

The Offset Multiband Trapless Antenna (OMTA)

Simple, easy to build, low cost, compact, multiband...interested?

By Robert Wilson, AL7KK

Box 110955

Anchorage, AK 99511-0955

Photos by the author

Once in a while an idea turns out to be so good that it can't stay a secret. The offset multiband trapless antenna (OMTA) is so simple to build, so easy to employ and works so well, it fits that category. It's made of three lengths of aluminum tubing set in a triangular shape. Only the driven element is grounded and shunt fed by 50- Ω coax about 44% up the element. The other two elements are completely insulated and driven by mutual coupling. Remarkably, the OMTA has a natural 50- Ω feed impedance on 15 (or 17), 20 and 40 meters. The antenna pattern and efficiency are excellent, too. It's just the compact antenna for your backyard!

Background

Over the years, I've critically checked the design of thousands of antennas. When I worked as an advanced planning engineer for the Voice of America, I was always on the lookout for simple, reliable and broadband antennas. Multiband antennas, however, invariably turned out to be complex, unreliable, have unusual feedpoint impedances, were difficult to build and tune, or involved what must be charitably called "magic."

On the other hand, the OMTA antenna moved along properly right from its mathematical beginning. It's not a true wide-band antenna, but it is a true *multiband* antenna. *MININEC* proved the possibilities. Without a single hard-to-tune trap or matching device, it's possible to use a single 50- Ω feed on three ham bands and have a true $1/4\lambda$ vertical on 40 meters, and genuine $1/2\lambda$ verticals on two other bands.

The theory behind this antenna is open to all and involves no trickery. The key to its operation is the offset feed of the driven element. Normally, the coaxial feed line is connected to a vertical's bottom. At that point, the antenna's feedpoint impedance is much less than 50 Ω . By tapping up from the bottom of the element, it's possible to find a point that provides a 50- Ω match. Remember: The coax shield must be attached to the *lower side* of the element. By adjusting the element length a little, it's possible to remove residual reactance and achieve a low SWR. I placed two $1/2\lambda$ parasitic elements in an equilateral triangle configuration adjacent to the 40-meter driven element. These parasitic elements use traditional coupling techniques, exactly the same as those employed in a Yagi antenna (see Figure 1). With use of the correct element diameter and spacing, the feedpoint impedance is exactly 50 Ω on all three bands, without any matching tricks or traps.

Because the 40-meter element uses an offset feed (see Figure 2), it's able to couple efficiently to adjacent $1/2\lambda$ parasitic elements. I found that it's possible to build a physically sturdy vertical for either 40, 20 and 15, or 40, 20 and 17 meters. Remarkably, there is very little required adjustment to any of the elements from the mathematically derived design. Absolutely no magic, just solid engineering.

Construction

The most difficult part of building the antenna is obtaining the correct size and length of aluminum tubing. The parts list, Table 1, does not demand specific components since few things about this antenna are critical. Still, element length, diameter and spacing are the only things that you should try *not* to change—at least, not first. One-inch OD aluminum tube is preferred, but other metals will probably work, too. I prefer to use 6061 and 6063 aluminum alloys because they're readily available and are the best trade-offs between strength and corrosion resistance. Select your choice of a 40-20-15 or a 40-20-17-meter antenna. Then construct four tubes to the appropriate lengths shown. One approach to a

or a 40-20-17-meter antenna. Then construct four tubes to the appropriate lengths shown. One approach to a good-looking system is to use six 12-foot tubes and join them with short, close-fitting internal tube sections secured with stainless-steel self-tapping screws. After that, the tube lengths can be cut precisely.

The bottom ends of the two parasitic elements *should not be grounded* and must come to within only 4 inches of the ground (see Figure 3). The insulator pipes I used are 1-inch-diameter ID, schedule 40 PVC water pipe. If you're lucky, the aluminum tube and PVC pipe will fit together snugly. If you're not so lucky, some reaming and heating of the PVC pipe may be necessary. Heating can be done in boiling water. A bit of soap and the judicious use of a hammer often help in final persuasion. If such persuasion fails, you'll just need to use a larger PVC pipe size.

The Feedpoint

Two tubes are joined by a PVC-pipe insulator to form the 50- Ω coax feedpoint of the 40-meter element. It's necessary to provide electrical connections for the coax here. Make sure the screw holes are undersize so there will be a good electrical connection. Run the coax down the side of the leg and tape it tightly to the leg to prevent overcoupling to the other elements. Also, drill a 1/8-inch-diameter hole at the bottom of each leg to act as a drain hole. Place a cork or cap on the top of each element tube to help keep out precipitation.

Finding the right material to space and insulate the elements was difficult. I looked at a lot of options such as plastic wastebaskets, fungus-proofed plywood and white plastic (polyethylene) breadboards. The breadboards won. They can be cut easily with a saw and the element holes are readily made using a 1-inch-diameter drill bit according to the pattern shown in Figure 4. Rounding the corners of the triangles makes them esthetically more appealing.

The base plate shown in Figure 5 can be made of plastic, wood or metal. Adjust its size to your ground conditions—you don't want the antenna to sink into the ground or tip over. Three small nylon ropes, each about 40 feet long, can be used as guys to help prevent tip-over.

RF grounding is essential. Four bare copper wires of almost any gauge, each 33 feet 5 inches long, are required. More wires—and larger diameter wires—will work better, but a minimum of four is essential. Space the wires 90° apart. These ground wires can be buried, or just placed on top of the ground or roof.

Summary

Covering the antenna with a nonreflective paint that more or less matches the general area background does a lot toward eliminating complaints. Place an 8-foot-long metal ground rod close to the base of the 40-meter element and connect the ground rod to the base of the 40-meter element with a piece of coaxial-cable shield or heavy gauge wire.

When you're done, you'll have a neat, auto-switching, inherently matched, trapless antenna. On 40 meters, the vertical pattern is that of a true $1/4\text{-}\lambda$ antenna; on the other two bands, it's a real $1/2\text{-}\lambda$ pattern. I think you'll find this antenna is superior to a conventional trap antenna with only a $1/4\lambda$ on each band, and I'm sure you'll be happy band-hopping with the OMTA!

Robert Wilson was born in 1930 in upstate New York. At 11, he became interested in ham radio, but because of World War II, he didn't get his first license (W9RNL) until 1947. He was later a radio officer and navigator. Still later, he studied physics at the State University of Iowa and hand built some of the first US satellites. His space designs were instrumental in developing satellite television, deep-space communications and satellite navigation systems. Bob was planning engineer for the Voice of America in the Caribbean, Europe and the Orient. Presently, Bob owns two airplanes, which he claims are his "airline" and always flies with an Amateur Radio H-T.

See Feedback in December QST.

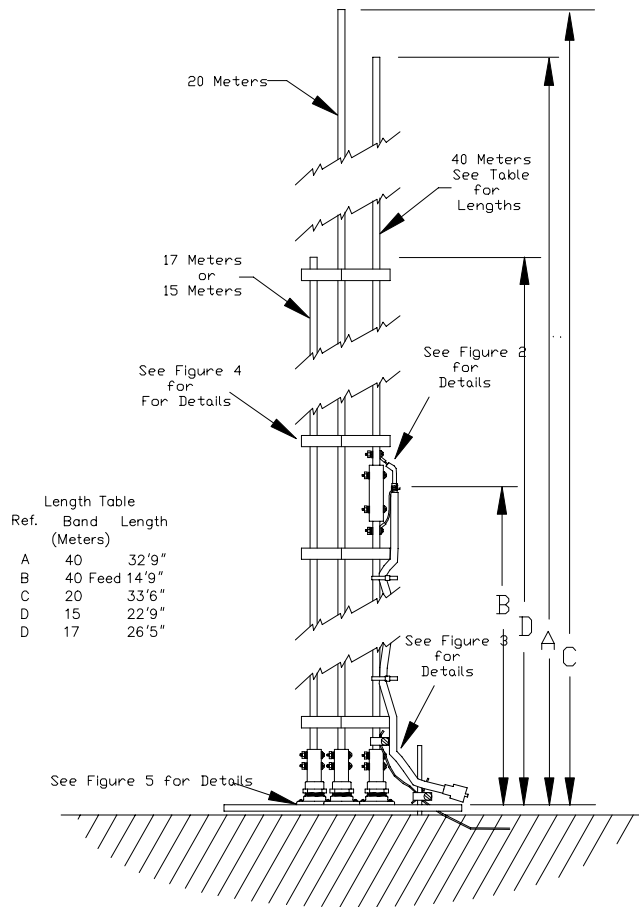


Figure 1—General assembly of the offset multiband trapless antenna—the OMTA. Maximum lengths are shown in the accompanying table. Adjustments may need to be made for individual installations. Try decreasing element lengths three inches at a time, noting the SWR and adjusting for minimum SWR.

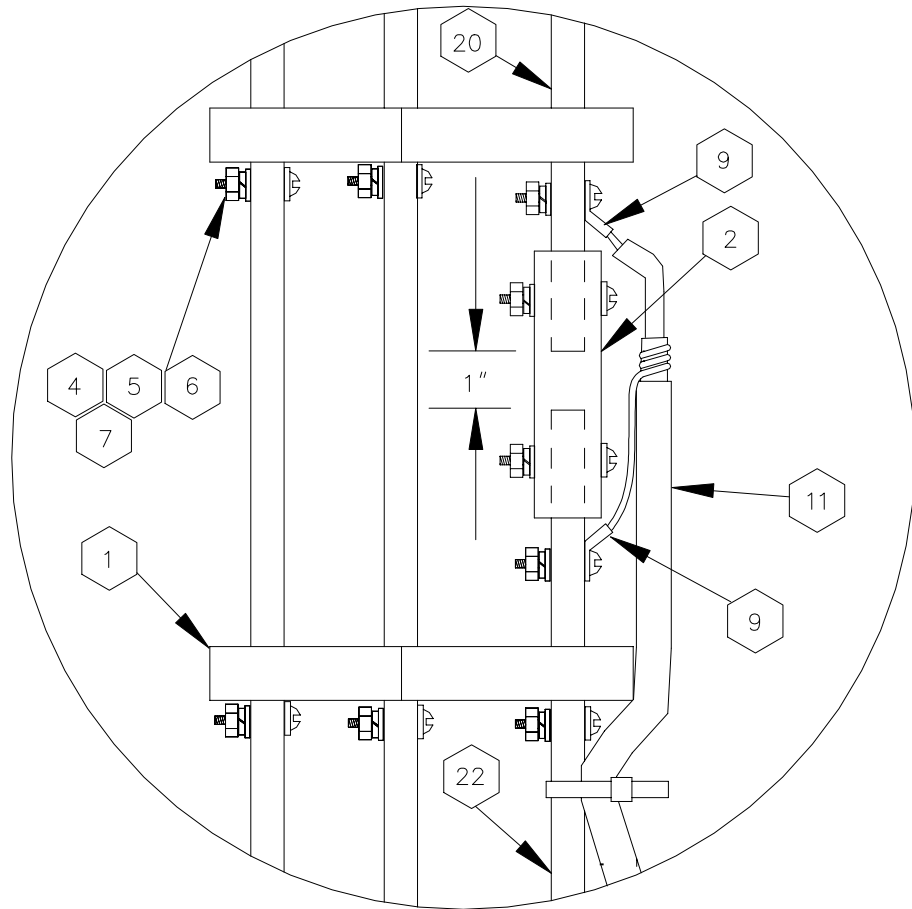


Figure 2—Detail of the OMTA feedpoint. Refer to Table 1 to identify the individual parts. The feedpoint is 14 feet 9 inches up from the base of the 40-meter element. The feedpoint tap positions aren't critical—an inch or so each side of the PVC insulator is fine.

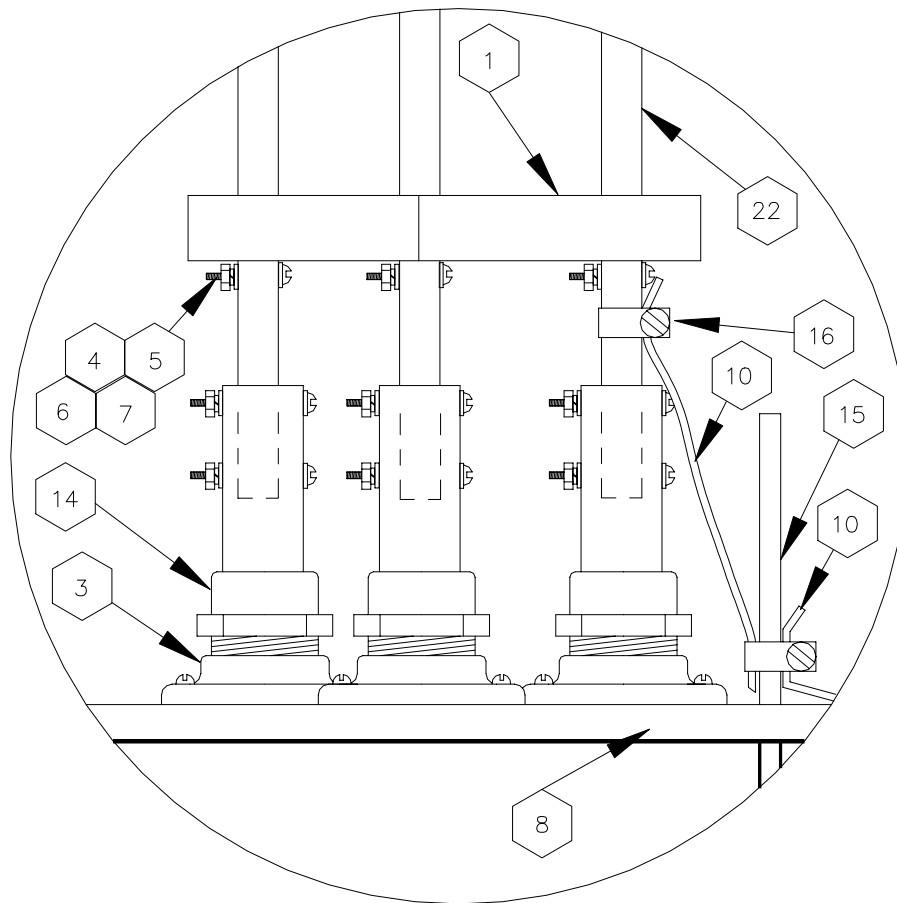


Figure 3—Base assembly detail of the antenna. Refer to Table 1 to identify the individual parts. A minimum of four 33-foot 5-inch radials make up the ground system.

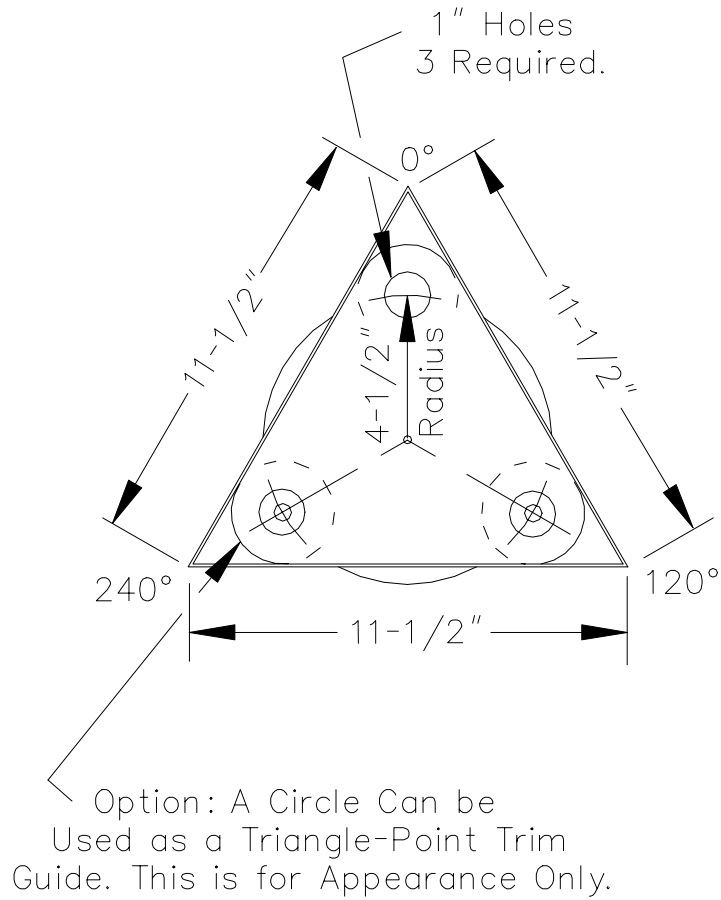


Figure 4—To keep the vertical tubes properly spaced, 1/2-inch-thick plastic breadboard spacers (pressure-treated wood can be substituted) are used.

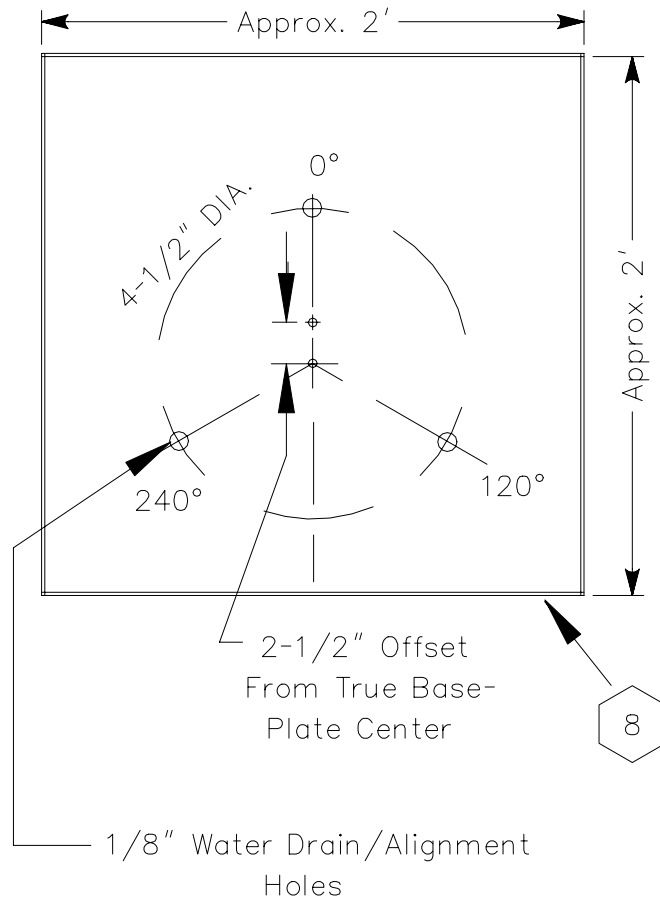


Figure 5—A base plate for the OMTA. A 2-foot-square piece of plastic breadboard (pressure-treated lumber can be substituted) supports three 1-1/4-inch deck flanges. The flanges are spaced 120° apart, centered on a 4-1/2-inch radius circle. To align the floor flanges, 1/8-inch-diameter holes are drilled through the base and serve as drain holes.

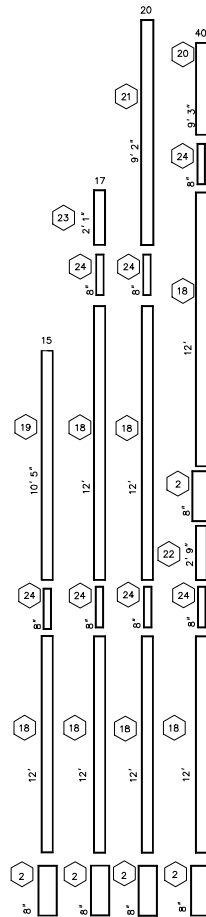


Figure 6—An exploded view of the antenna construction. Refer to Table 1 to identify the individual parts.

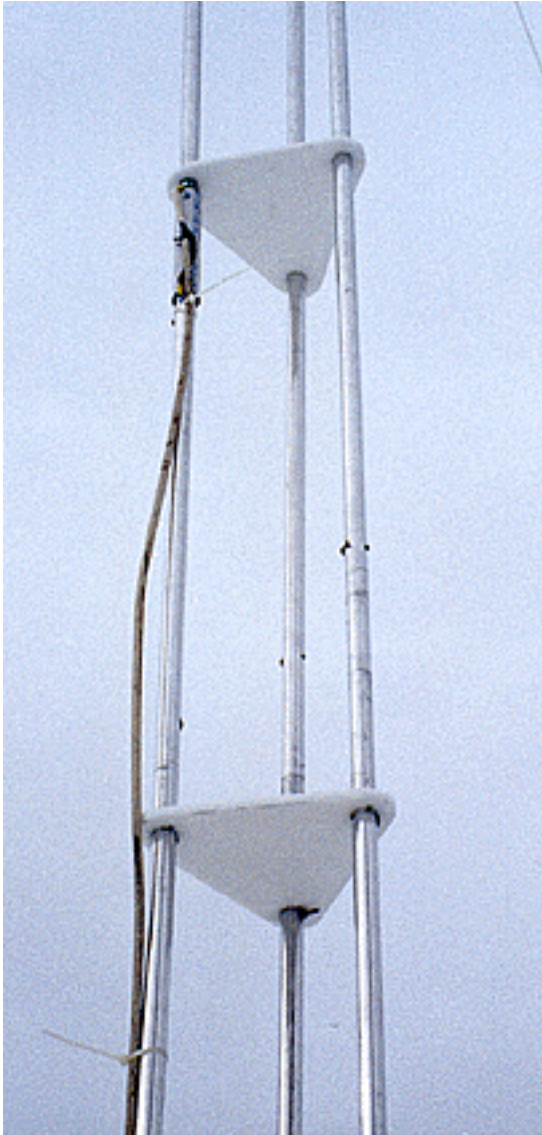


Figure 7—A view of the plastic breadboard insulators and the 40-meter feedpoint 14 feet 9 inches from the base of the 40-meter element.

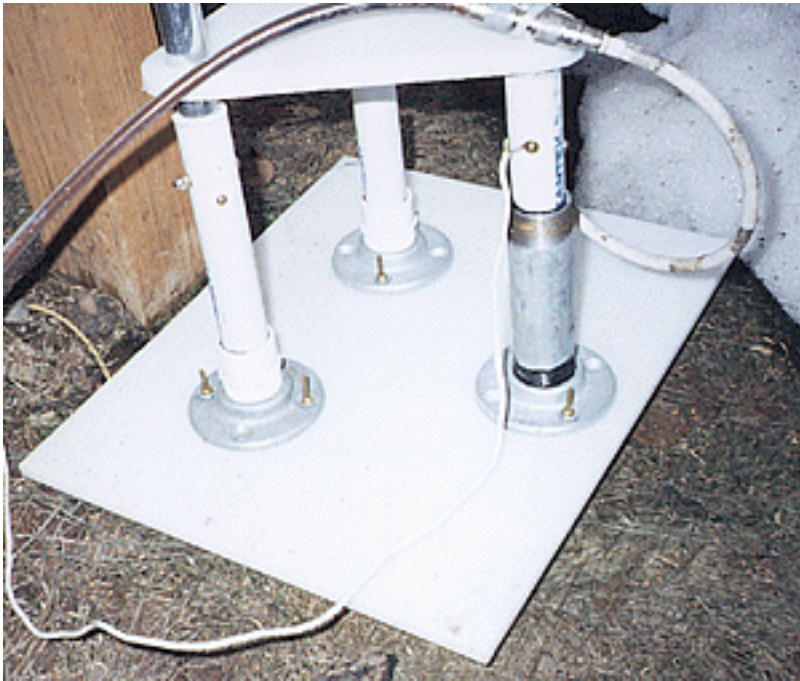


Figure 8—The base of the antenna is made from a plastic breadboard and supports three floor flanges that accept the vertical insulator pipe adaptors and PVC pipes. The metal sleeve on one of the legs is part of the experimental development and is not used in the final assembly.

Table 1

Part List for the OMTA (The references are used in accompanying drawings to identify the individual parts.)

Ref	Qty	Description
1	4	Insulating spacers, 11-1/2" triangle, 1/2" thick, plastic or wood; see Figure 4 for details
2	5	Plastic pipe, 8" long, 1" ID
3	3	1-1/4" cast-iron deck flanges
4	23	#6-32 stainless steel screws, 1 1/2" long
5	23	#6 stainless-steel split washers
6	23	#6-32 stainless-steel nuts
7	46	#6 stainless-steel flat washers to fit screws
8	1	Plastic or metal base plate; see Figure 5 for details
9	3	#6 solder lugs, heavy outdoor duty type
10	135 ft	#10 to #16 copper wire, cut into 4 equal lengths for ground radials
11	16 ft	Feed line (RG-213 coaxial cable or other)
12	1 tube	Silicone sealing compound
13	1 can	Plastic-pipe cement
14	3	Pipe adaptors, 1-1/4" threads to 1" ID plastic pipe
15	1	5/8" dia. copper-plated steel ground rod
16	2	1-1/4" stainless-steel hose clamps
17	1	Coax connector to fit coax
18	7	6063 aluminum tubing, 12' 1" OD, 0.058" wall, (main construction sections)
19	1	6063 aluminum tubing, 10' 5" long, 1" OD, 0.058" wall (15-meter tip

- 19 1 6063 aluminum tubing, 10' 5" long, 1" OD, 0.058" wall (15-meter tip section)
- 20 1 6063 aluminum tubing, 9' 3" long, 1" OD, 0.058" wall (40-meter tip section)
- 21 1 6063 aluminum tubing, 9' 2" long, 1" OD, 0.058" wall (20-meter tip section)
- 22 1 6063 aluminum tubing, 2' 9" long, 1" OD, 0.058" wall (40-meter base section)
- 23 1 6063 aluminum tubing, 2' 1" long, 1" OD, 0.058" wall (17-meter tip section)
- 24 7 6063 aluminum tubing, 8" long, 7/8" OD, 0.058" wall (internal connector sections)