DSPIRA Horn Assembly

Design of a low cost and simple radio telescope for use with a Software Defined Radio backend.

Overview of Telescope Design

The Horn is designed as an 'optimal' horn, constructed from 1 gallon square paint thinner can and aluminized insulation board. The wooden frame is designed with its largest dimension of 75 cm so that it just fits through a standard door.

MATERIALS NEEDED:

4' × 8' sheet of aluminized home insulation board – one sheet can make one horn; two sheets can make 3 horns

1 gallon square paint thinner can (F syle metal gallon container)

Copper wire for probe (gauge 4 or 6) – the probe is 5.25 cm long

Bulkhead SMA connector for the feedthrough

Aluminum flashing – for providing support between the horn and the can. We use 2" wide pieces, but any width that will fit on the can is fine.

HORN CRADLE:

two 20" long 2×2's

two $9\frac{5}{8}$ " long 2×2's

one $6\frac{11}{16}$ " long 2×2

three 9 " long 2×2's

one ¼ " plywood piece, 7" × 8"

Note: These eight 2"×2" pieces can be cut from a single 8' long piece.

BASE STAND:

four 3' long 2×4's

two 2' long 2×4's

two 2' long 2×4's with 45° cut at one end for support brace

CONSTRUCTION MATERIALS:

Foil tape – e.g. 3M HVAC tape or Metal Repair tape – for taping the horn interior

2 ½" construction screws – for assembling the base stand

1" or 1 ¼ " construction screws – for attaching the thin plywood base to the cradle

Two 3 ½ " long ¼-20 bolts

Two ¼-20 wing nuts

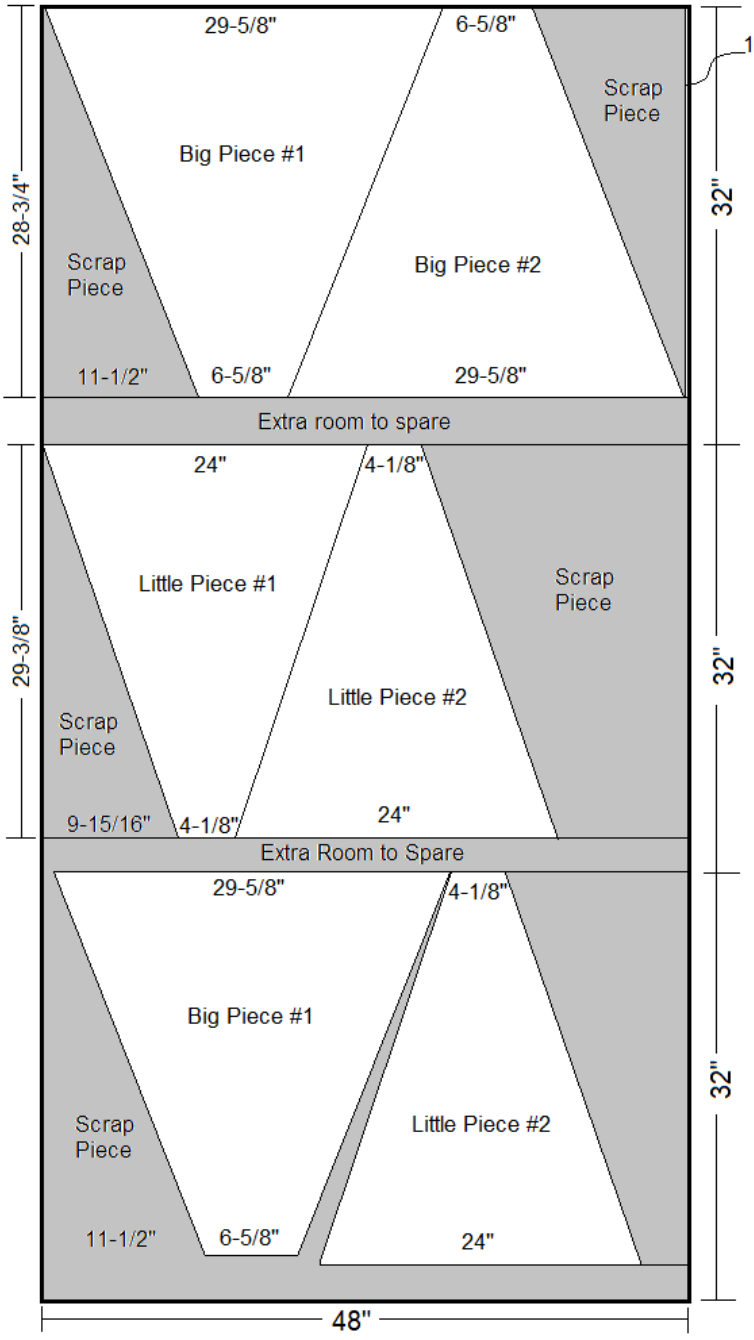
Washers - four ¼" fender washers

Duct tape – because you can't do a building project without it.

CONSTRUCTION

HORN ASSEMBLY:

1. Cut the horn sides out of the 4’ × 8’ sheet of aluminized home insulation board, as illustrated below:



CUTTING HORN PIECES FROM 4' x 8' SHEET

A 4' x 8' sheet of folied insulation foam board will be enough to make one horn.

There will be enough extra to make two spare pieces.

The 4' x 8' sheet could be cut into three 32" strips at the hardware store for easier transport.

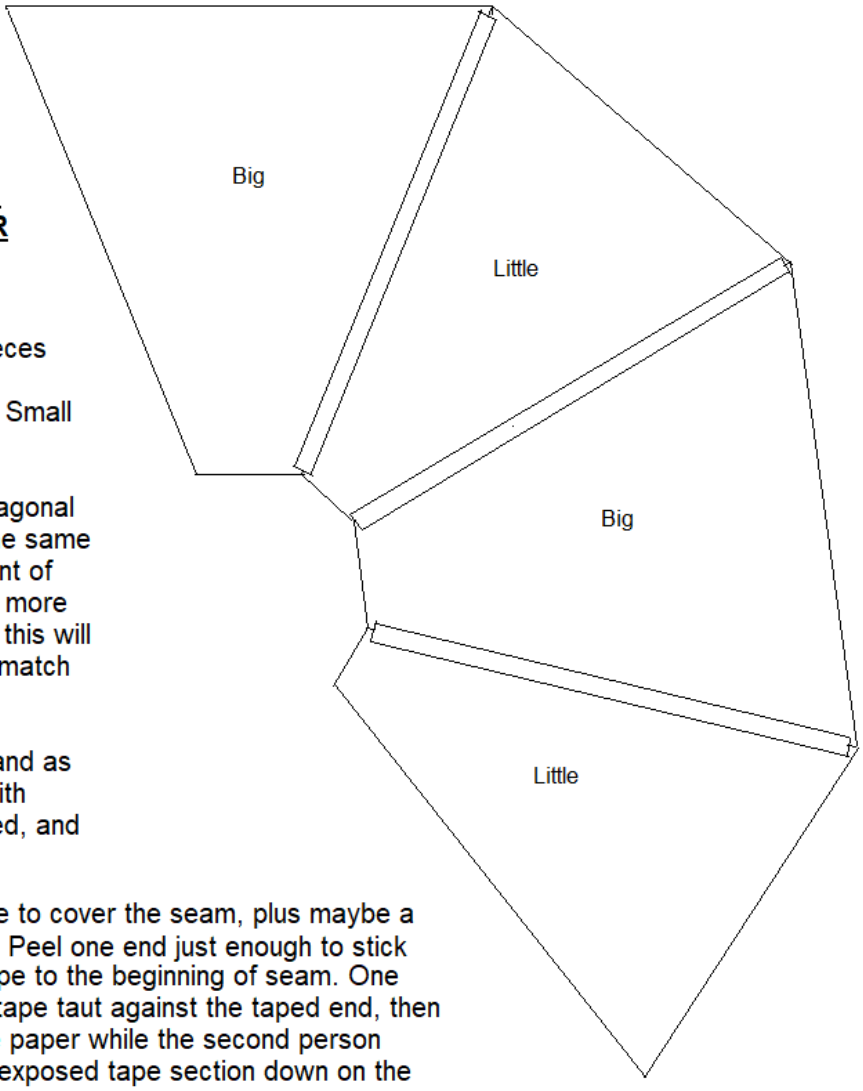
It is easiest to cut the 2 big pieces or the two little pieces as shown in the diagram. Doing one of each is awkward, as can be seen in the bottom pair of the diagram.

Measure all dimensions from the same side (left side in diagram)

The shorter ends of the trapezoids are most important since they need to line up with the tin can dimensions.

2. Align the panels side by side and use the foil tape to tape the panels together:

TAPING THE HORN PIECES TOGETHER



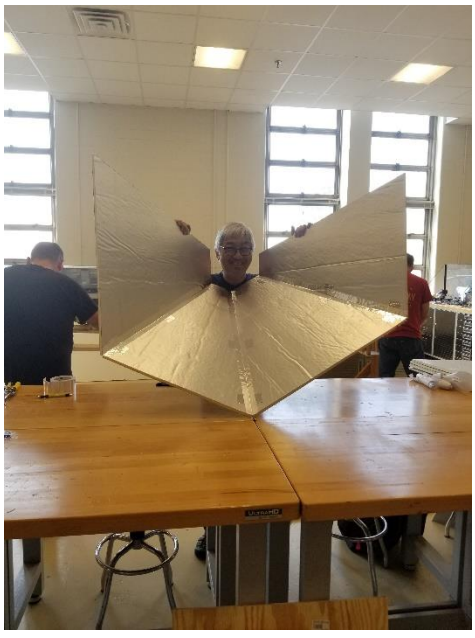
Line up the four pieces on a flat surface alternating Big and Small pieces.

Even though the diagonal edges should be the same length, the alignment of the shorter ends is more important because this will be put together to match up with the can.

So, line up edges and as best as possible with smaller ends aligned, and get ready to tape.

Roll out the foil tape to cover the seam, plus maybe a 1/2 inch extra. Cut. Peel one end just enough to stick down the end of tape to the beginning of seam. One person should pull tape taut against the taped end, then start to peel off the paper while the second person presses the newly exposed tape section down on the seam.

3. Complete the horn assembly by taping the remaining edges together to form a square pyramid horn.
4. Tape the top and bottom edges of the horn using the foil tape so that the edges are sealed. This provides protection to the horn edges from damage. (It also looks nice.)

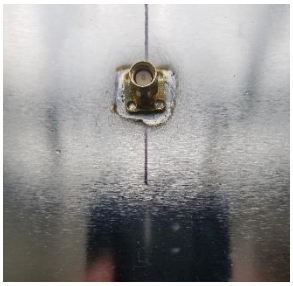


CAN:

1. Cut off the bottom of the can using a smooth edge can opener (e.g. an Oxo Smooth-edge can opener).
2. Solder the 5.25 cm long copper probe to the pin of the SMA feedthrough. See below.
3. Drill a ¼ " hole through the side of the can along the midpoint at a distance of 5.25 cm from the capped end of the can, as illustrated below.

   Suggestion: Place a block of wood on the inside of the can as you drill. This helps prevent the can from collapsing during drilling.

4. Solder the SMA feedthrough to the can with the copper probe extending into the can.



ATTACH THE HORN TO THE CAN:

1. Cut two 2" × 6" pieces of the aluminum flashing. Mold the flashing into a square "S" shape. These will fit along the contour of the can-horn connection to provide structural support. See photo below.
2. Place the can on the floor, open end up.
3. Place the horn on top of the can and align the openings.
4. Fit each flashing piece into the contour of the junction between the horn and the can on the outside, and tape (Use either duct tape or foil tape). See photo.
5. Use the foil tape to tape these pieces together on the inside. Be sure to completely cover the adjoining seams so that there are no openings or gaps.

Flashing piece taped to can.

Looking down into the can from the mouth of the horn. Notice the taping along the corner edges and at the can/horn seams.

BASE STAND CONSTRUCTION:

The bottom pieces of the base consists of 2×4's notched together, enabling the base pieces to fit together like a log cabin for easy assembly/disassembly.

1. Cut saddle notches in the 2×4's as illustrated below. Each notch is 1 ½ " (the width of a 2×4) by 1 ¾ " (half the height of a 2×4).

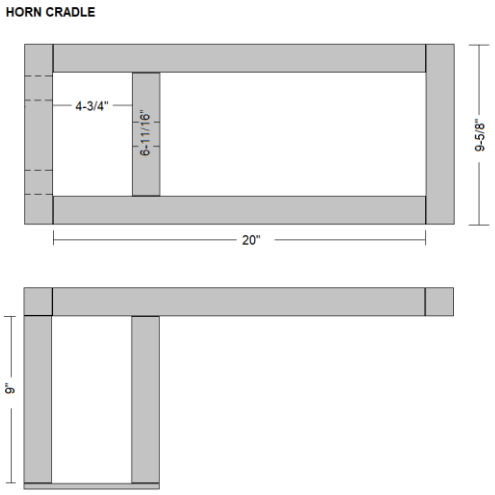
2. Use the 2 ½ " screws to attach two of the 3' long 2×4's to the other two 3' long 2×4's at 90° at a distance of 10 ½ " from one end.

3. Attach the 2' long 2×4's with the 45° end cuts to the two 3' long 2×4 pieces, as illustrated below.

HORN CRADLE CONSTRUCTION:

The horn cradle is constructed of the 2"×2" pieces.

1. Use the 2 ½ " screws to assemble the 20", $9\frac{5}{8}$ " and $6\frac{11}{16}$ " pieces into a rectangle with a cross bar, as illustrated in the top view diagram shown.



Top

Side

2. Attach the two 9” pieces extending downward from the corners at the left end of the rectangular frame and one 9” piece from the midpoint of the $6\frac{11}{16}$” .
3. Attach the ¼ “ plywood piece to the bottom of these three extensions. This should form a structure that the can can fit into.

FINAL HORN CONSTRUCTED:

The final structure is illustrated below: