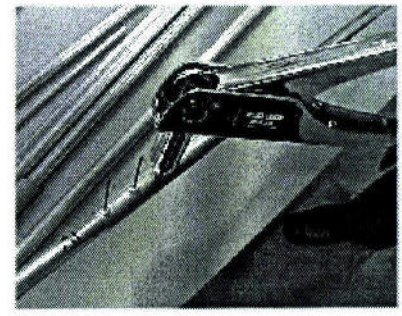
1) Apply Noalox with brush



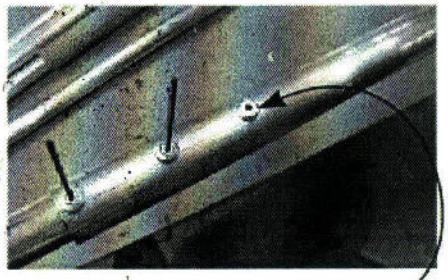
2)Insert tube into matching piece



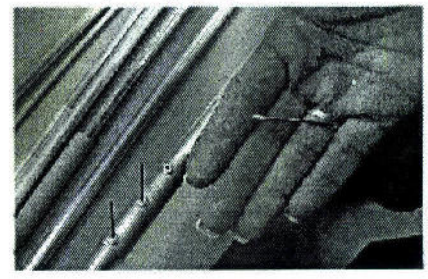
3) Insert all rivets before riveting



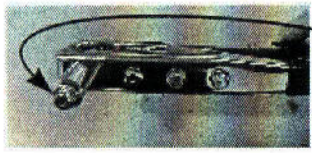
4) Slide rivet tool over mandrel and pull ("pop") the rivet



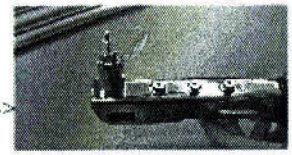
5) Pulled rivet is on right



6) Mandrel removed from rivet tool



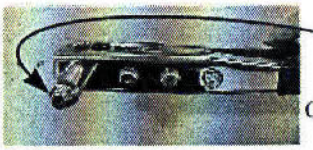
RIVET TOOL
NOZZLE
<--Wrong one on left - hole is too large
Correct on right - small hole fits mandrel -->
(rivet shown dropping into nozzle)



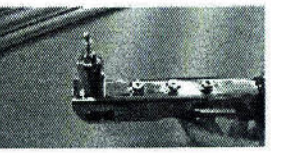
Force 12

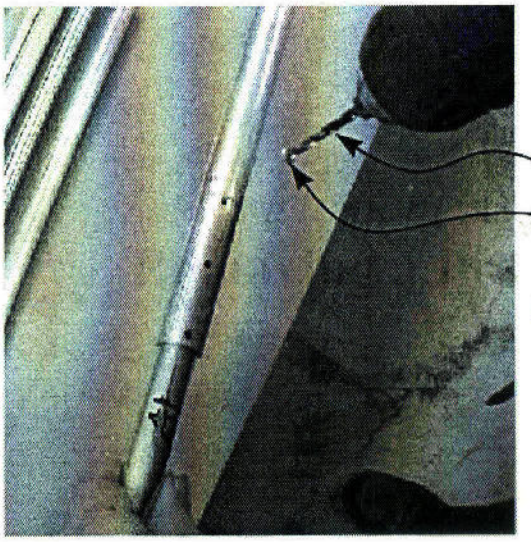
Element Assembly Example

Removing a Properly Installed Rivet



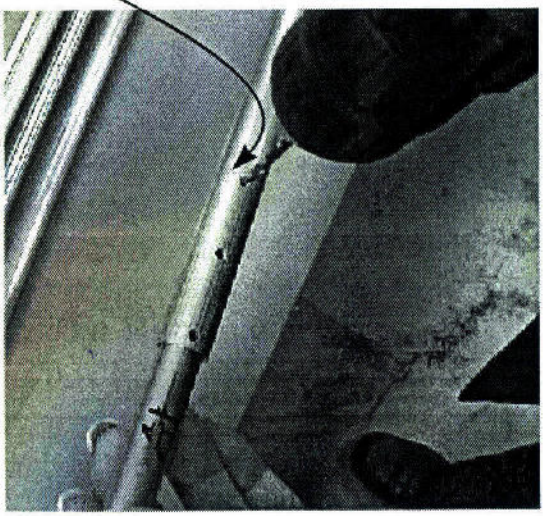
RIVET TOOL
NOZZLE
<--Wrong one on left - hole is too large
Correct on right - small hole fits mandrel -->
(rivet shown dropping into nozzle)





To Remove a Rivet
(that has been properly installed)

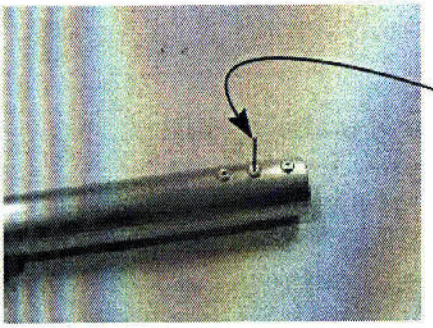
___1) Use 1/8" drill bit
___2) Run drill slowly until rivet head comes off
___3) Remove rivet head from drill tip
___4) Drill through hole



Force 12

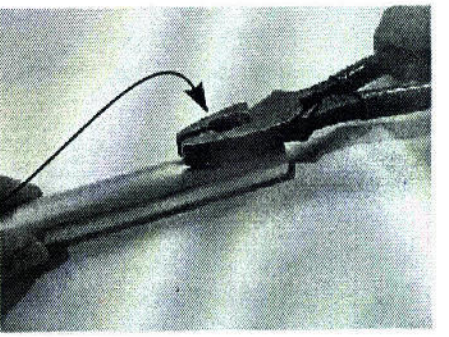
Element Assembly Example

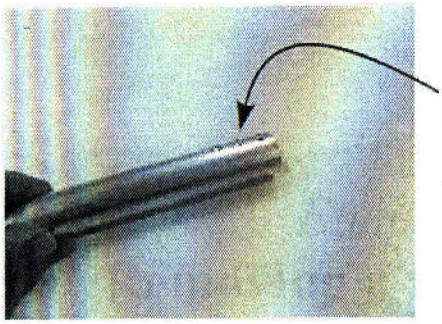
Removing a Rivet with a Broken Mandrel



___1) Broken mandrel

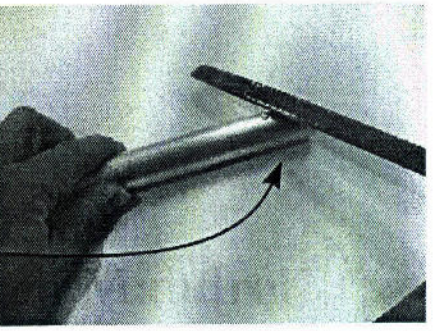
___2) Cut mandrel close to rivet head

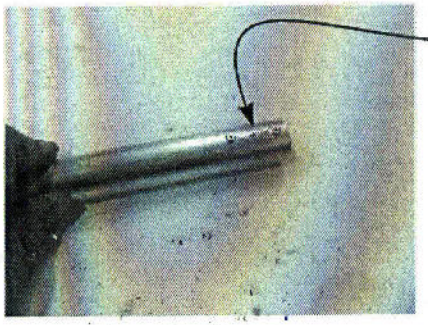




___3) Mandrel is now cut

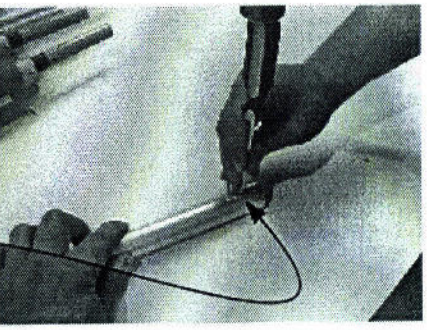
___4) File mandrel AND rivet head flush with tubing



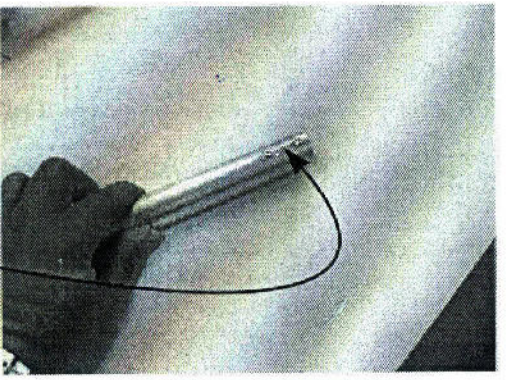


___5) Rivet head and mandrel filed off flush with tubing

___6) Punch rivet through with pointed tool (and hammer)

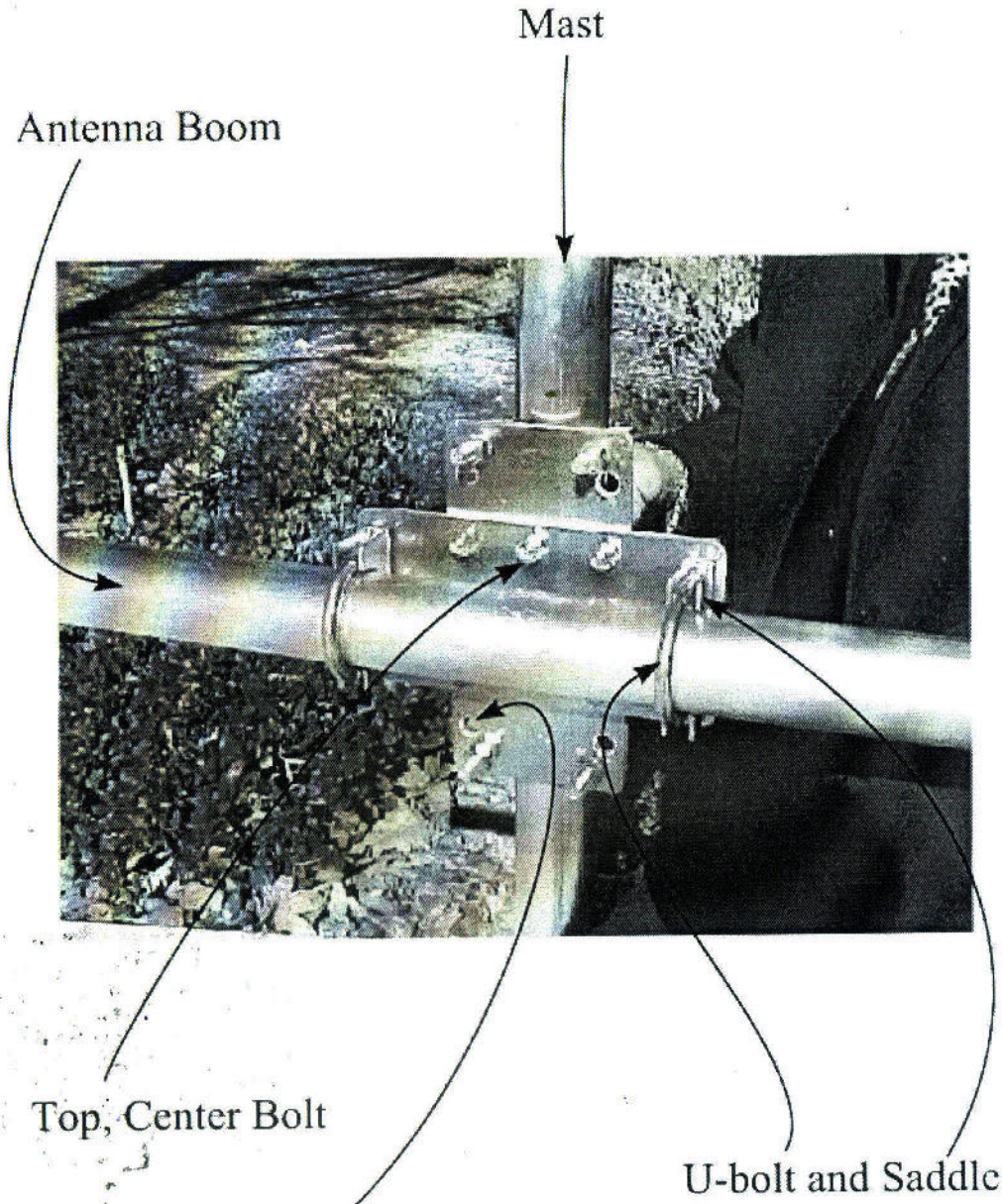


___7) Hole is now clear for new rivet.

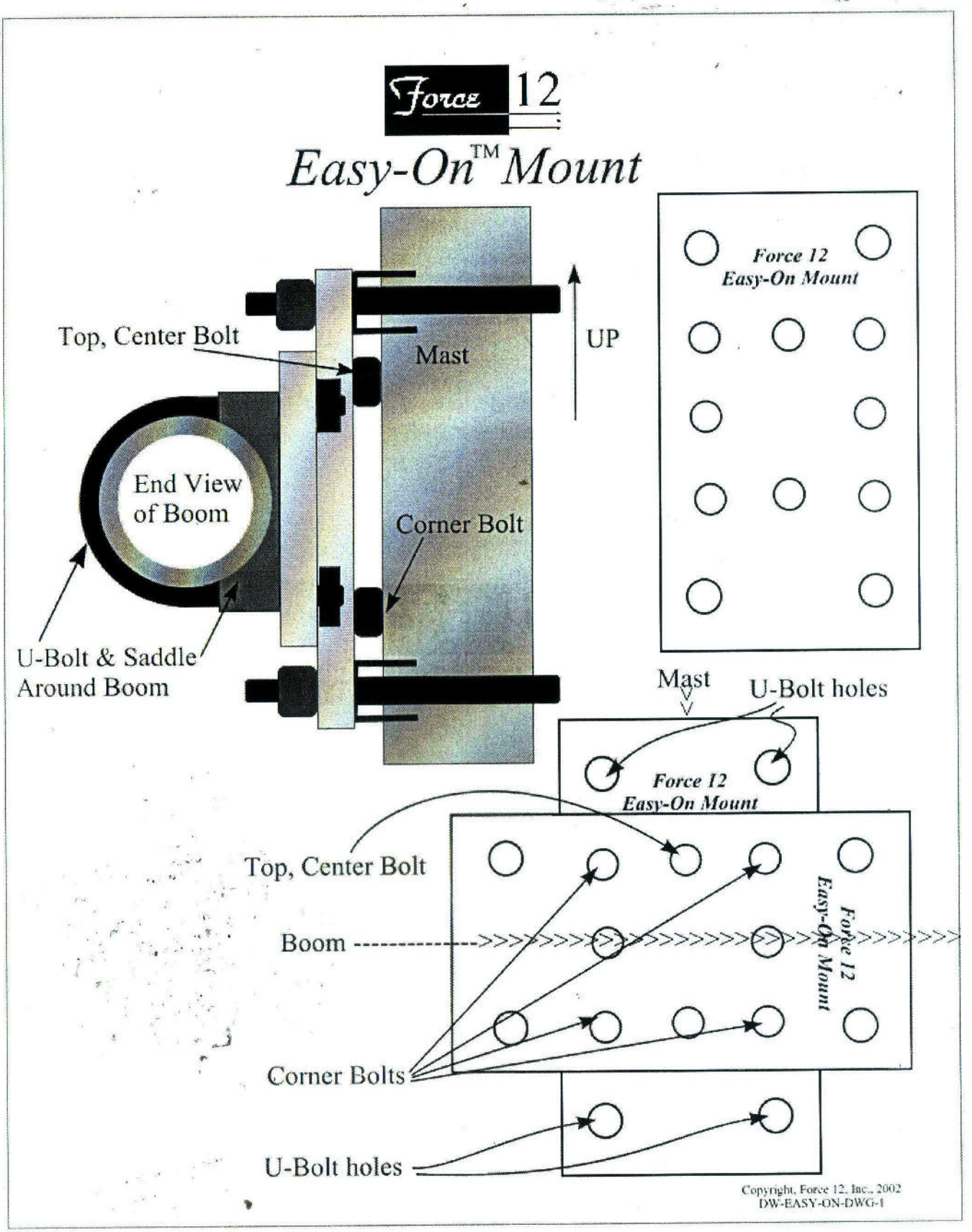


Force 12

Photo of Easy-On™ Mount

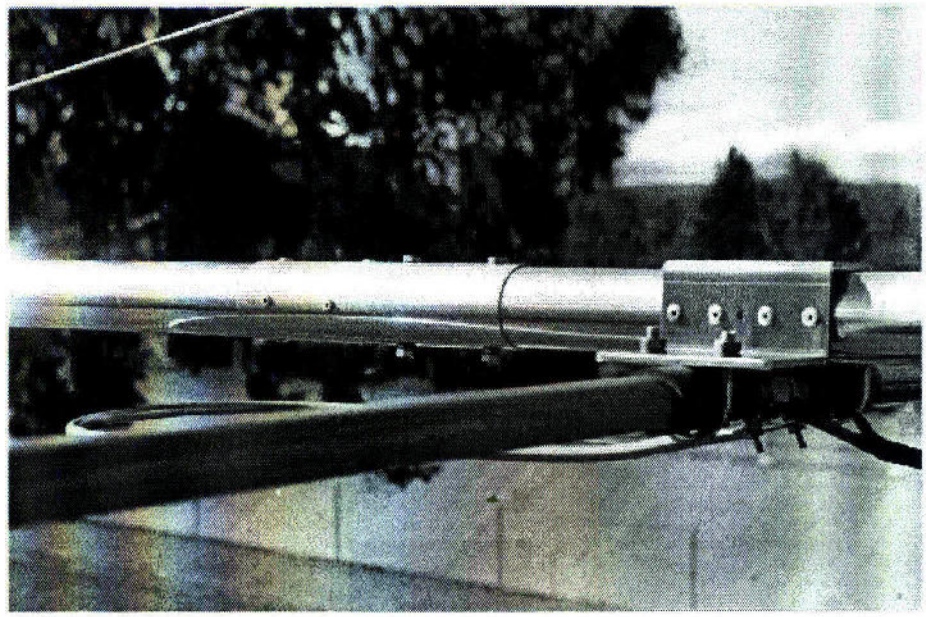


(Note: in this example, extra holes have been drilled for 2 1/2" U-bolts / 2 1/2" mast)

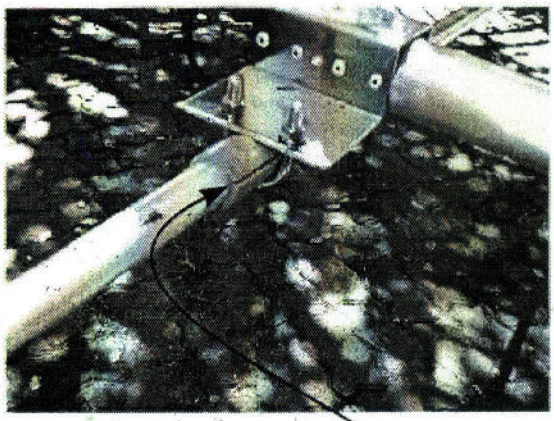

Force 12
Easy-On™ Mount
Top, Center Bolt
Mast
UP
End View of Boom
Corner Bolt
U-Bolt & Saddle Around Boom
Force 12 Easy-On Mount
Mast
U-Bolt holes
Force 12 Easy-On Mount
Top, Center Bolt
Boom
Force 12 Easy-On Mount
Corner Bolts
U-Bolt holes
Copyright, Force 12, Inc., 2002
DW-EASY-ON-DWG-1

Force 12

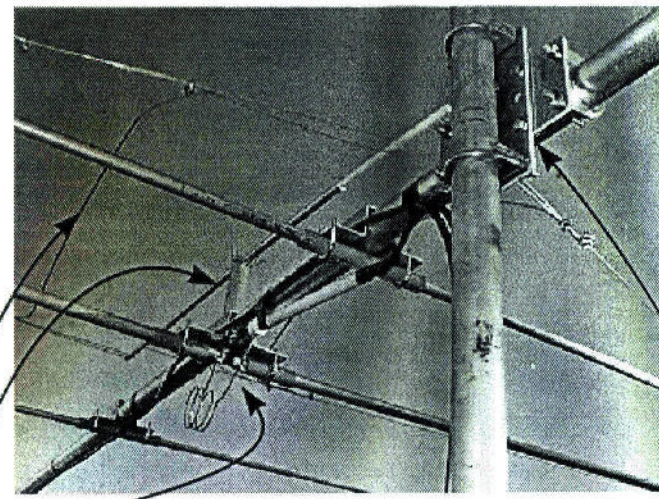
Element to Boom Examples



Driver element, coax attachment (no balun) and hairpin.
Note that the element bracket is not deformed by overtightening of the U-bolts.



PVC slot alignment
on driver elements

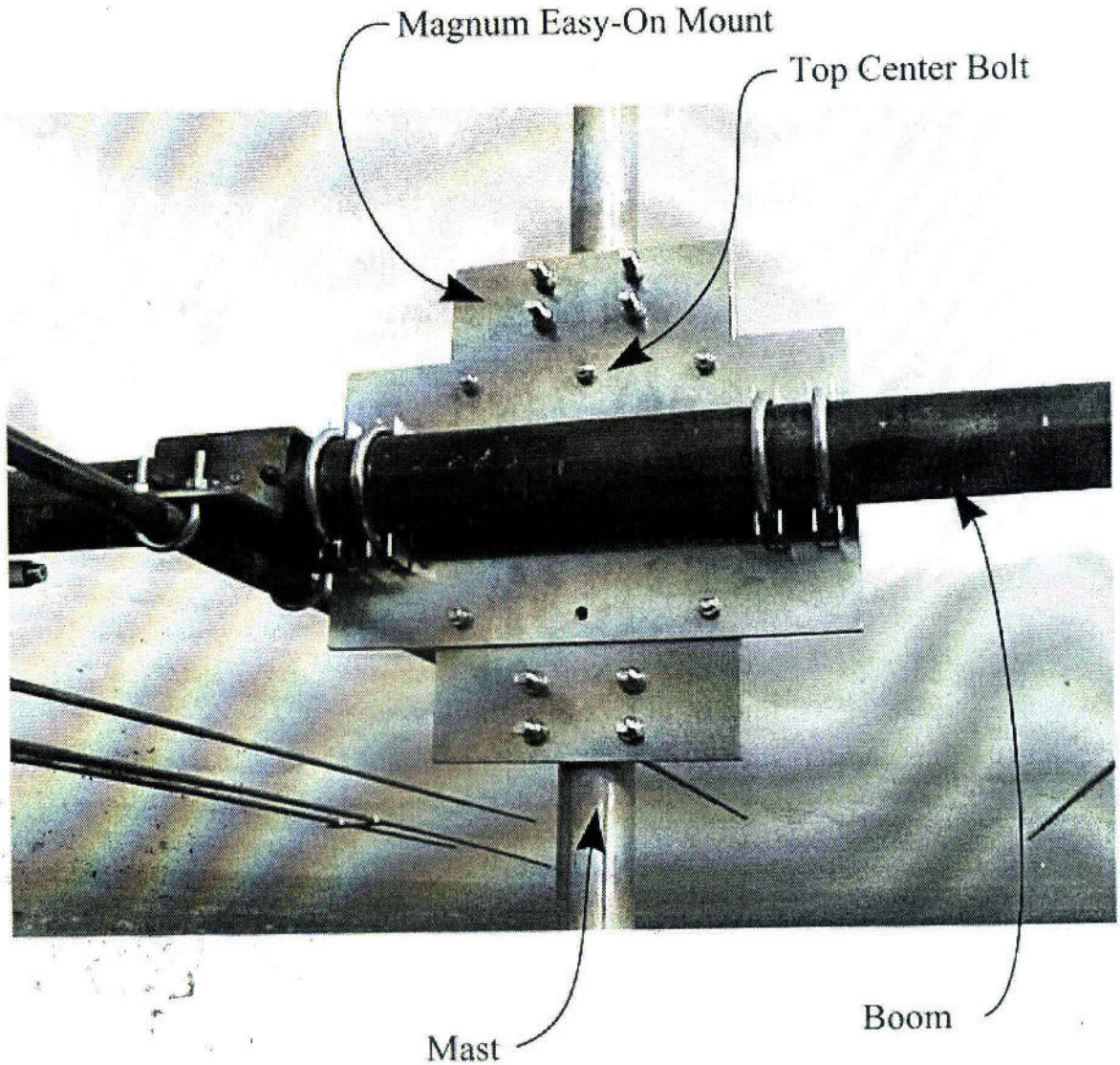


Various views (C-4SXL)
Split driver, hairpin & Force 12 B-1 balun
Easy-On Mount™
Center 40 mtr spreader and tuning jumpers

Force 12

Magnum Easy-On Mount

Shown on C-31XR



EF-140S and EF-140S/H

40 Meter Linear Loaded Dipole

FREQUENCY COVERAGE: 6.850 - 7.500 MHz (adjustable)

Force 12, Inc.
P.O. Box 1349 Paso Robles, CA 93447
Technical Support 1.805.227.1680 FAX 1.805.227.1684 Order Line 1.800.248.1985

The Force 12 ***EF-140S*** is a shortened 40 meter dipole. It is 37.8' long, which is 56% of full size. The ***EF-140S*** utilizes a single linear loading system and is mounted either on the user's own 2 inch diameter mast, or added to the boom of another antenna, such as the ***C-3***. The ***EF-140S*** antenna uses FORCE 12's efficient linear loading design, which provides the highest feed point impedance and broadest bandwidth of any shortened antenna to date. 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 increased the rating for both to 95 mph. The ***EF-140S***/H is for 120 mph winds and assembly detail is on the "H" drawing.

These instructions apply to all models of the ***EF-140S***. A DXpedition model was previously manufacturer to fit into a 4' box, making it perfect for travel. This design has now been incorporated into all the ***EF-140S*** models. The /H models are larger and have additional internal reinforcement.

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 and according to their tapers, with all the "A" pieces on one side and all "B" sections on the other. 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 expected 2:1 VSWR bandwidth of the antenna is more than 100 kHz at the antenna, usually about 130 kHz at the transmitter. The element 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 feedpoint is less than 50 ohms and is stepped up to 50 ohms by using a hairpin match mounted across the feedpoint. 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 is recommended 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 antenna may also be used on other bands with a tuner, 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-140S*** 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.

If there are several antennas on the mast, this antenna might be best mounted parallel to the boom(s). 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.

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 feedpoint 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 feedpoint 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 disassembled 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/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) **Lay out the element assembly sections.**

_____a) Side A

_____b) 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) 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.

_____b) 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).

_____c) 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.

II. ATTACHMENT TO MAST or C-3 to C-4, C-3S to C-4S, or C-3SS to C-4SS CONVERSION

_____1) If this is a stand-alone dipole antenna mounted to a mast, please continue to STEP 3).

_____2) If this is an addition to a C-3, C-3S, or C-3SS trapless antenna for 20-15-10 (plus 17 & 12), please proceed to SECTION III.

_____3) If you are here, the ***EF-140S*** is being used as a stand-alone and will be attached to a mast.

_____4) The center mounting plate is attached next. This is the aluminum plate with several holes for various mountings. The largest pair of holes are for the U-bolts and saddles (2") for the mast; the others are for the vertical support holding the center spreader and for the element itself.

_____5) The plate is secured to the element using two (2) U bolts, nuts and washers. The U's are placed over the PVC insulators on both sides of the element at the center. They are a very snug fit over the PVC. They will be placed over the element from the side. The bottom of element has the rivets and the slot in the PVC facing downward.

_____a) Start the lock washers and nuts to the U's.

_____b) Do not tighten the nuts yet.

_____6) With the nuts still loose on the plate, align the element so that:

_____a) The rivets are pointing downward.

_____b) The 10-24 machine screws are at about a 45 degree angle (so that attachment can be made). Double check that the screws are pointing away from where the mast will be.
_____c) The slots in the PVC insulators are downward.
_____d) The aluminum studs at the outer insulator are horizontal.

_____7) Now the nuts can be tightened. It is only necessary to tighten them until the element does not rotate with hand pressure, then about a half-turn more.
_____a) Double check that the split lock washers under the nuts are compressed.

_____8) Proceed to SECTION IV, which is attaching the linear loading.

III. CONVERSION OF C-3 to C-4, C-3S to C-4S or C-3SS to C-4SS.

_____1) This section details adding the ***EF-140S*** to the boom of a C-3, C-3S, or C-3SS Classic 3-band trapless Yagis.

_____2) If the C-series antenna is presently on the tower, this can be done without removing it; however, the procedure will be much easier if the antenna is removed.
_____a) Removing the antenna is usually quite simple and quick.
_____b) It is safer to add the ***EF-140S*** on the ground!

_____3) Locate the element-to-boom bracket, which is the formed aluminum piece that is 4"x8" and has an aluminum center support post welded to it. (It is like the ones on the C-series antenna that support the driver and 20 meter reflector, element #1).

_____4) Mark the location on the boom for the ***EF-140S***, which is 20" ahead of the 15 meter reflector (element #2) towards the mast.
_____a) Mark both sides of the bracket.
_____b) The front edge (closest to the mast) of the ***EF-140S*** bracket should be 20" from the front edge of the 15 meter reflector bracket (element #2).

_____5) The ***EF-140S*** will actually be attached to the bracket BEFORE the bracket is secured to the boom. This helps in making sure the elements remain parallel to each other.

_____6) Place the bracket on the boom from the top side at its proper location.

_____7) The ***EF-140S*** element should already be assembled to full length, except for the linear loading.

_____8) Slide the ***EF-140S*** underneath the boom and center it under the mounting bracket.

_____9) Using the appropriate U-bolts, slide the U-bolts from the underside, over the ***EF-140S***, 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 feedpoint screws to enable easy access to the nuts.

_____f) Check so that the feedpoint 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.

_____10) The bracket is now secured to the boom.

_____a) Carefully align the ***EF-140S*** with the existing elements on the C-series antenna so that they are in alignment (parallel).

_____b) Double check the horizontal position (20" in front of the 15 meter reflector).

_____c) Carefully drill the first hole through one of the four holes in one side of the bracket and through the side of the boom.

_____c1) The drill size is 3/16".

_____c2) As you drill the hole, check the alignment.

_____c3) The center 1/4" hole is for another purpose, so do not use it. Thanks.

_____d) Start one of the sheet metal screws through the bracket and into the boom.

_____f) Drill a (second) hole on the OTHER side of the bracket.

_____g) Start another sheet metal screw into the second hole.

_____h) Check the alignment again and secure these first two sheet metal screws.

_____i) If the alignment is not as exact as you want, remove one of the screws and start another hole with the proper alignment. The hole not used can be filled in LAST, after the element and bracket are correct.

_____j) Complete all screws in the bracket.

IV. LINEAR LOADING ATTACHMENT

_____1) The linear loading system is attached in a similar manner whether the ***EF-140S*** is a stand-alone dipole or used on a C-3, C-3S, or C-3SS (now a C-4, C-4S, C-4SS).

_____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.**
USE EYE PROTECTION.
USE EYE PROTECTION.

_____4) Select one of the linear loading cables (they are all the same length).

_____a) Pass it through the aluminum stud closest to the tip by loosening the 1/4-20 hex bolt in the end of the stud.

_____b) 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.

_____c) 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 cab be used on the flat portion of the stud to re-align it and/or hold it in position.

_____d) Select the another cable and attach it in a like manner to the other end of the element.

_____e) The other cables are likewise attached to the stud on the inward side of the outer insulator.

_____f) Check that the nuts are tight and that the cables are running towards the center of the antenna.

_____5) If the ***EF-140S*** is used as a stand-alone:

_____a) Mount the vertical spreader support on the mast side of the mounting plate using U-bolts, lock washers and nuts. Align the support with the 1/2" hole lined up and so that the spreader, when passed through the hole, will be perpendicular to the element.

_____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 tightest 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 some droop still present (i.e. not

straight). This is because to make the loading guys tight creates compression on the element and can actually cause it to be less strong than if there were no guys at all.

_____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 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, 16" to the tuning jumper and cable clamp will center the antenna at about 7.060.
_____c) 18" will center higher, to about 7.120 MHz
_____d) 14" will center lower, to about 7.020 MHz
_____e) The actual setting will vary somewhat, due to actual location and tension in the loading wires.

_____10) Attach the tuning jumper on the other side, as above.

_____11) The antenna is now ready for mounting.

V. MOUNTING TO THE MAST (stand-alone antenna)

_____1) If this is a conversion for a C-3 to a C-4, C-3S to C-4S, or C-3SS to C-4SS, proceed to VI.

_____2) If you are here, the ***EF-140S*** is going to be mounted to a mast.

_____3) Notice that the mast will actually pass through the linear loading. To accomplish this, one linear loading wire is removed from the spreader during installation.

_____4) Identify the loading wire that needs to be temporarily removed from the spreader.
_____a) Loosen the cable clamp and carefully slide the wire back out of the center spreader.

_____5) The ***EF-140S*** can now be raised into the desired position and secured to the mast with the pair of 2" U-bolts and saddles. These will clamp on to smaller masts as well as 2".

_____6) Once in position, re-attach the linear loading wire temporarily removed.

VI. MOUNTING to the C-3 boom, making a C-4; a C-3S into a C-4S; or a C-3SS to a C-4SS.

_____1) As an option, the matching coil, balun and feed line can be attached now or after re-attachment to the mast (see next section).

_____2) Note that the balance has now changed.

_____3) Loosen the Easy-On™ plate attached to the boom and slide it towards the ***EF-140S*** antenna about a foot (12"), or until the antenna balances again. The antenna can be re-balanced again once it is on the mast.

_____4) Carefully re-attach the C-4, C-4S, or C-4SS (formerly C-3, C3S, C-3SS) to the mast as before.

VII. 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***, 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) The spreader can be moved closer through the center support for ease in reaching the farthest tuning connection.

_____3b) 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.

_____3c) If adjusted at about 15' above ground, the antenna will shift less than 15 kHz upward as it is raised.

_____3d) 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) After tuning is complete, insert the Alum-O-Weld wire through the center support and through the spreader. Bend down both sides. This will keep the spreader from moving.

_____5) 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.

VIII. 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.

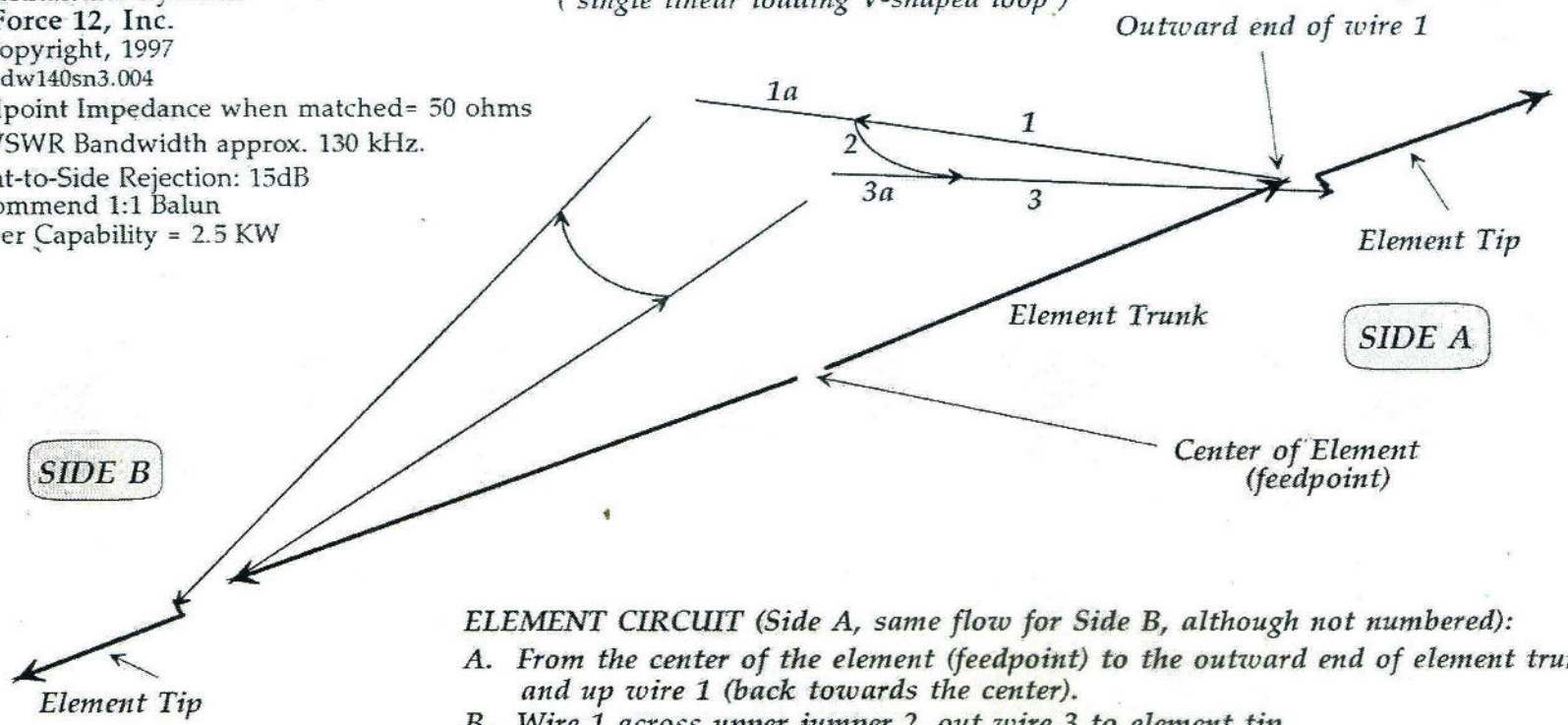
Force 12

Antennas and Systems
Force 12, Inc.

dw140sn3.004

LINEAR LOADED ELEMENT DESIGN
40 Meter, EF-140S Model.....Circuit Visual Flow
(single linear loading V-shaped loop)

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



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

A. *From the center of the element (feedpoint) to the outward end of element trunk and up wire 1 (back towards the center).*
B. *Wire 1 across upper jumper 2, out wire 3 to element tip*
C. *Sections 1a and 3a of wires 1 and 3 are the capacitive portions of the loading system.*
D. *Initial settings for approximately 7.050 MHz are:*
   Jumper from Center Insulator = 14"
E. *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'.*

dw140Sn3.003

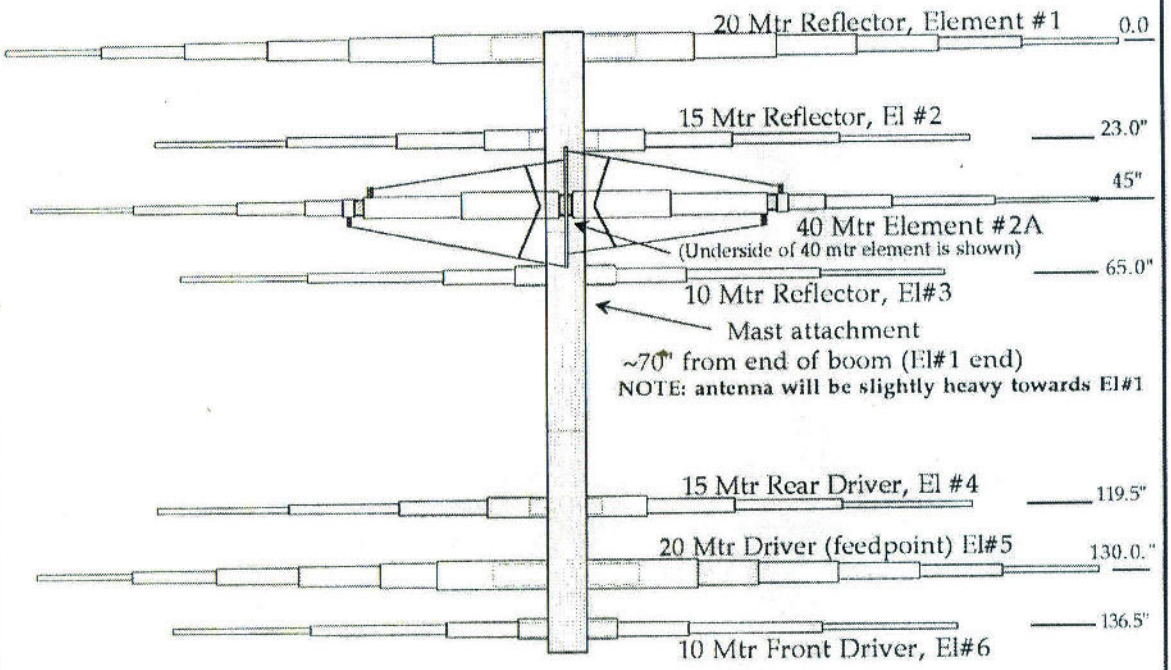
Force 12

STRIKE FORCE Classic 4-Band, C-4S

7 Element 40, 20, 15 and 10 Meter Yagi-style Antenna

FREQUENCY COVERAGE 6.900-7.500; 13.950-14.400; 21.000-21.450; 28.000-29.700 MHz (>1MHz 2:1)

"C-4S"



15 Mtr Rear Driver tips have 2 adjustments available: 1 up and 1 down
each hole in/out adjusts center frequency approx 125 kHz (std center freq is ~21.225)

10 Mtr Front Driver tips have 4 adjustments available: 2 up and 2 down
each hole in/out adjusts center frequency approx 250 kHz (std center freq is ~28.800)

FRONT of ANTENNA

BOOM is 12' x 2" OD

WINDLOAD 5.66 Square Feet Maximum at 15 degrees from boom center
MAST TORQUE: <200 inch pounds at 70 mph
WEIGHT Approximately 35 Pounds
TURNING RADIUS 19.8 Feet
POWER RATING 3KW
WIND SURVIVAL 80 mph
FEED SYSTEM: Single 50 ohm coax through RF choke or 1:1 balun
Hairpin match on 40 mtrs through RF choke or 1:1 balun

dwc4s1.001

Elite Force EF-140S

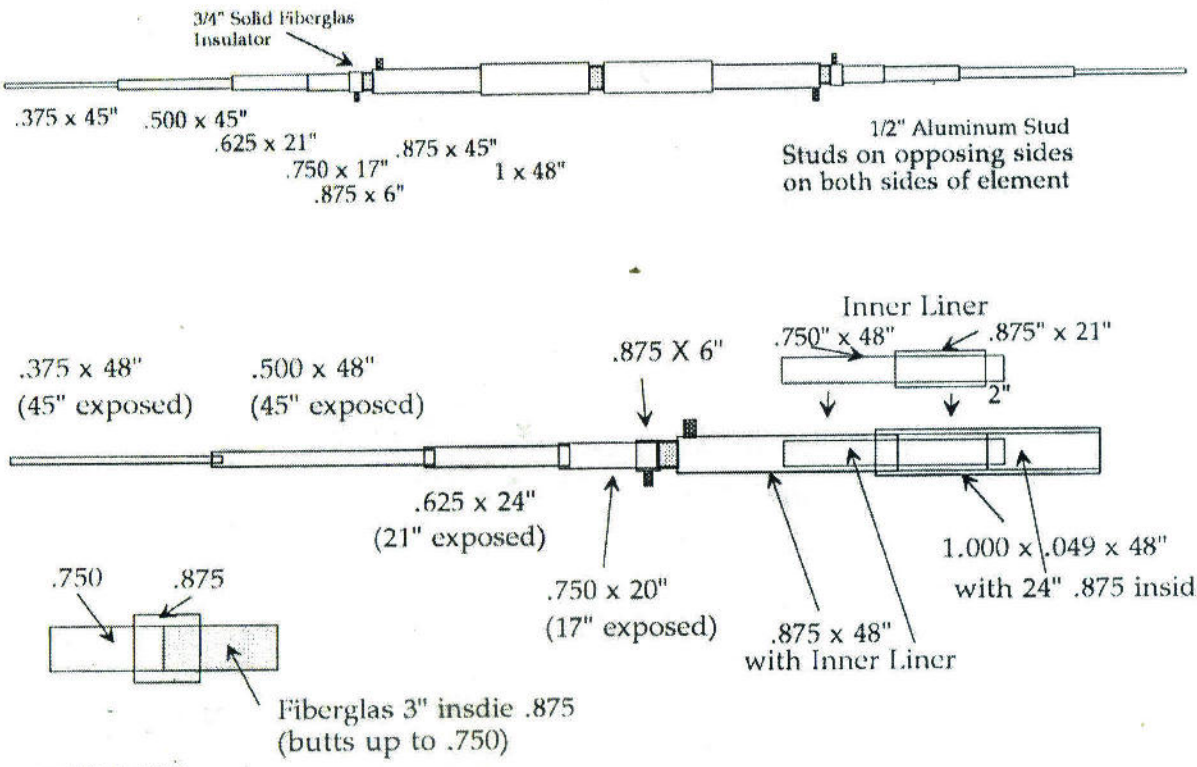
New, as of July 20, 1998; now rated at 100 mph

(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:

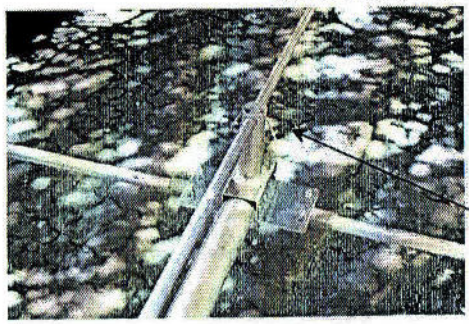
1) let WD-40 set for a couple minutes

2) wipe off tape residue

pix40s1.001

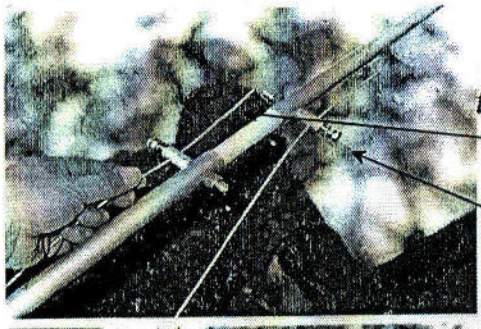
Sample photos for assembly of EF-140S, 40 mtr element(s) on: C-4SXL, C-4XL, C-4, C-4S, , EF-140S, EF-240S, EF-320X/240S.

GENERAL INFORMATION, Page 2



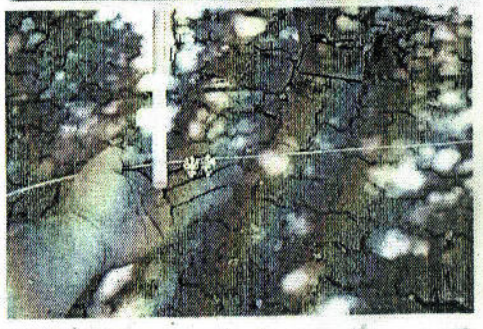
The center spreader and support post for the 40 mtr element(s).

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

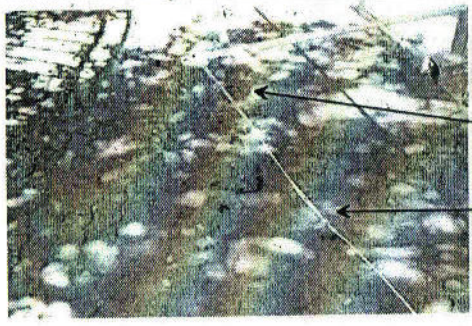


The Alum-O-Weld linear loading wire has been straightened out. It is passed through a stud. There is about 5" (12cm) of wire through the stud.

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.

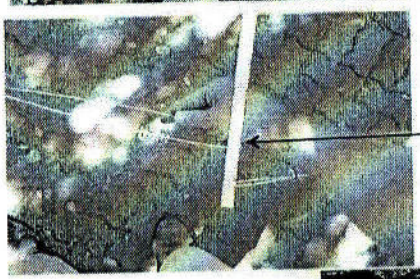
pix40s1.001

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.

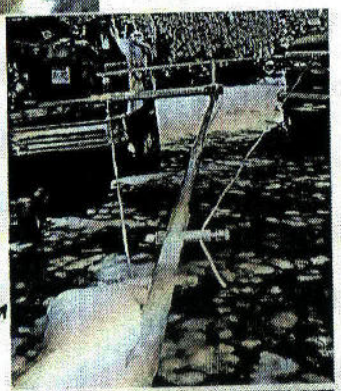
GENERAL INFORMATION, Page 3

Use your thumb to tension the llinear 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.

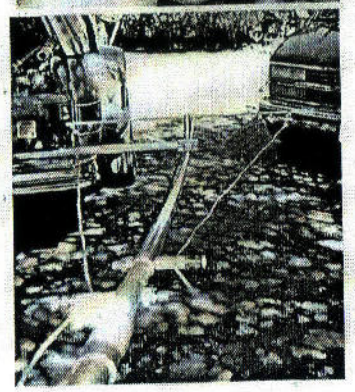
Look from the tip towards the center. Use the 5" extra wire to make very small adjustments in the wire. This will make the element straight.

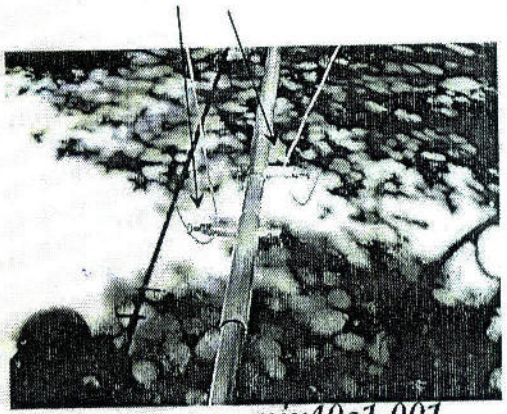


After the element is straight and equal on both sides, tighten the 1/4-20 bolt and nut. This will secure the linear loading wires. I
NOTE: it is NOT necessary to overtighten the bolts onto the wire. Tighten about 1/6 turn past snug.

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

Lift up





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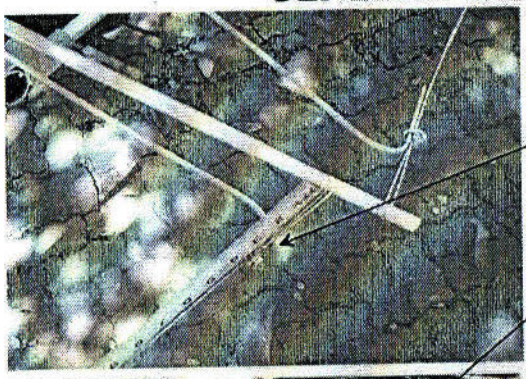
Force 12

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.

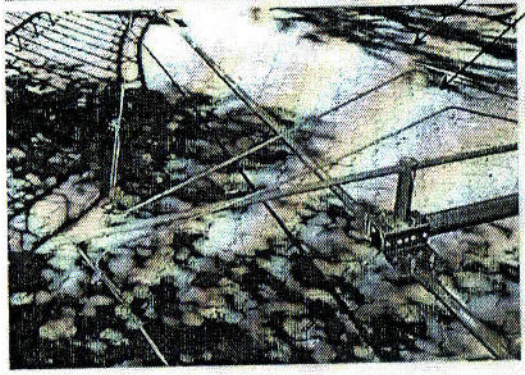
GENERAL INFORMATION, Page 4

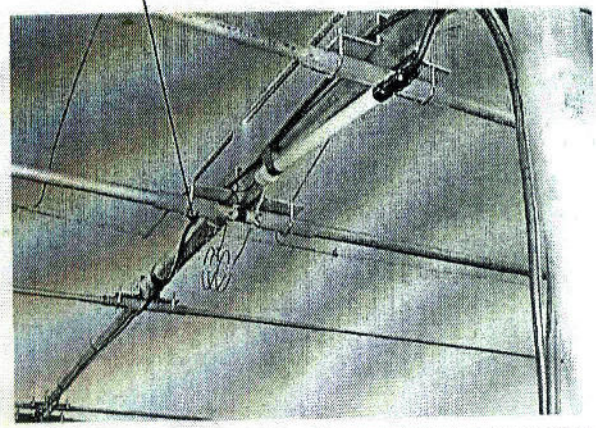


Measuring to clamp. Shown is 3" on the reflector element for C-4SXL, C-4XL, 240S.

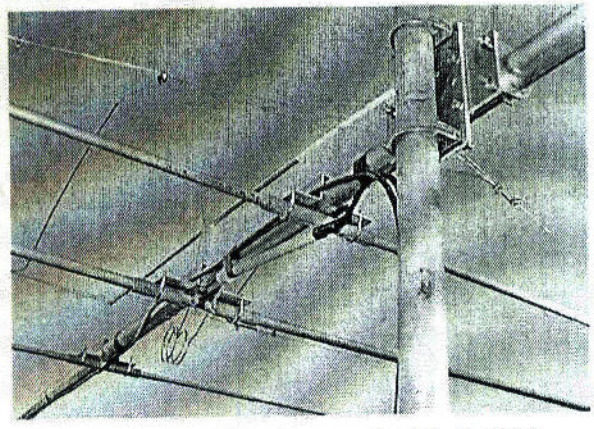
Make tuning jumpers like this. Be sure they are parallel to each other.

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.



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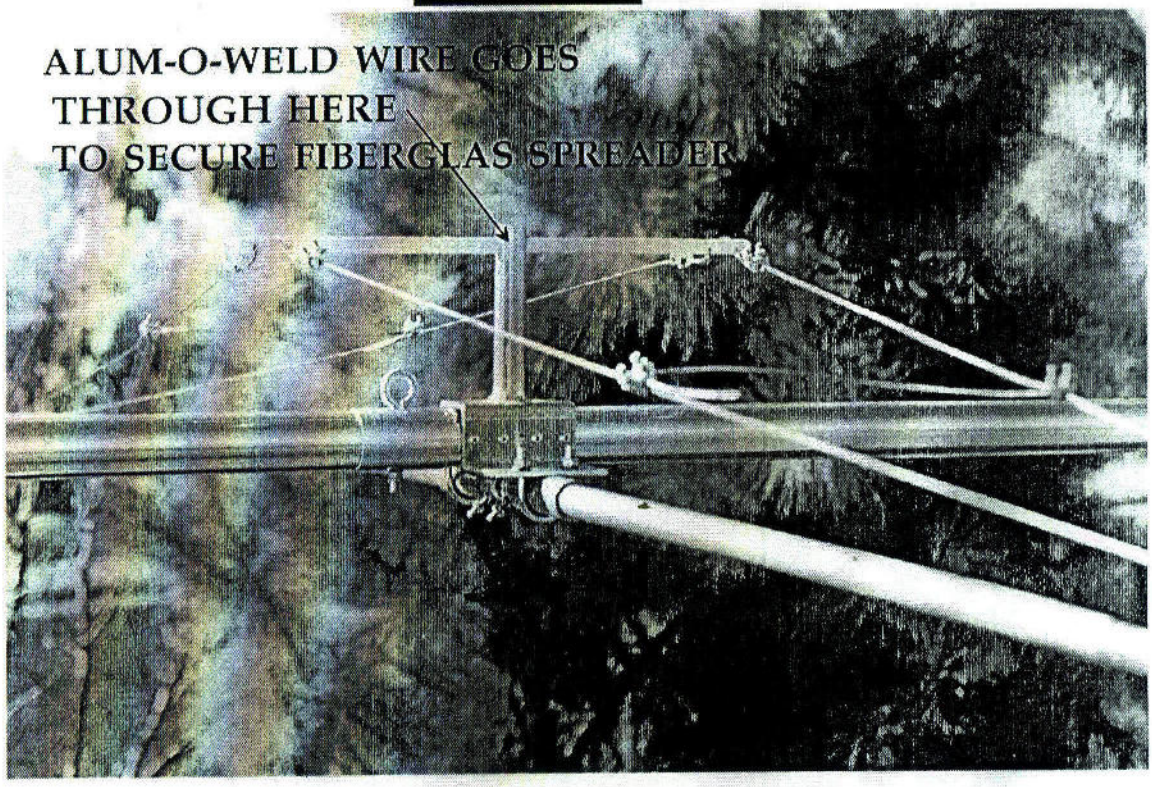
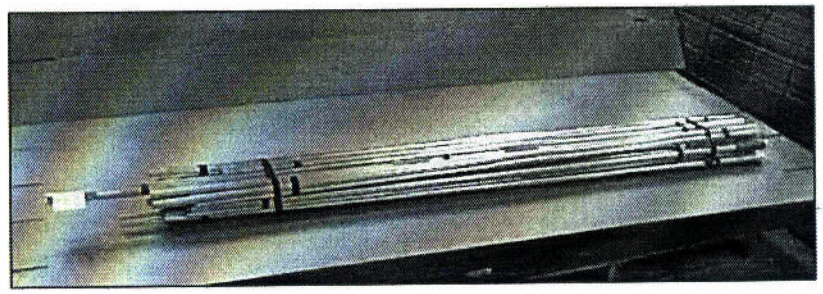
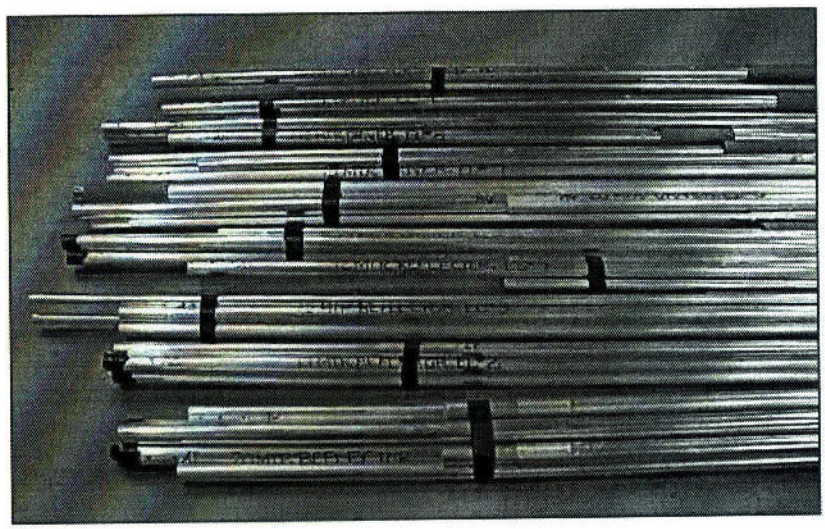
Force 12



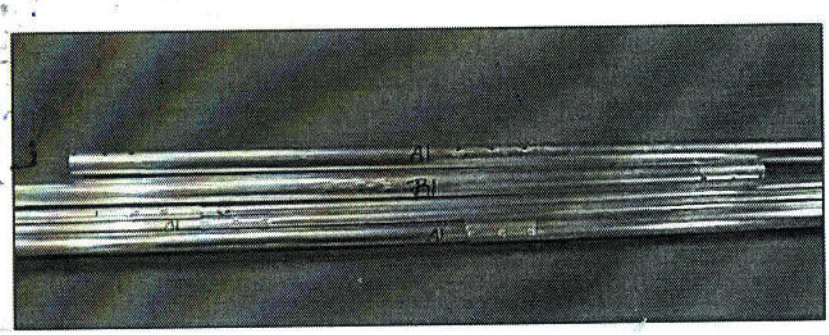
Sample of linear loading
for
EF-140, 240, 340 (40 mtr) and EF-130, 230 (30 mtr).
EF-140S (D and XP) have 4' aluminum/fiberglass spreader
and semi-rigid tuning jumpers
INCLUDING SECURING OF FIBERGLASS SPREADER TO VERTICAL SUPPORT WITH SHORT JUMPER.



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



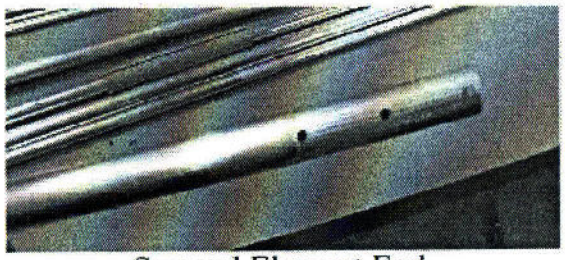
INDIVIDUAL ELEMENT BUNDLES
(Model XR-5 shown)



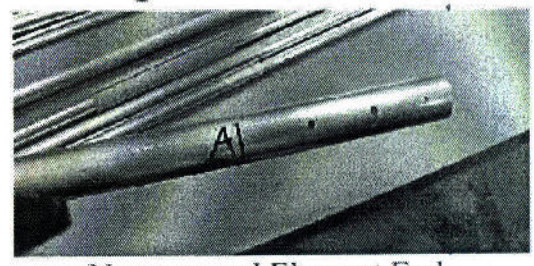
"A" and "B" MARKINGS ON ELEMENT PIECES
"A1" & "B1" identify they are part of element #1.

Force 12

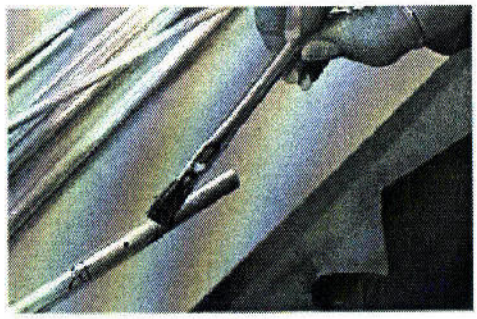
Element Assembly Example



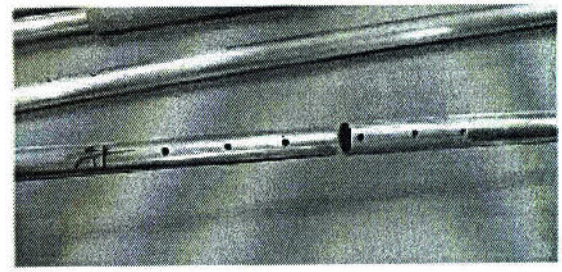
Swaged Element End
(swager marking lines and rivet hole is close to end of piece)



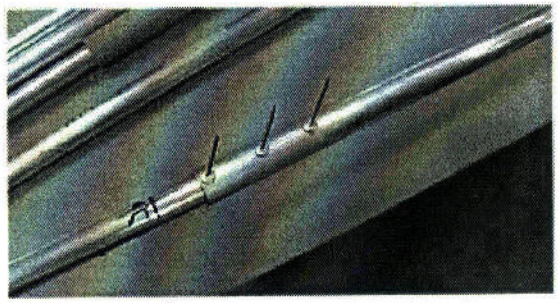
Non-swaged Element End
(no swager marks and rivet hole is not close to end of piece)



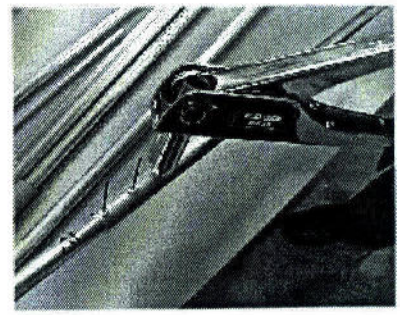
1) Apply Noalox with brush



2)Insert tube into matching piece

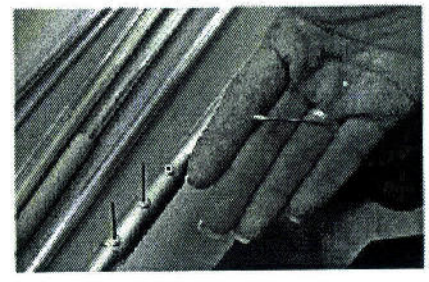


3) Insert all rivets before riveting

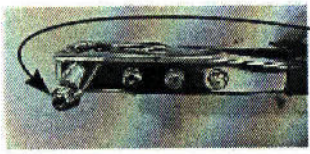


4) Slide rivet tool over mandrel and pull ("pop") the rivet

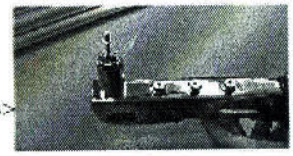
5) Pulled rivet is on right



6) Mandrel removed from rivet tool



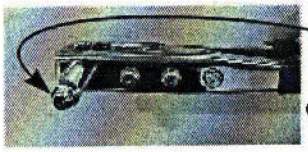
RIVET TOOL
NOZZLE
<--Wrong one on left - hole is too large
Correct on right - small hole fits mandrel -->
(rivet shown dropping into nozzle)



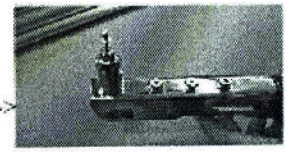
Force 12

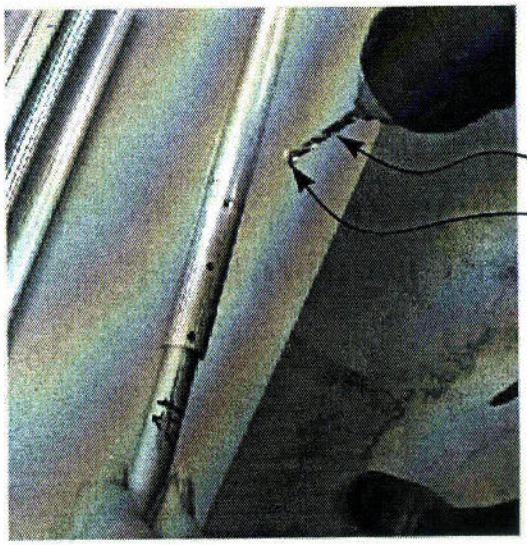
Element Assembly Example

Removing a Properly Installed Rivet



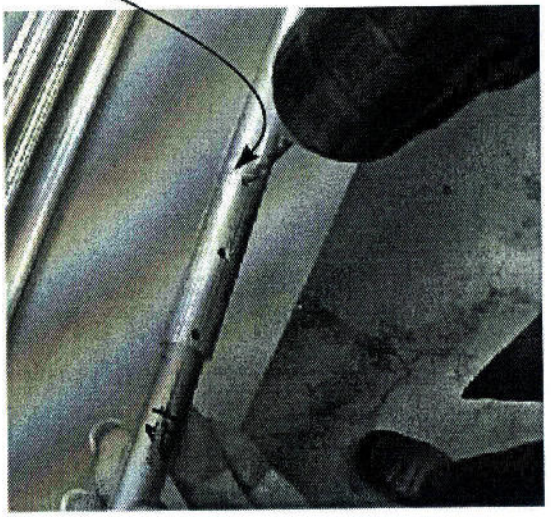
RIVET TOOL
NOZZLE
<--Wrong one on left - hole is too large
Correct on right - small hole fits mandrel -->
(rivet shown dropping into nozzle)





To Remove a Rivet
(that has been properly installed)

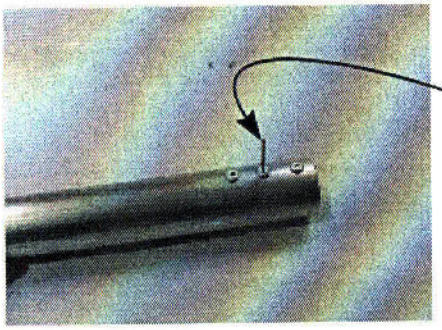
___1) Use 1/8" drill bit
___2) Run drill slowly until rivet head comes off
___3) Remove rivet head from drill tip
___4) Drill through hole



Force 12

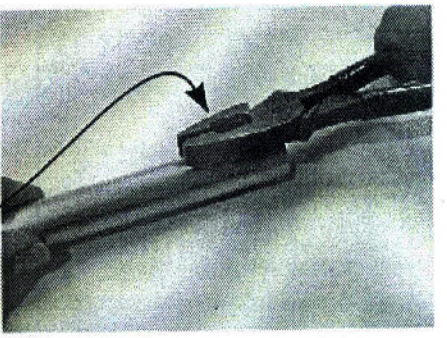
Element Assembly Example

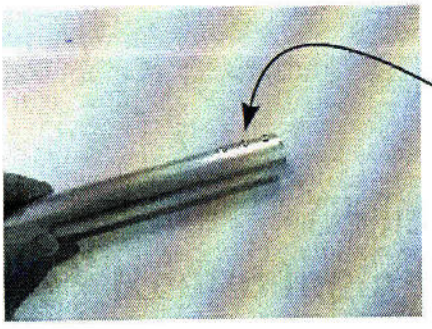
Removing a Rivet with a Broken Mandrel



___1) Broken mandrel

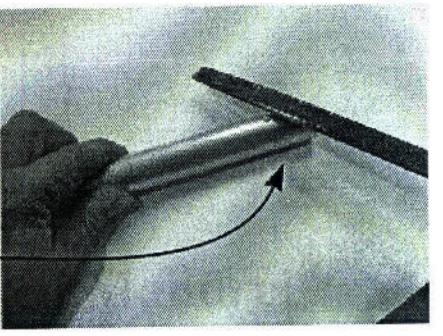
___2) Cut mandrel close to rivet head

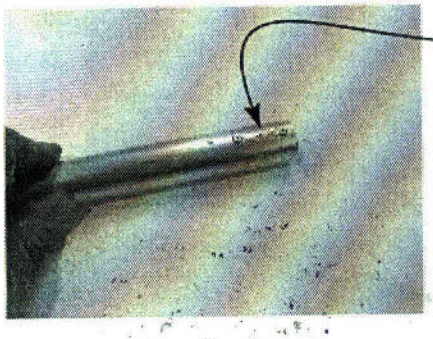




___3) Mandrel is now cut

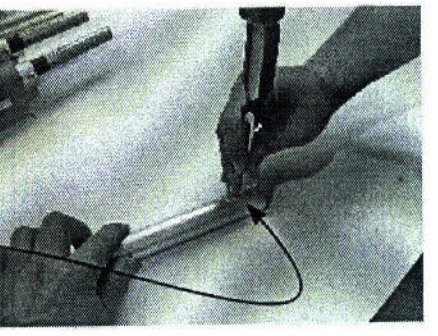
___4) File mandrel AND rivet head flush with tubing



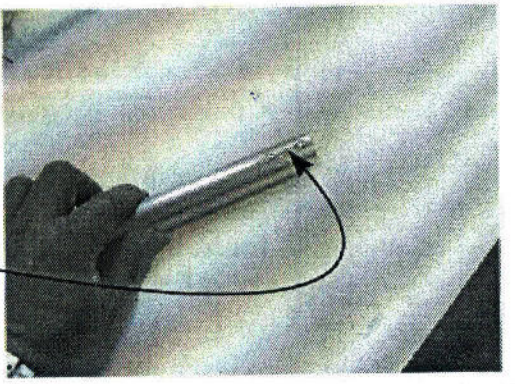


___5) Rivet head and mandrel filed off flush with tubing

___6) Punch rivet through with pointed tool (and hammer)

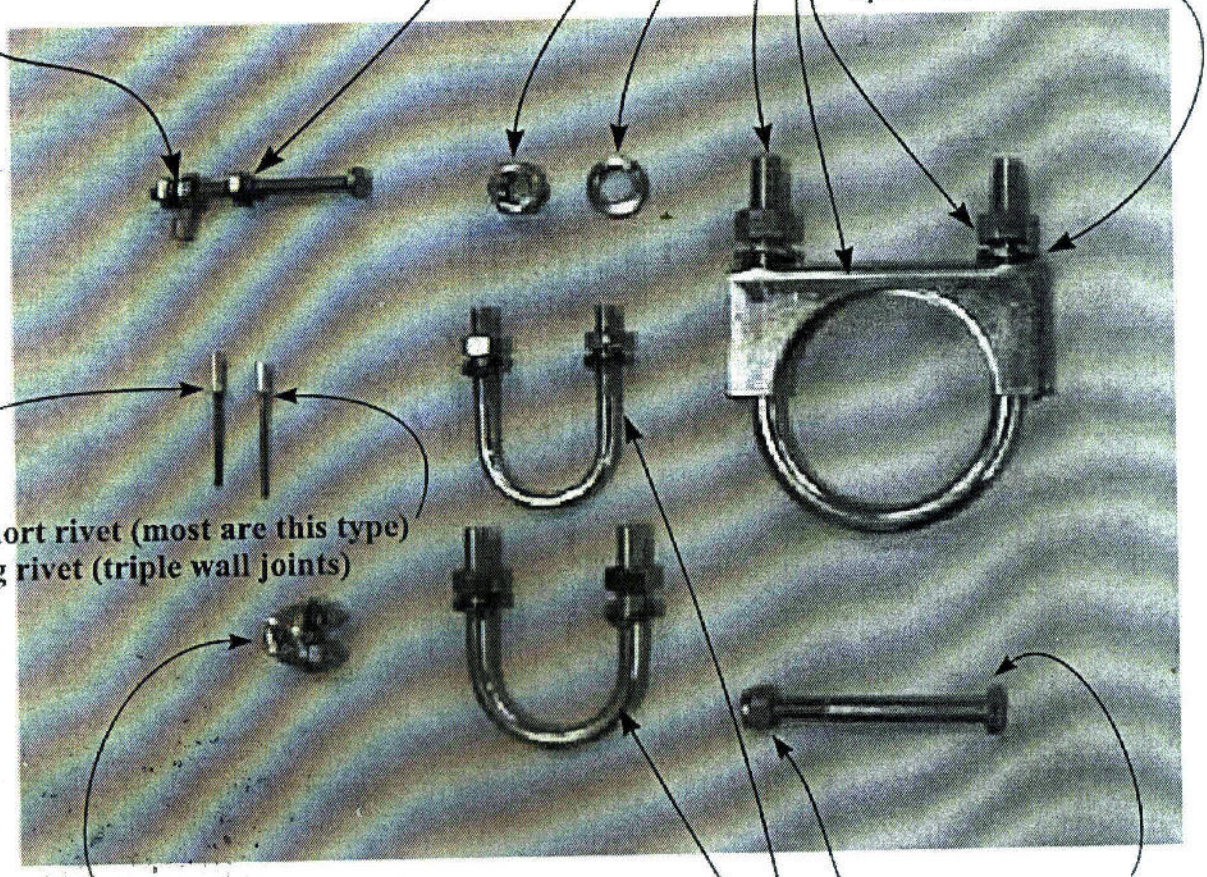


___7) Hole is now clear for new rivet.



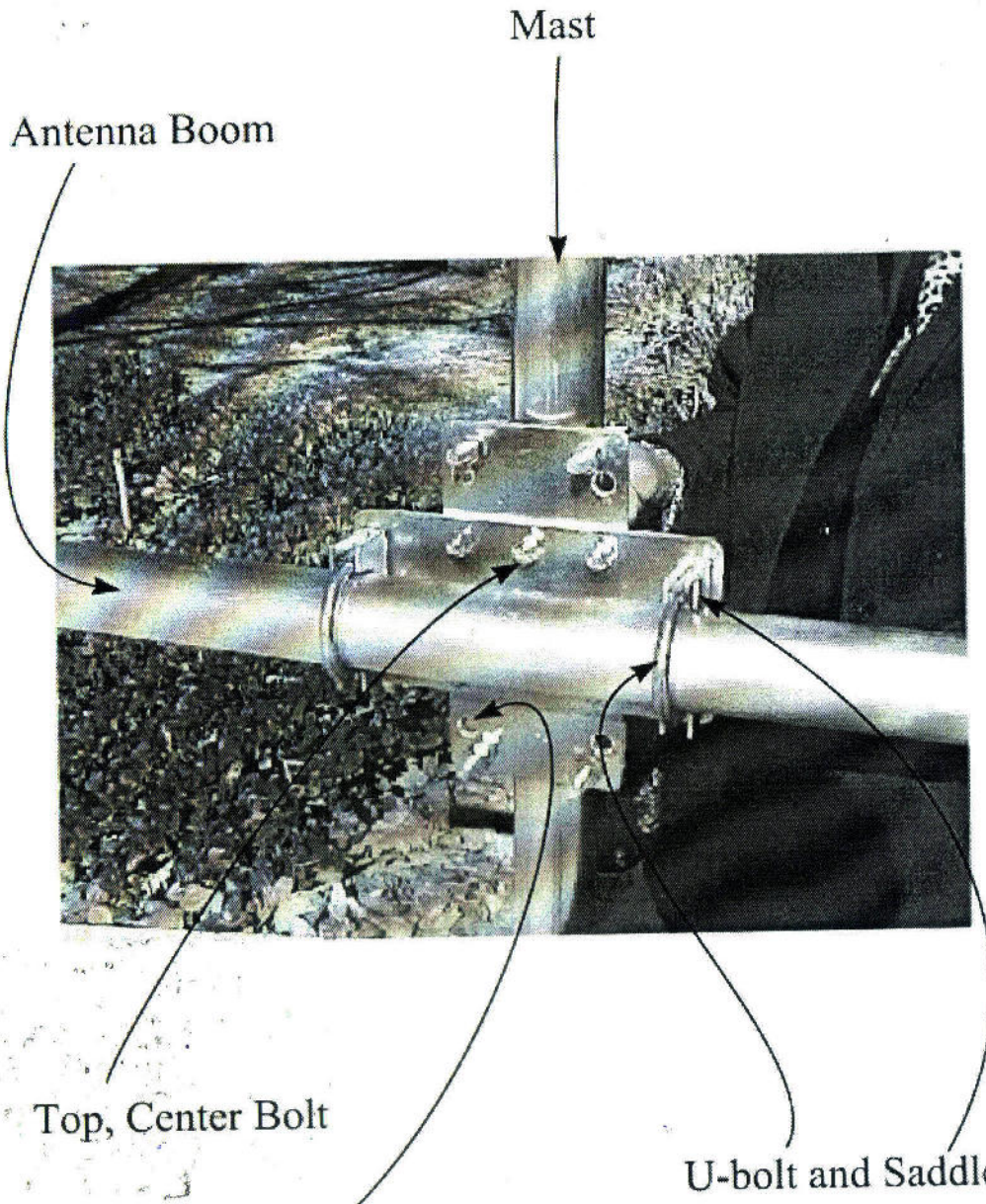
Force 12

Element Assembly Example
Typical Parts

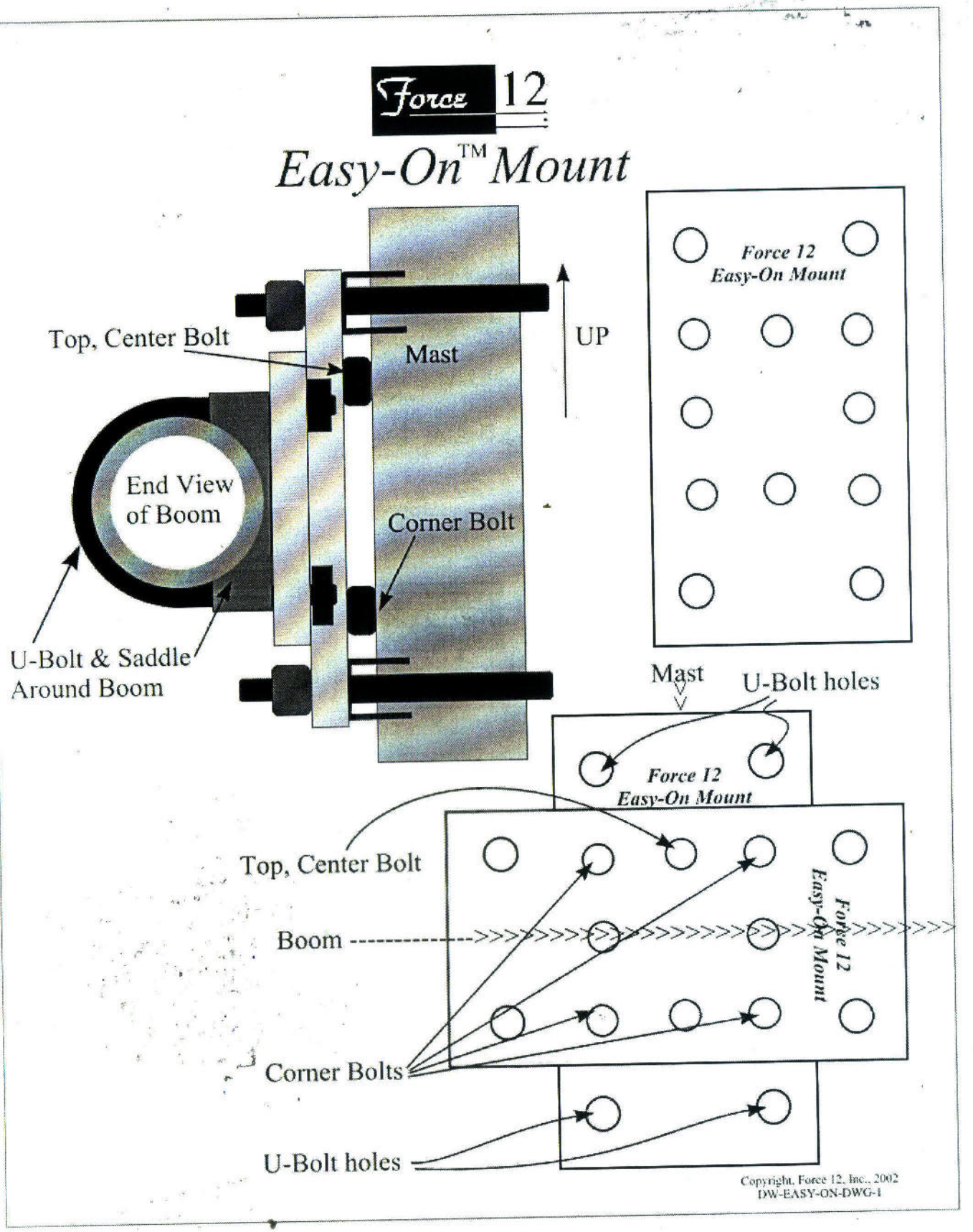


Force 12

Photo of Easy-On™ Mount



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


Force 12
Easy-On™ Mount
Top, Center Bolt
Mast
UP
End View of Boom
Corner Bolt
U-Bolt & Saddle Around Boom
Force 12 Easy-On Mount
Mast
U-Bolt holes
Force 12 Easy-On Mount
Top, Center Bolt
Boom
Corner Bolts
U-Bolt holes
Force 12 Easy-On Mount
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DW-EASY-ON-DWG-1