

## Wally Pitts 2002 Jan Newsletter STF Article

Welcome to the 2002! As we prepare for the upcoming competition season, we thought a bit of historical perspective might be in order. As you all know IMAC is not the first SIG to deal with noise, nor will we, I believe, be the last. Much work has come before on this issue, so in this addition of the IMAC Newsletter, we would like to share a historical perspective on the sound issue. Dave Von Linsowe offers a perspective on the evolution of sound reduction as it occurred in pattern, a quick and informative read. George Hicks details the intricacies of the decibel system of measurement. While somewhat technical in nature it is an excellent read and a wonderful source material. I know you will enjoy it.

Recently a friend and fellow modeler gave me an article that concerned itself with model airplane sound reduction. As I read it I was happy to see that it covered many of the same issues that were discussed in my last IMAC Newsletter article. Mr. Don Lowe wrote the article for *Model Aviation* magazine. It was an excellent discussion of many of the relevant issues IMAC faces, and very timely. It also offered up many solutions. I wished I had seen it sooner as it could have made my first article much easier to write. At this point, I know many of you are asking yourself, "I haven't seen an article recently from Don Lowe in *Model Aviation*," and you are right, the one I refer to appeared in the *July 1988* edition! Even back then, the issues were plain to see, almost a full decade before the first 150cc engine appeared on the market! At the end of the article you will see that sound meters have not gone up in price much over the last fourteen years, so no excuses for not getting one! Additionally, we recommend not only increasing pitch, but in many cases increasing the diameter of the prop as well to reduce sound levels.

I have received Mr. Lowe's permission to use his words from that almost fourteen-year-old article. I have paraphrased to save space. I hope you will enjoy the issues he presents and while reading, remember the following is from 1988 (when much smaller planes ruled the air), as you will see, the issues have not changed:

" 'SOUND' according to Webster, is '...the sensation produced in the ears when certain vibrations are caused in the surrounding air.' 'Noise' on the other hand is called ' sound, of a loud, harsh, or other confused kind.' Human perception of sound seems to vary with the individual; what may be noise to one person may or may not be experienced negatively by another.

We are well aware of the consequence when the sound of our operations in close proximity to surrounding populated areas is not controlled: loss of flying sites. This has happened repeatedly in the past, and it becomes an ever-increasing problem as, more and more, housing moves into the areas of established sites. A safe, secure, 'no problem' situation can rapidly become a crisis when a loss of lease is threatened."

Mr. Lowe goes on to state that with typical monetary investments clubs make to site improvement, it is prudent to protect the investment through a model sound reduction plan He then goes on to state:

" We tend to think that the sound generated by model airplanes originates solely in the operation of the engines, but that's a fallacy. Other noises (for example turbulent flow over the airframe) are usually masked by engine sound. Therefore changing to a good muffler will not in itself achieve adequate sound reduction; the total propulsion system must be treated. Sound is produced by a combination of things including the following:

- a. Engine exhaust
- b. Propeller
- c. Engine mechanical noises
- d. Radiation of sound from the walls of the engine and muffler
- e. Intake
- f. Airframe

The total sound that your model produces is the nonlinear summation of *all* the above factors. *Each condition, by no matter how small a measure contributes to the aggregate sound footprint of the model.*" (Emphasis mine).

Mr. Lowe then examines individual sources of noise.

"EXHAUST. Engine noise is generated by the burning of the fuel and its rapid cyclic expansion into the atmosphere. At 100% engine efficiency, these gases would be fully expanded to atmospheric pressure and temperature before escaping into the atmosphere, and sound production would be negligible. A good muffler compensates for some of the engine inefficiency allowing the gases to cool and expand on a controlled basis prior to their release in top the atmosphere.

This process normally requires a certain minimum volume and/or multiple passes. A compact muffler of simple open chamber design *does not do the job!* A hollow chamber muffler, which is typical of current production, is not quiet enough; consequently, internal baffling is required to reach lower noise level.

PROPELLER. While the assertion may surprise some, I'm convinced that the propeller is the single most difficult and problematic sound source modelers encounter. Eliminating propeller noise requires a lot of wizardry and a little cut-and-try design.

At present reduced propeller tip velocity has been definitively correlated with lowered sound. Simply employing a large-diameter prop without also reducing the rpm accomplishes nothing. In fact if you maintain rpm (by reducing pitch) with a larger-diameter prop, the sound will actually *increase!*

The magic of a three or four blade prop design does *not* derive from the use of multiple blades; rather, we simply are maintaining engine thrust through use of a smaller-diameter prop with lower tip speed. Full-scale aircraft employ multi bladed props not because they confer some automatic improvement in performance, but to provide a means of absorbing the engine horsepower through a prop diameter sufficiently practical to also keep the landing gear at a reasonable length

According to current knowledge, the quietest props seem to be the most efficient ones – a very happy circumstance. Again, keeping the tip speed down is *vital* to attaining quietness. Blade stiffness *and using thin blades* are also important factors. Sweeping the blade leading edge reduces sound too. It has been shown that racking back the last 10% or the prop tip is helpful. Props fabricated of very hard woods, laminations, and composites of carbon fiber and fiberglass appear to be very advantageous. These materials also permit stiffness in a thin bladed design.

Nevertheless, the single most effective means of suppressing propeller sound is to *get the tip velocity speed down!* When you do so however, it becomes necessary to increase prop pitch to keep the airspeed up. Airspeed is generated by rpm x pitch. When you reduce RPM you must increase pitch. Experiments have dramatically shown that using a very quiet muffler with a fast turning prop does not get the job done; lowering prop speed is necessary to effectively quiet the sound.”

This really hit home with me as we have tested a number of models with tuned canister mufflers. Anytime a too small prop was used, the resulting sound was quite loud, thus negating the effect of the mufflers. To reduce sound therefore must be a coordinated effort of both prop and muffler.

Mr. Lowe finished his article with the following two paragraphs:

“ It is also obvious that much more education on solutions to the problem and more help from industry is required. We need at least an optional choice from the engine manufacturers for a quiet muffler, and we need to employ higher pitched props. We also need a basic understanding of vibration-induced noise, and an introduction of products on the market to make this an easier change for the modeler.

Every model airplane can be operated at reduced sound levels without significant (or any) reduction in horsepower if the solution is properly designed.

Would you like to live next to an uncontrolled model-flying site? Not !! If your club site is within a half mile of neighbors, you should be concerned. Remember prevention is far better than facing a lot of irate neighbors; once positions are established; it's very hard for people to change their minds.

IN SUMMARY, I would like to emphasize once again that noise reduction involves the *total package*. A super quiet muffler may not be the total answer; it is a *necessary part* of the solution. Don't be afraid to experiment. Go to Radio Shack and plunk down 30 bucks for that indispensable sound meter and get started. I assure you it will be a rewarding and pleasant experience. In addition it may even save your flying site, *and* your hearing! “

Couldn't have said it better myself!

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