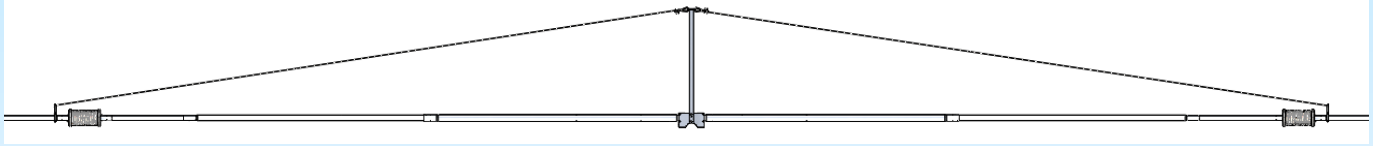
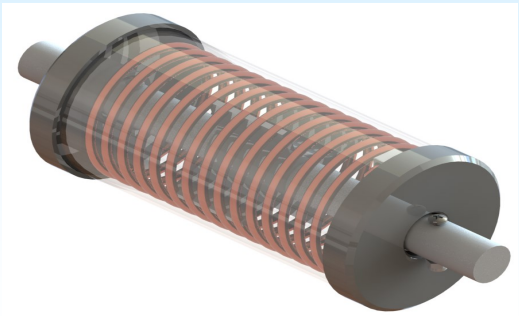
40M COIL CONVERSION KIT





FEATURES:

M^2 engineers developed a new coil using 3/16" copper wire with an aluminum core. The result is a lightweight inductor with great power handling and a Q near 1000. This allows for an almost lossless REDUCE SIZED element. Computer optimized 2 and 3 element Yagi designs for each supported brand are provided with each kit. Losses for each design are under 0.3 dB!. The question remains, why even use a full size Yagi on 40 meters? Why not CONVERT older linear loaded designs like KLM, Hy-gain, M^2, and Force 12 or outdated lossy coil designs like Cushcraft, and Mosley? Finally a product that can improve performance and simplify mechanical assembly.

The COIL CONVERSION KITS are easy to assemble requiring only a few new holes in existing parts. The important original element parts are used and only one short 1" tube section is added. The coils themselves virtually float in air minimizing dielectric loss. They are fully covered with end caps and a husky polyethylene cover (shown clear) for illustration. The kits are complete to upgrade one element. If you have an old two element design you will need two kits. If you have damaged parts in your old design or want to upgrade to M^2's rugged element to boom mounts or replace your balun, M^2 has all you need to get you back in the air with exciting new performance on 40m.

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Rev 1

M^2 40M COIL UPGRADE KIT OVERVIEW

This kit has the parts for upgrading ONE complete element. If you have a 2 element antenna to upgrade you will need two kits etc. In our research of other brands we found that tubing lengths have been changed between the oldest and newer models. If you place the coil where we recommend, these variations will have no effect on performance. However the COIL POSITION is very critical and even a 2 inch shift in dimension will affect tuning. Please contact us if you find you are unable to place the coils where we designate.

WHAT IS SO GOOD ABOUT THIS KIT?
The new M2 coil kit greatly improves mechanical lifetime, while minimizing losses. All modified antennas now will have overhead element support. Computer optimization for each model has been extensive and should yield the best performance and power handling possible with your old aluminum. YOU MAY NOT BELIEVE THE DIFFERENCE!

WHAT 40 METER ANTENNAS WILL BE IMPROVED GREATLY WITH THIS KIT
This kit is designed to upgrade older 40 meter antennas using both COILS and LINEAR LOADING. We have supplied details in this manual to upgrade KLM, M2, Hygain, Cushcraft, Moseley and Force 12 designs. Some older linear loading designs yielded very poor efficiency, or were MARGINAL handling the current 1500 Watt power levels used by many hams. Linear loading, while performing well if properly designed, can have long term mechanical problems with wind, ice and snow. Some early coil designs, still being sold today use coil construction and materials that are very lossy and while giving good bandwidth due to loss, will cost 2-3 dB in reduced gain and poor F/B. You should experience better gain and F/B after installing the kit. By modifying your antenna with this kit you will also reduce wind area slightly and improve its wind speed, ice and snow survival. It looks cleaner tool

THE EFFECT OF GROUND:
40 meter are very much influenced by their height above ground. The designs we offer in this manual have been optimized at 70 feet above average ground. At 70 foot, even 40 meter 2 element Yagis can produce exceptional front to back (F/B) exceeding 25 dB and yield a single lobe radiation angle of 25 degrees.

Lowering the antenna height to 55 ft or lower can greatly reduce F/B to 15 or even 12 dB. No amount of retuning can get that F/B up again because it is a function of the antenna height. The center frequency may also shift down as the antenna is lowered closer to ground. This characteristic can be fixed for the most part by retuning the antenna. We have computer models for most of the designs listed and can help with the retuning process if you need help. It is always a good idea to pre-test the antenna at 20 or so feet over ground checking for general function, but don't think it will stay the same as you raise it to its final height.

Placing the antenna at heights over 70 feet may also deteriorate the F/B and while main lobe angle of radiation will drop and gain will improve slightly, a very large bulbous lobe will appear over the top of the main lobe lowering F/B to as little as10 dB on signals arriving at very high angles. Sometimes this big overhead lobe can help or hurt you but you should at least be aware that it will be there to some extent until you reach 130 to 140 feet in height. At 140 feet over ground the F/B will return, the overhead lobe will disappear and gain will improve by almost a dB and at a radiation angle of 13 degrees.

We have included a few typical radiation patterns of 40m Yagis at 70 ft. as well as a sample of 45 ft and 90 ft that you may find interesting and helpful.

WHAT ELSE CAN M2 DO TO MAKE YOUR UPGRADE EASIER OR EVEN BETTER?
Many early designs did not have very good BALUNS. We suggest you use a good modern balun that can handle 1500W. M2 can supply most tubing sizes in case you have a bent or missing section. Hygain's newer 1 inch sections were double walled not allowing our kit 7/8" diameter fiberglass rod to be inserted. We can supply new 1 inch sections allowing assembly. Feel free to enhance your kit to your particular needs. Most brands use a hairpin matching device on the driven element. Mosely Yagis have center coils (very inefficient) and use taps on the coil for matching. You will need a different matching scheme. Both M2 and DX Engineering sell optional hairpin Kits or you can make your own from used parts.

ARE YOU CRAMPED FOR MAST SPACE?
We have had good luck placing our upgraded 40M elements on the same boom with 20M Yagi.
Because of the coil location in the 40M elements, the element is effectively broken into 4 pieces, all shorter than a 20M 1/4 wave. This makes them near invisible at 20M. Stacking very close (1 to 4 ft.) is another option.

GENERAL 40 METER ELEMENT DISASSEMBLY NOTES

Old antennas should be inspected carefully during the disassembly and cleaning process. Careful preparation here will make the upgrade reassembly easier and quicker.

CHECK FOR:
The original Manual or download a current manual..
Corroded joints
Rusty hardware
Worn out hardware like hose clamps
Damaged or missing parts. For example, the BUTT insulators on Hygain elements deteriorate with time. Sometimes they are cracked or have been burned or arced through. Also later Hygain element sections have been double walled the entire length making it impossible to insert the 7/8" fiberglass rods in the kit.

PARTS TO BE REMOVED AND NOT USE IN THE NEW UPGRADE BY BRAND.

KLM*: Remove all 3/8" linear loading tubing, insulators and any brackets or rods and shorting straps.
The inner 1" tube must have a second hole drilled 1-1/2" from the outer end in line with the original hole. See details on KLM page. The short fiberglass piece and the short 1" x 5" tube is also replaced with a long 7/8 dia. fiberglass rod and 1" x 24" new tube.

M2*: Remove all the linear loading rods and arms, shorting bars and support hardware, including the short vertical support post. Also remove the short fiberglass section.

HYGAIN*: Remove all 1/8" linear loading wire and support parts Keep the hairpin but clean and replace hardware with stainless (not supplied in upgrade kit). Clean the boom to element stamped plates and replace the 1/4" hardware with stainless (not supplied in upgrade kit). Two holes matching the new fiberglass rod must be drilled in the outer end of the 1" section. See Hygain "FINAL ASSEMBLY" page.

CUSHCRAFT: IN DEVELOPMENT

MOSELEY: IN DEVELOPMENT

FORCE 12: IN DEVELOPMENT

*** The following antennas have be tested with the M2 coil kit;**

M2: 40M2L and 40M3L
KLM: 40M2 and 40M3
HYGAIN: 402BA AND 403

M^2 40M COIL UPGRADE KIT ASSEMBLY DETAIL

1. Locate the 7/8” x 10-5/8” fiberglass rods and slide a BLACK coil support web near the center of each rod. Final positioning will be done later in the assembly process.

2.. The coils are wound tight at the factory to prevent damage during shipping. Use the shank of a 5/16” drill bit or a 5/16” bolt shank and carefully insert it into the first turn of the coil. Now gently push or roll the drill or bolt through all 15.5 turns of the coil. Now the coil is nearly in its final shape and is ready to be “threaded onto the BLACK coil form support web.

3. Use pliers to gently straighten the last 1/2” of the coil wire slightly and file off any burrs. Using large wire cutters, to trim off just the bent end of the other end of the coil. Straighten the last 1/2” and deburr as well.

4. Begin threading the coil onto one end of the coil form support web. BE CAREFUL to not deform the coil during this process. The coil should thread smoothly.. Continue until about 5-1/2 turns are past the web.

NOTE PENETROX PASTE FOR LUBRICATING SCREW THREADS AND TUBING JOINTS HAS BEEN SUPPLIED. USE A VERY SMALL AMOUNT ON EACH SCREW THREAD AND UNDER THE COIL POSTS DURING THE NEXT OPERATION.

5. Always refer to the exploded view of the coil assembly. Be sure you have 15.5 turns NOTE: See the coil detail. First rotate the coil and the web so the leading end of coil goes over and just past the inner hole in the fiberglass.. Now slide on one coil support post so it is right over the first hole. Next, carefully slide on the 1” by 24” tube and align it so both holes in the tube match the two holes in the fiberglass rod.

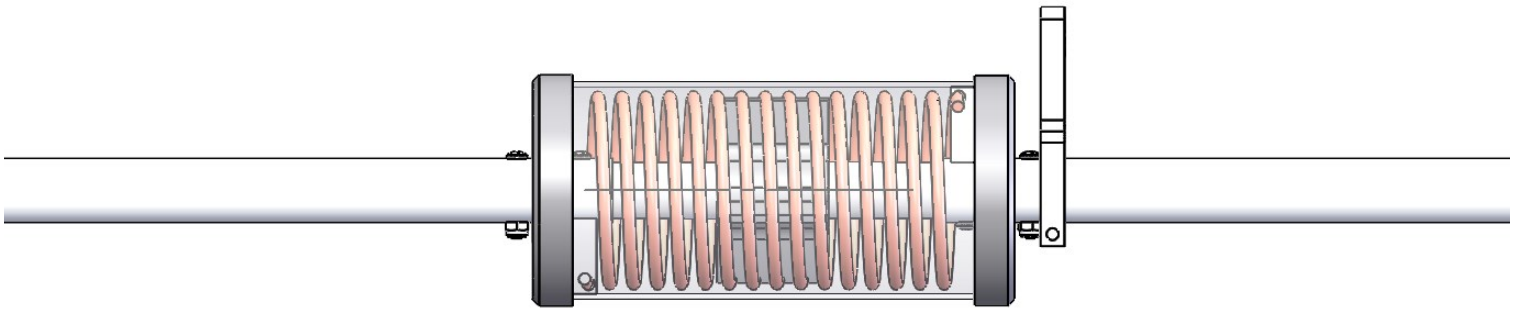
6. Insert a 8-32 x 1-1/4” screw through the tube and the fiberglass and begin threading it into the coil post. BE VERY CAREFUL not to cross thread the screw. If it stops abruptly, backup and realign the screw. Once the screw is threaded properly, tighten it securely.
Thread a 1/4-20 x 1/4” long set screw into the top of the post and with about 1/2” of wire protruding past the post, tighten the set screw gently. With the 1/8’ allen wrench supplied. Final tightening should be done after the second post is installed.

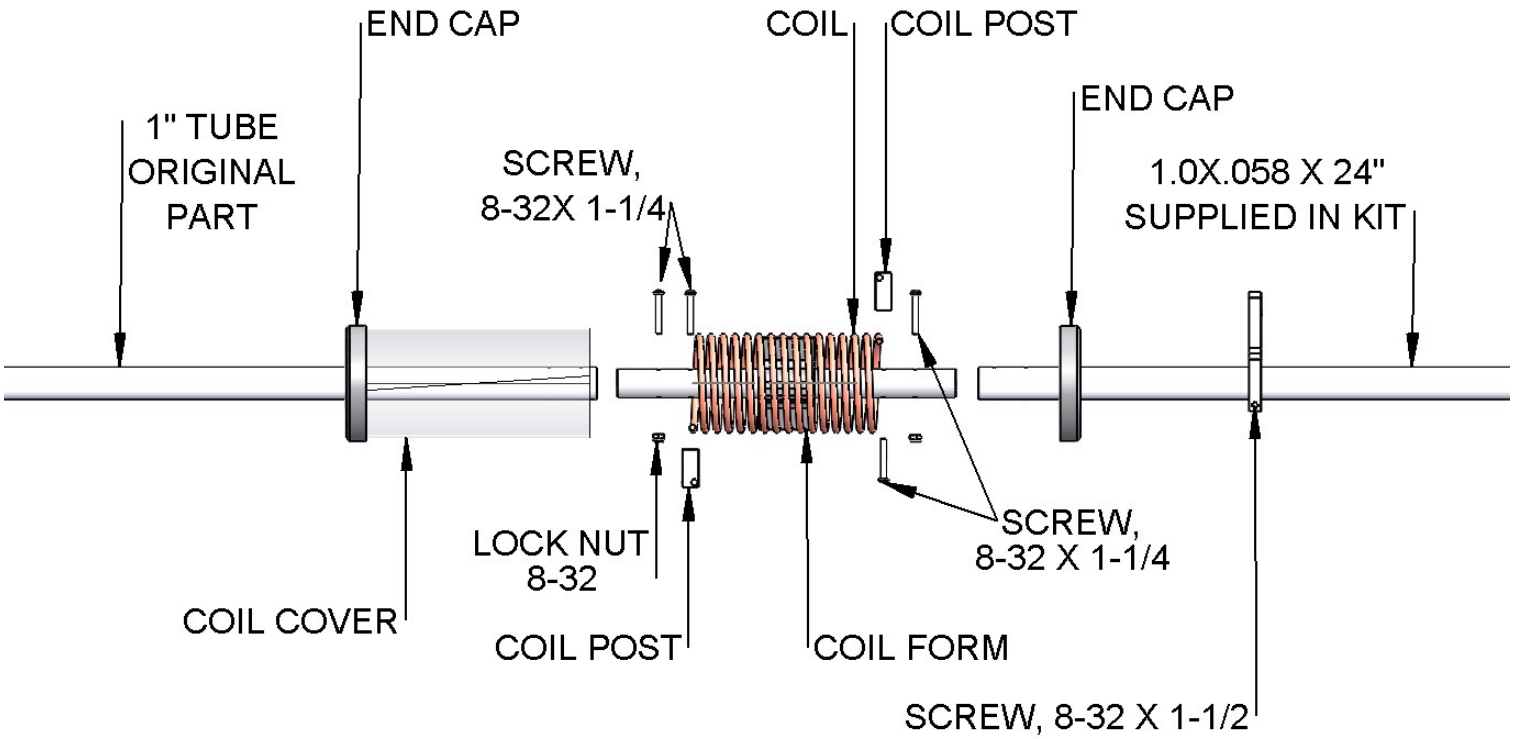
7. The second post is mounted on the OPPOSITE SIDE of the rod so 15-1/2 turns of coil are used. A small amount of coil wire should pass over the support rod mounting hole. Slide on the second post and align it over the hole. Slide on the second 1” tube section, align the holes as before and insert the second 8-32 x 1-1/4” screw up through the tube and rod and carefully thread the screw into the post.

8. Insert the second 1/4-20 x 1/4” set screw in the post and tighten it gently. Now view the coil and web and adjust the coil and web location for equally spaced turns. The distance between each turn is the same as the coil wire diameter. Once the coil is straight and aligned, tighten the set screws securely.

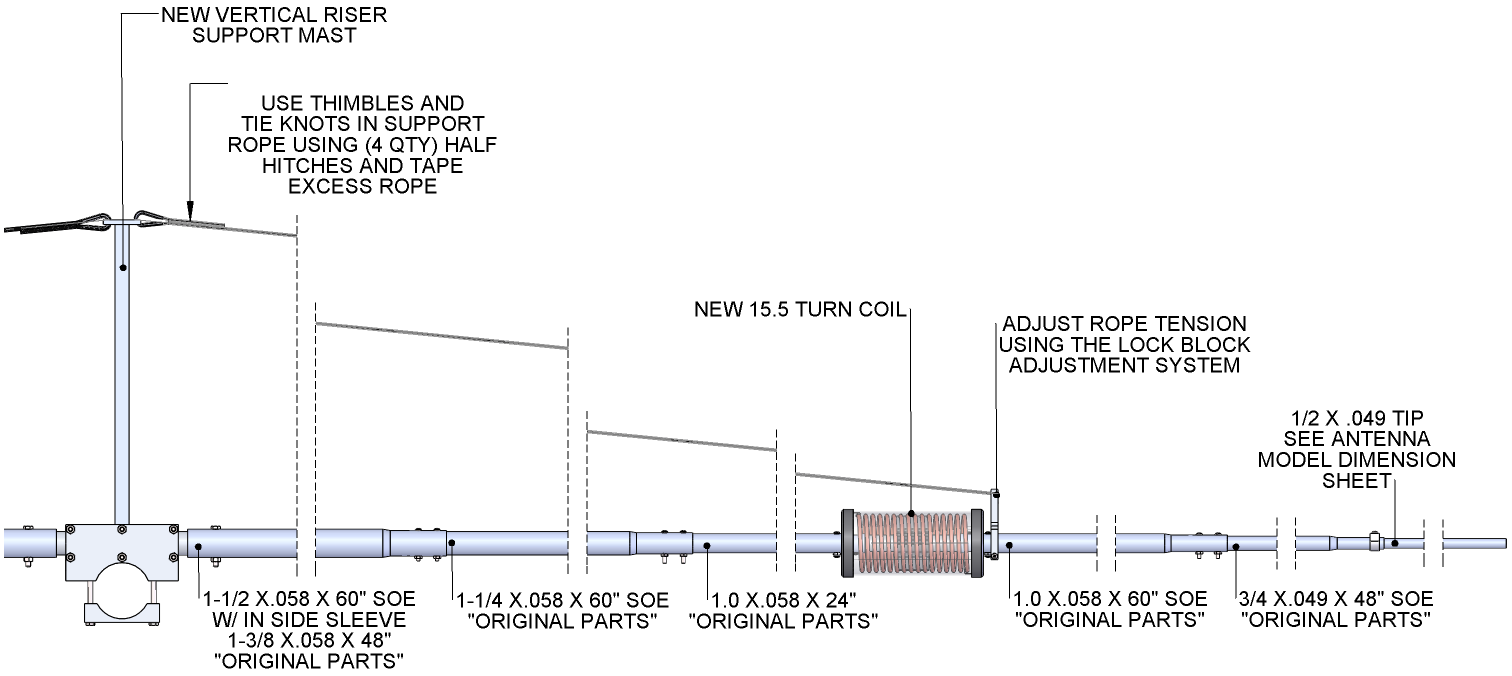
9 repeat for the second coil assembly.

M² 40M COIL DETAIL



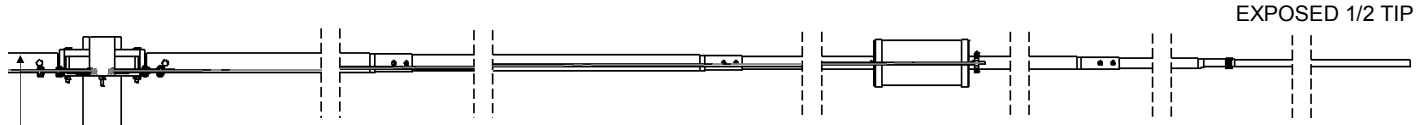


M2 40M ELEMENT HALF ELEMENT ASSEMBLY DETAIL



M2 40M2C DIMENSION SHEET

REFLECTOR ELEMENT



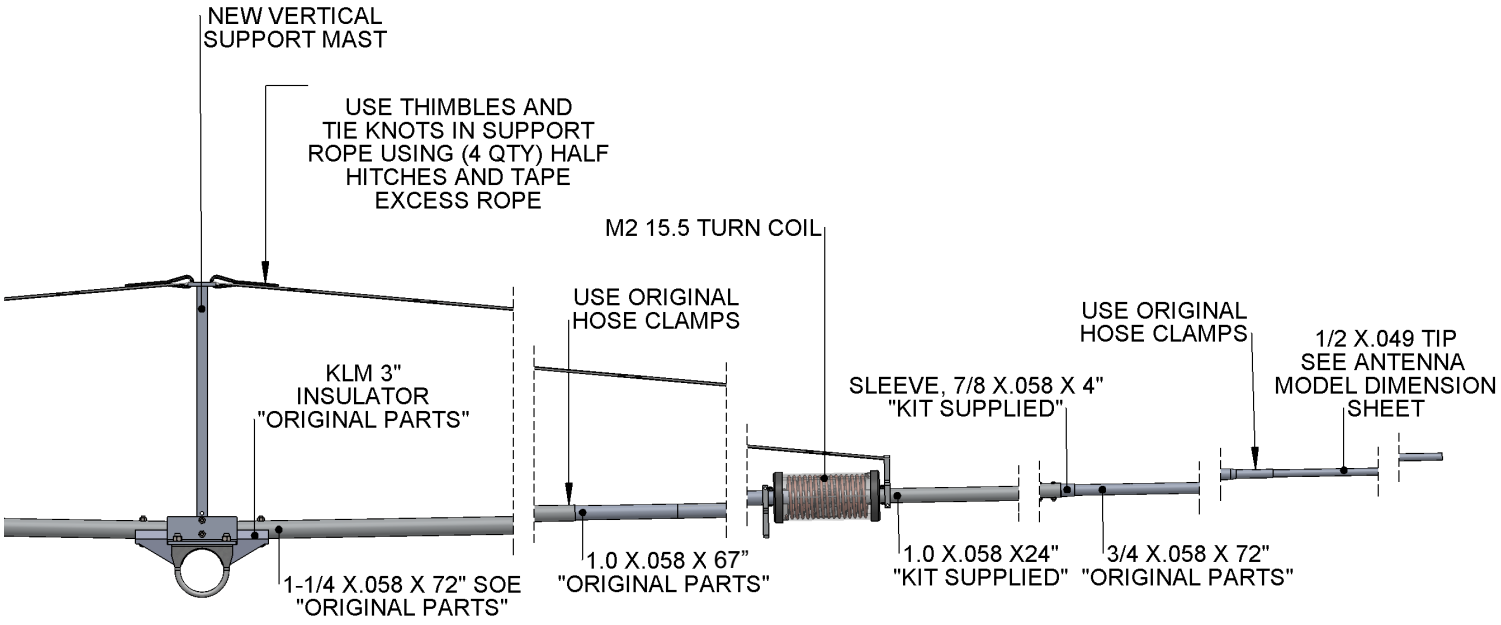
TUNING CHART

ELEMENT	7.0-7.1 MHZ EXPOSED 1/2 TIP	7.1-7.220 EXPOSED 1/2 TIP	7.2-7.3 EXPOSED 1/2 TIP
REFLECTOR	47”	41.750”	38.50”
DRIVEN ELEMENT	37.25”	32.00”	28.50”
HAIR PIN POSITION	54”	54”	54”

The Stock M2 hair pin tubes are 55” long and are to short to allow the 54” shorting bar dimension. We have added (2) 3/8 x10” long hair pin extension tubes and 3/8 splice blocks. Use the 3/8 splice blocks at the ends of the original hair pin tube by putting half of the splice block over the end of the original hair pin tube and insert the 3/8 x 10 tube into the opposite to extension the tube, fasten using the supplied 1/4-20 x 1/4 set screws. Place the shorting at 54” from the center of the driven element to the inside edge of the shorting bar.

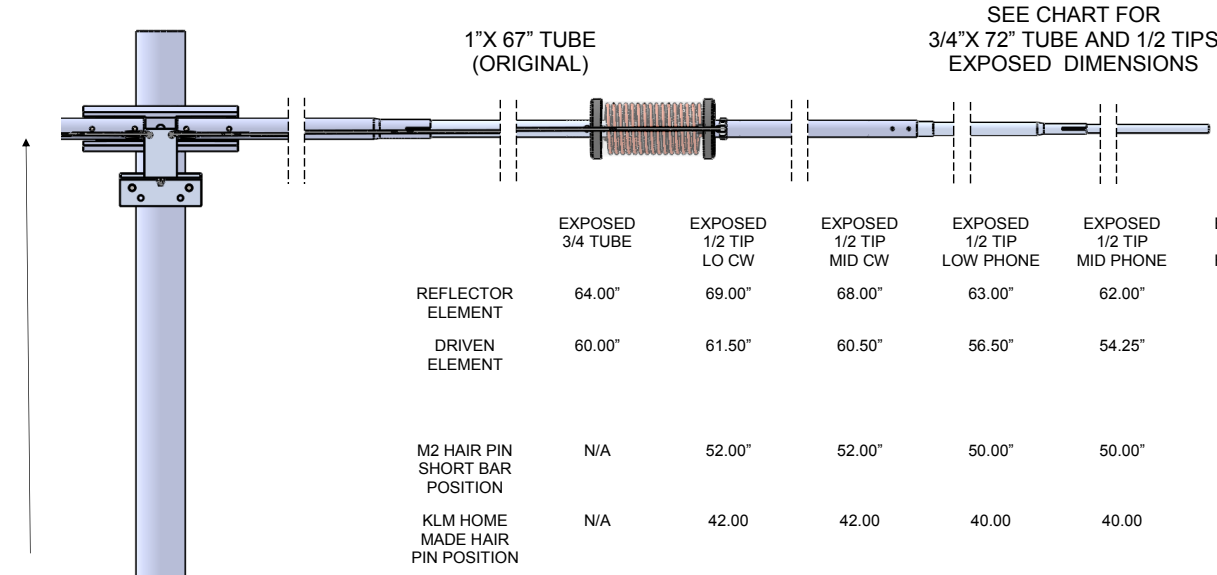
DRIVEN ELEMENT

KLM 40M STOCK HALF ELEMENT ASSEMBLY DETAIL



KLM 40M2 MODIFIED W/ M2 COIL DIMENSION SHEET

REFLECTOR ELEMENT



	EXPOSED 3/4 TUBE	EXPOSED 1/2 TIP LO CW	EXPOSED 1/2 TIP MID CW	EXPOSED 1/2 TIP LOW PHONE	EXPOSED 1/2 TIP MID PHONE	EXPOSED 1/2 HI PHONE
REFLECTOR ELEMENT	64.00"	69.00"	68.00"	63.00"	62.00"	59.50"
DRIVEN ELEMENT	60.00"	61.50"	60.50"	56.50"	54.25"	52.50"
M2 HAIR PIN SHORT BAR POSITION	N/A	52.00"	52.00"	50.00"	50.00"	48.00"
KLM HOME MADE HAIR PIN POSITION	N/A	42.00	42.00	40.00	40.00	38.00

The KLM element, should have 64" of 1.0" tube exposed before installing the coil. Between the 1.250" tube and the inside coil cover will measure approx. 62.625" exposed.

The KLM 7.2-2 40 MONOBANDER was originally supplied with 2 types of feeds. One being the feed KLM called a Maxi Match that used a fixed mica Capacitor. The other match was a 2:1 step down transformer. It was supplied with two coil cable in parallel. Each of these feeding system had there own flaws and we do not recommend using either.

We now use HAIRPIN type match and 1:1 balun. For this conversion, you have all the parts you need to make a HAIRPIN except for a 1:1 balun. To make your own HAIRPIN, you will use two lengths of 3/8" diameter tube, left over from your old linear loading, and drilled at one end to fit over the same two center screws where the original feed system connected. You will form a small bend in each tube about 6" from where you drilled the holes. The bends should be enough to get 6" spacing between the tubes. You will use the left over LINEAR LOADING JUMPER STRAPS for the hairpin shorting strap.

Once fabricated and in place set the SHORTING STRAP to the KLM home made dimensions shown above. This setting should be close or perfect for an excellent match in your desired band segment. If adjustments are required for you particular installation and height above ground, changes of 1" at a time will be enough to show that the match is getting better or worse. These adjustments are not touchy. If you have a good SWR but it is too low in frequency, shorten the tips of the DRIVEN ELEMENT ONLY by 1" for every 20 KHz you want to raise the frequency Increase the tip length to lower the frequency. In most cases you will not have to adjust the HAIRPIN.
When you are done matching the antenna, you can ground the middle of the shorting strap to the boom using a small sheet metal screw. This will not have any effect on the match but may help with rain static etc.

If you choose to buy the M2 HAIRPIN Kit, the tuning instructions are the same as note above but the dimension for the shorting bar changes because the lines are closer together.

DRIVEN ELEMENT

40M COIL UPGRADE KIT
PARTS AND HARDWARE PER ELEMENT

DESCRIPTION	QTY
COIL 15.5 TURN (M2ACA1550)	2
COIL FORM INSULATOR (M2CA1554)	2
COIL COVER, POLY (M2ACA1553)	2
COIL END CAP, UHMW (M2ACA1552	4
COIL POST, 1/2 X 1/2 X 1.188 (M2ACA1551)	4
COIL SUPPORT INSULATOR, FIBER GLASS (M2AFG0050)	2
ELEMENT OVERHEAD SUPPORT (M2APL0212)	2
VERTICAL RISER, 3/4 X 3/4 X18 WELDED (SAVR0010) KLM	1
VERTICAL RISER, ANGLE BRACKET (M2AVR0046)	1
TUBE, 1.0 X .058 X 24 PLAIN, KLM	2
SLEEVE, 7/8" X .058" X 4", KLM	2
SPLICE BLOCK, 3/8 (M2APL0025) M2	2
TUBE, 3/8X.049 X 10" M2	2

HARDWARE:

3" U-BOLT & CRADLE	1
2" U-BOLT & CRADLE	1
THIMBLE, 3/16 ZINC	2
MASTRANT ROPE, 1/8" X 144"	2
NUT, 3/8-16 SS	2
LOCK WASHER, 3/8 SS	2
NUT, 5/16"-18, SS	2
LOCK WASHER, 5/16 SS	2
SET SCREW, 1/4-20 X 1/4, SS	8
BOLT, 1/4-20 X 1-1/2", SS	2
LOCKING NUT, 1/4-20, SS	2
SCREW, 8-32 X 1-1/2", SS	2
SCREW, 8-32 X 1-1/4", SS	12
LOCKNUT, 8-32, SS	10
ALLEN HEAD WRENCH, 1/8"	1
PENETROX PASTE, SMALL CUP	1

REPLACEMENT BALUN, OPTIONAL

BALUN, 1:1 W SO239 CONN (FGBL1200) 3 KW	1

HAIRPIN KIT HF, OPTIONAL (FGHAIRPIN)

HAIR PIN TUBES, 3/8 X 55 (STRAIGHT)	2
CLAMP BLOCKS, 3/8	4
SHORTING BAR, HF	1
BAND CLAMP # 2.5"-3.0" WITH HOLE MOD	1
SPACER, 3/8 X 1.0	1
SET SCREW, 1/4-20 X 1/4 SS	2
BOLT, 1/4-20 X 2.5 HEX HD SS (FULL THREAD LENGTH)	3
NUT, 1/4-20 SS	2
LOCK NUT, 1/4-20 SS	3

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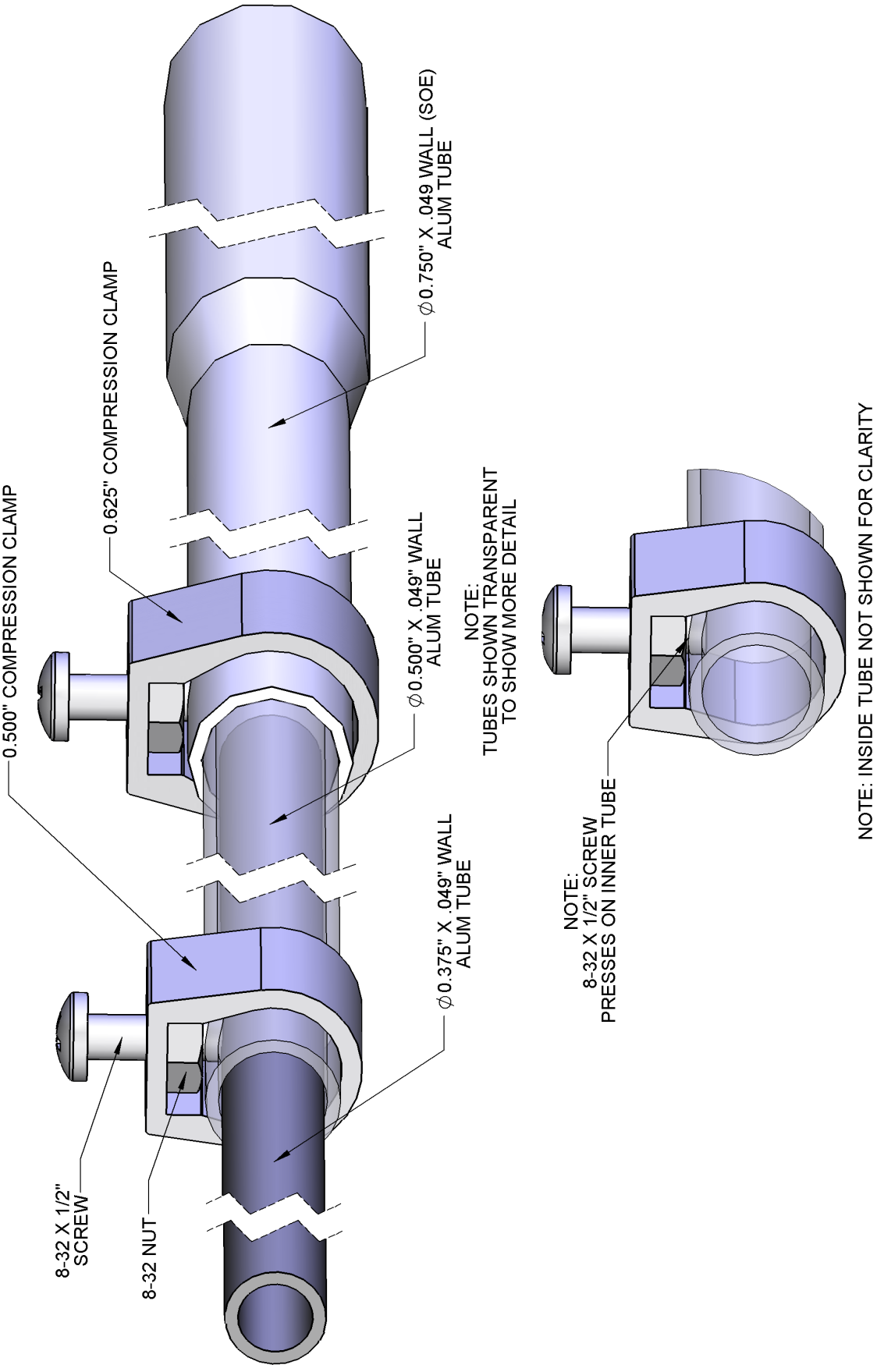
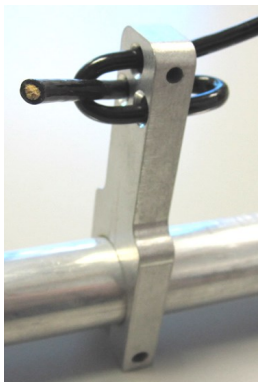
COMPRESSION CLAMP DETAIL



ELEMENT OVERHEAD SUPPORT REFERENCE DETAIL




REF 2.

1. ELEMENT OVERHEAD SUPPORT DETAILS.

- For M^2 element to boom clamps, insert two **1/4-20 X 3.5" BOLTS** through **VERTICAL RISER** and both **ELEMENT CLAMP PLATES.** Fasten with **1/4-20 LOCK NUTS.**
- **For KLM, Hygain and other brands the 18" riser is attached to a rugged, 2" angle bracket using two 1/4-20 1-1/4" bolts and locknuts. The angle bracket is then attached to the boom next to the element mount and positioned so the holes in the flag at the top of the riser are directly over the center of the element.**
- **12 foot lengths of SUPPORT LINE or cord are supplied and form the overhead support system. First attach the cord to the riser flag using cable thimbles supplied and secure the cord with 3 half hitch knots. See drawing on the element assembly page.**
- **Route the cord out and through the top hole of the short support arm. Raise the element end 6 to 8 inches, pull the slack from the cord and route the cord back and forth through the two other holes in the arm as shown above. Finally, secure the end of the cord under the first loop as shown. Repeat for the other element half. Re-adjust as required to keep the element level when the whole element is lifted by the riser or set on the boom.**