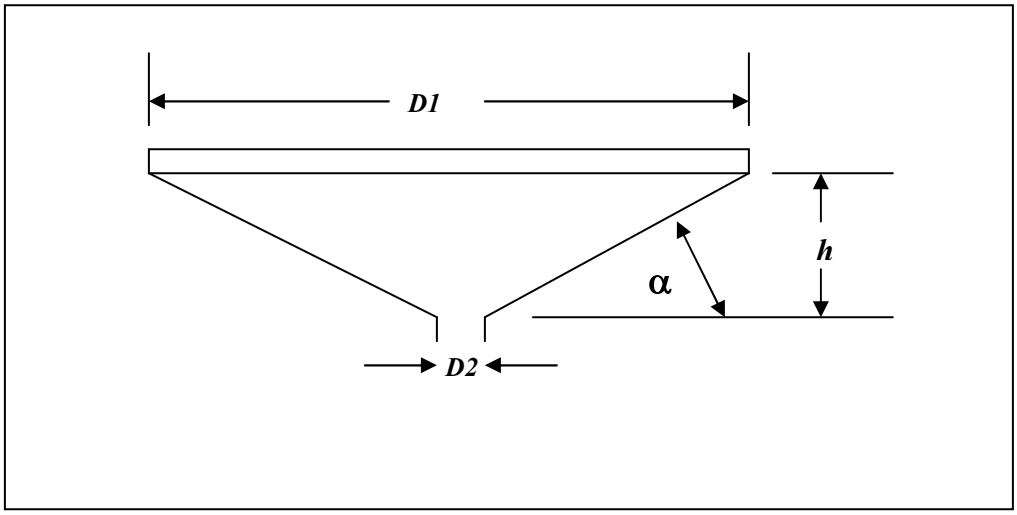
# Speaker Cone Math

**By Mark Palmquist**

Over the past few months I've been putting together an Atwater-Kent model 70 radio from parts found at swap meets. The cabinet will have to be built from scratch. The latest part found was a type N speaker that my friend Sam Mashburn found for me at a swap meet for $5. The good news is that these speakers sometimes go for $90 on Ebay. The bad news is that the speaker cone is in bad shape and will have to be repaired or replaced. At the last SARS meeting radio restoration expert Charles Pierce told me that he always tries to repair and preserve the original speaker cone if possible. He showed some examples of speakers with more than half the original cone gone that had been successfully patched, resulting in acceptable sound quality. He stated that it's often better to remove the original cone completely from the speaker frame before patching, to give the freedom and access needed. Charlie uses Duco™ Cement, available at Wal-Mart for gluing patches of repair paper onto the cone. Repairs around the flexible portion of the cone at the rim are handled with a flexible silicone adhesive found at Recreational Vehicle (RV) dealers, used to seal rubber window grommets to the frame of the RV.

Sometimes the original speaker cone is completely gone or so far gone that it has to be replaced. How do you make a replacement cone with the correct outside diameter, inside hole diameter and height so that it fits perfectly into the speaker frame? The solution to this problem has been known since the days of Archimedes and Euclid. Making a cone is easy. Cut a circle out of a piece of paper, put a smaller circle in the center, cut a pie-shaped wedge out of the circle, and overlap and glue the circle together to make a cone. Before you start, you will have to make some measurements and do some middle school math:




Measure the major diameter *D1*, the minor diameter *D2* and the height *h* of the old cone.

Measure the height by putting a straight-edge across the speaker and measuring the depth from the center of the straight-edge to the point where the center of the speaker is glued to the voice coil.

First, calculate the angle $\alpha$ of the cone. This is given by $\alpha = \tan^{-1}( h / (D1-D2) /2 )* \pi / 180.$ For example, if the outer diameter ***D1*** is 10 inches, the inner hole diameter ***D2*** is 1.75 inches and the height *h* is 2.75 inches, the angle will be 34.8 degrees. Use your calculator to find **cosine** of this angle, which is 0.821. Make sure your calculator is working in degrees, not radians. The outer diameter ***D3*** of your flattened cone will be $(D1/\cos \alpha)$ or 12.18 inches. The inner hole cutout ***D4*** at the center of the disc will be $(D2/\cos \alpha)$ or 2.13 inches. The angle of the radial pie-shaped cutout will be (360-(360*(D2/D4)) or 64.49 degrees. At this point draw a 64.5 degree angle from the center of the disc to the outside. Leave and extra half-inch of cone material to make a gluing flap and cut out the pie-shaped slice. Put some Duco on the gluing flap and overlap the flap and glue the cone together. You should now have a cone 10 inches in diameter and 2.75 inches high with an inner hole 1.75 inches in diameter.

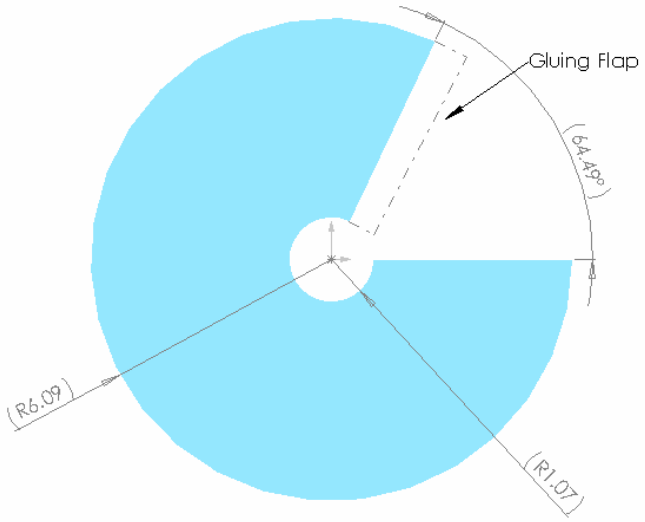



**Figure 1 Flattened Cone Dimensions (radius shown)**

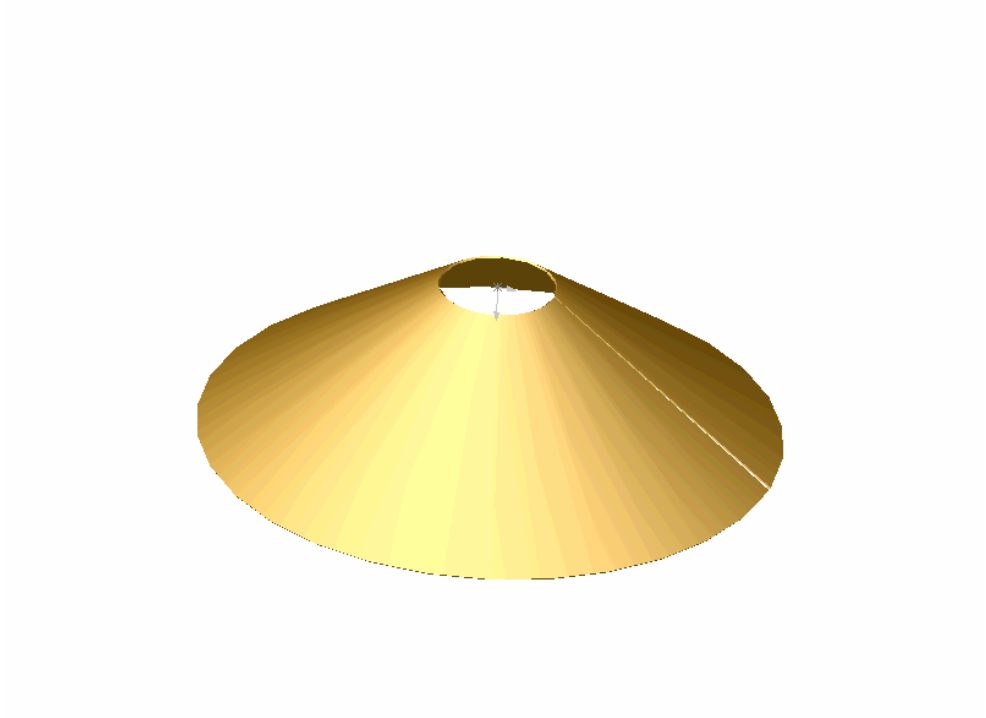


Figure 2 Folded Cone

# HUUUMMMMMMMM……

**By Les Cane**

A guy walks into a doctor's office and says, "Hey Doc, every time I turn on my vintage radio I hear a loud annoying hum." The doctor replies, "Oh, that's easy, Don't turn on the radio." I guess that's one way to solve the problem that Henny Youngman would appreciate.

As most of us know, one of the most common annoyances related to the audio stage of that vintage radio we just found is the extraneous noise known as hum. It may be described as a steady low pitched oscillation of 60-120 Hertz. However, what can be acceptable background noise to one person, may be a relentless irritation to another.

There are numerous causes of hum, such as improper shielding, defective tubes and rectifiers, or an open grid circuit. The most common cause of hum in the AC receiver is a defective filter capacitor. Capacitor cans of yesteryear containing one or more capacitors filled with wax or tar will ultimately require their replacement to more modern day small capacitors. Some of us use the "shotgun" method, choosing to replace all the capacitors and hope we have eliminated the troublemakers. Others, with more sophisticated instruments or techniques, are able to pinpoint where the problem is and replace only the bad ones. It's a good idea to bench test a radio for at least 24 hours once it is repaired. Radio components which have not been subjected to voltage and current for 20 or 30 years often fail in the first few hours of operation.

Capacitance is measured in farads, but since this unit is too large for radio capacitance, the microfarad ($10^{-6}$ farad) or picofarad ($10^{-12}$ farad) is utilized for measurement. Many of the old paper tube units will list the capacitance directly in proper units e.g., 0.1 microfarad at 630 volts. Newer capacitors with smaller values often use a code like 10K4 meaning 100,000 picofarads or 0.1 microfarads. 10K4 implies 10 with 4 zeros after it, expressed in picofarads.

With a few lessons in soldering and appropriate placement of new capacitors purchased, just about anyone of us can eliminate one of the causes of hum. Listed below are a number of sources for capacitors that are more commonly used in radio receivers. Like all of us, checking out these sites, their parts lists and prices, will typically yield the best supplier from cost perspective. Don't forget most suppliers have a minimum order and shipping charge. Do your research to save some money. You could take the lazy man's route and give the receiver to Charlie or Mark to handle. Also, Bret Menassa (Bret's Old Radios) produced a videotape entitled Antique Radio Restoration. There is a portion that covers hum and the replacement of capacitors, that you might find of interest.

Source List: Just Radios www.justradios.com ; Antique Electronic Supply www.tubesandmore.com ; All Things Radio www.allthingsradio.com ; Radio Daze www.radiodaze.com, The Antique Radio Store, DH Distributors (no web site: P.O. Box 48623, Wichita, Kansas 67201) to name a few. Swap meets and flea markets sometimes turn up NOS (New Old Stock) components a bargain prices.