Nose Gear Lessons Learned

Objective: Improve assembly, inspection, and maintenance of the nose gear to improve the safety of the nose gear fasteners. We are talking about improvement, prevention, and safety; not any inherent flaw in the RV-A nose gear design.

Contributors (in alphabetical order): Walt Aronow ("Walt" on VAF, RV-7A), Bruce Hill (bruceh, 9A), Bill Palmer (same, 8A in-work), Bill Pendergrass (rzbill, 7A), and Alex Peterson (AlexPeterson, 6A).

Applicability: RV-6A, 7A, 8A, & 9A

Disclaimer: *These "Nose Gear Lessons Learned" are opinion-based, consensus recommendations based on the personal perspectives and experiences of those individuals contributing to this post. These lessons are deduced from our own experiences and the experiences of others as reported on VAF and are not as the result of definitive engineering studies, testing, or similar professional analyses. These lessons learned do not represent the recommendations of Van's Aircraft except as noted in Van's published Service information (bulletins, letters and notices, and revisions and changes . . . see the included links). In other words, as an RV-A builder or flier, it is entirely your personal decision whether to acknowledge these lessons learned or ignore them.*

Link to Van's SB page:
http://www.vansaircraft.com/public/service.htm

LESSONS LEARNED (RECOMMENDATIONS):

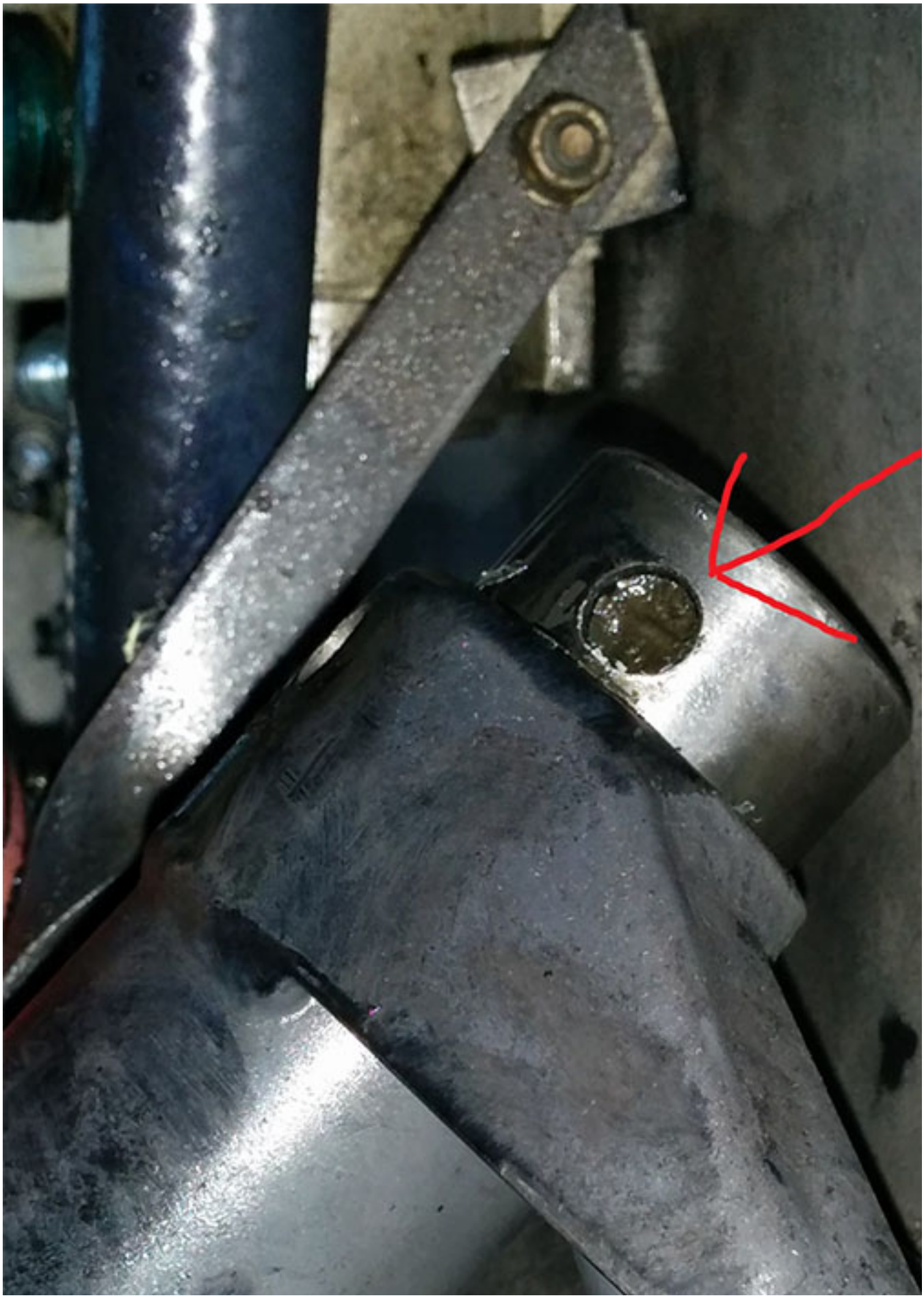
1. Installation

Make sure that all nose gear components are installed correctly.

For example, the stop collar (flange) can easily be installed backward which severely limits nose wheel castering and can create high shear loads on the nose gear leg retainer bolt. If you

can visually check the stop collar easily, we recommend referencing Van's installation drawing for proper stop collar orientation = stop tabs (arms) forward.

Sheared leg retainer bolt from incorrectly installed stop collar:



We highly recommend performing Van's new Service Bulletin to check the stop collar orientation before further flight:

http://www.vansaircraft.com/pdf/sb14-12-22.pdf

All of the nose gear system components are subjected to high loads, so pay extra attention to correct installation. We recommend carefully checking the entire nose gear system for proper installation, operation, and adjustment. High-quality workmanship is important!

2. Nose Gear Fork

If you still have the older-style nose gear fork, Perform Van's Mandatory Service Bulletin 07-11-09 (Nose Gear Leg and Fork Upgrade)

http://www.vansaircraft.com/pdf/sb07-11-9.pdf
http://www.vansaircraft.com/pdf/Nosegear_sb_faq.pdf

Read these Van's Service Letters:

http://www.vansaircraft.com/pdf/Nose...ice_letter.pdf
http://www.vansaircraft.com/pdf/letters/nosegear.pdf

3. Nose Wheel

Replace the Van's-supplied Matco nose wheel with an improved Grove, Berringer, or Modified Matco (Anti-Splat Wheel and Bearing Modification) wheel. Reasons: Lower rolling resistance; reduced nose wheel shimmy. Periodically (at least annually) balance the wheel/tire assembly and check the tire for roundness. Replace/rebalance the tire as necessary.

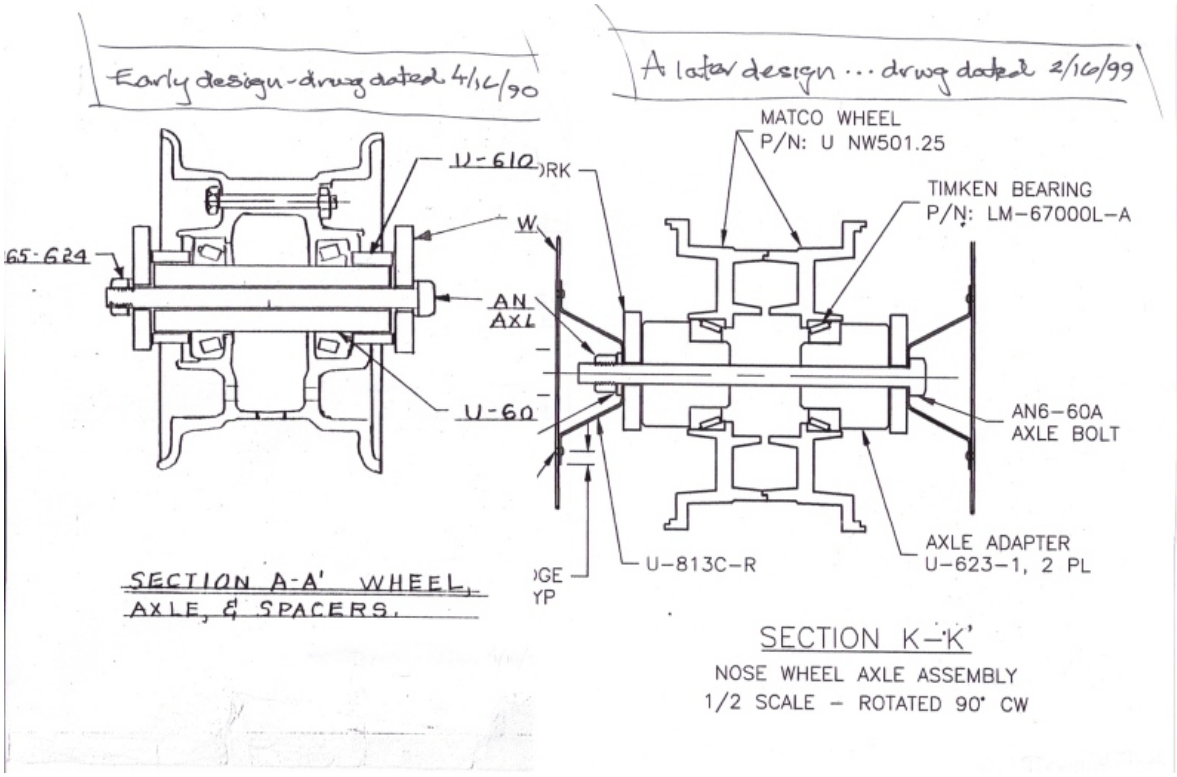
Matco Wheel Alternative: Carefully and frequently check the Matco Nose Wheel Axle Torque per Van's Service Letter:

http://www.vansaircraft.com/pdf/Nose_W_T.pdf

Goal: Reduce/Eliminate Wheel Binding and Shimmy.

Comment: The reason that we are recommending changing or modifying the Matco wheel is that many RVers have had difficulty properly installing, lubricating (packing), and adjusting (torquing) the combination of the nose gear fork, 3/8-inch axle bolt, and Matco wheel system (wheel, roller bearings, and cones/mushrooms). Without a perfect installation and frequent, proper adjustment and lubrication, this fork and nose wheel system is prone to perhaps exhibiting bearing binding or even lockup. Proper alignment and stacking of the Matco wheel system to the nose gear fork is not easy, the roller bearing preload is set by the axle torque, and the axle is relatively flexible. We highly recommend installing a nose wheel system which completely separates the bearing preload from the axle torque. A more rigid axle is recommended as well.

Note: Earlier model 6A's had a more rigid design axle from Vans as shown:



4. Nose Gear Leg Retaining Bolt

Periodically (every annual or more often if operating off rough fields), carefully inspect the nose gear leg and engine mount connection.

(1) Per Van's drawing, check to make sure that a washer is NOT installed under the head of the retaining bolt. If a washer is installed under the bolt's head, the bolt's grip length does not fully contact the engine mount at the bottom. If you insist on installing a washer under the bolt head, the next longer bolt will be required; probably with two washers at the base to avoid showing too many threads beyond the lock nut.

(2) Lift the nose wheel off the ground and check the nose gear leg for play (gear leg movement at the engine mount socket). If some play is observed then remove the AN5-20A nose gear leg attachment bolt and inspect the bolt and bolt hole for wear.

Note: AN5 bolts can have a diameter as low as 0.309. If you have a "slightly loose" nose gear leg either upon initial fabrication

or at a periodic check, you might try installing a close-tolerance AN175-20A or NAS6605-26 bolt instead. Note: The NAS6605-26 is specified, because its overall length is the same as the AN5-20A. The -25 (same grip length as the -20A) is too short.

If the engine mount's bolt hole has been enlarged such that the AN5 (or AN175/NAS6605) bolt is no longer a "close fit," enlarge the hole slightly (ream) and install an oversize NAS 6605-26X (+.0156 inch) or NAS6605-26Y (+.0312 inch) bolt. The appropriate reamers from Genuine Aircraft Hardware are, respectively, the straight-shank PPR-.3261 (for -X) or PPR-.3417 (for -Y). Both reamers have an approximate 2-1/4-inch flute length with a standard 0.309-inch diameter, 9/16-inch long pilot. Threaded shank versions are PPRT-.3261 and PPRT-.3417. Optional reamers are the PPRL-.3261 or PPRL-.3417 with a 3-inch flute length; same pilot.

Note that oversized NAS6605 bolts still have standard 5/16-24 threads, so standard AN960-516 washers and AN363-516 (MS21045-5) all-metal locknuts fit the oversized bolts.

Note that Van's Aircraft has not approved the installation of an oversized NAS bolt, but flying with a loose nose gear leg is definitely not recommended!

Technically, the only approved Van's Aircraft solution for fixing a loose nose gear leg would be to repair (weld and drill) or replace the engine mount and continue to use an AN5-20A bolt as specified. This assumes, of course, that the hole in the nose gear leg itself is not enlarged. If this hole is also enlarged or damaged, the nose gear leg would need to be replaced to remain within what is currently published by Van's Aircraft (the original plans and drawings).

5. Breakout Force

Periodically (every 50 flight hours or less), check the nose gear lateral breakout force (22 pounds MINIMUM at the wheel axle). Many RV-A builders/fliers set the breakout force at 24 pounds.

Goal: Reduce/Eliminate Wheel Shimmy.

Note: Slightly lapping the outer contact edges of the two Belleville (spring) washers usually helps in the adjustment and retention of the breakout force (increased contact area).

6. Tire

Every time you fly, pay careful attention to proper tire inflation (35 psi recommended). Check the tire condition and replace the tire or tube as needed for safe operation. Check the pant-to-tire clearance considering tire deflections under load. If needed, modify the wheel pant for adequate tire clearance.

Tip: Use LOTS of talcum powder when installing and inflating the inner tube to make sure that the tube is not sticking, distorting, or folding against the inner wall of the tire. Also, make sure that the valve stem is properly positioned and not under any side stress. An improperly positioned or seated inner tube can be a strong contributor to tire imbalance, out-of-roundness, and nose wheel shimmy.

Note: Tire pressure and nose wheel shimmy can be indirectly coupled by nose gear system problems. Therefore, when changing tire pressure, we would recommend doing so incrementally interspersed with a shimmy check. Generally, there should be no correlation between reasonable (in-range) tire pressure adjustments and shimmy. On the other hand, if shimmy is noticed, then all the nose gear system components and adjustments need to be carefully examined to discover what might be driving the shimmy. A tire pressure change which seems to excite a shimmy should be looked upon as a symptom; not a cause.

7. Takeoff & Landing

Consider treating, or partially treating, every RV-A takeoff and landing as a “soft field” operation. On takeoff, lift and hold the nose wheel/tire off the runway early in the takeoff run. On landing, keep the nose wheel/tire off the runway until the aircraft

slows a little and then lower the nose wheel gently.

Goal: Keep the nose gear loads as low as practical.

Comment: If new to RVs, transition training is strongly recommended!

8. Runway Surfaces

CAREFULLY ASSESS runway and taxiway condition BEFORE use. Consider avoiding OBVIOUSLY "Very Rough" or "Very Soft" surfaces. Note: To be clear, we are not saying to avoid grass runways as there are many fine grass runways, but we are recommending that one should consider avoiding very rough or soft surfaces whether they are asphalt, dirt, concrete, grass, gravel, or whatever. Soft surfaces can become particularly treacherous when soaked. Also, sporadically holed or pitted surfaces are risky.

Comment: Anti-Splat Aero sells an add-on brace for the nose gear leg ("The Nose Job") which is designed to keep the nose gear leg from folding under longitudinal high-load conditions by transferring the load up the gear leg. Anti-Splat also sells "The Lip Skid" designed to provide a slipping surface at the bottom of the nose gear leg. The effectiveness of these products is still open to debate. They may increase safety somewhat for rough or soft field operation, but, in our opinion, it is better to carefully assess and avoid obviously rough or soft surfaces than to depend on these products to bail you out of a potentially bad situation.

BOTTOM LINE: We hope these "Nose Gear Lessons Learned" help our fellow RV-A builders/pilots to safely build, maintain, and operate their great RV airplanes!

Some builders have chosen to go with a taper pin for some improved load margin up-front, but we recommend that the taper pin installation should be viewed as an optional enhancement; not a requirement. Below is some info on taper pin installation.

Alternate method for Nose Gear Leg retainer bolt:

Alternative: If you have not installed the engine mount or can easily remove the engine mount for working access, you can elect to replace the AN5-20A bolt with an AN386-4-13 taper pin. Many RV-A builders have done this and this alternative seems to be working fine. However, it should be noted that installing a taper pin is not a method approved by Van's Aircraft.

There are currently two taper pin installation methods:

a. Manual Taper Pin Install (manually ream and taper the gear leg and engine mount simultaneously) by Jim Ellis and posted on Matronics as follows:

http://www.matronics.com/wiki/index.php/Nose_Gear_Strut
Note: ACS now stocks the AN386-4-13 taper pin without a separate part number, and there are other online sources for this taper pin as well.

Taper Tools:

Procedure: Manually reaming the nose gear leg and engine mount combination is a three-step process that requires considerable patience and force.

(1) The nose gear leg and engine mount must be properly aligned and clamped in-place to prevent movement. Temporarily installing the AN5-20A bolt or a 5/16-inch hardware bolt (undersized) helps. Both the gear leg and the engine mount are then simultaneously (2) match-drilled and (3) reamed:

(2) Measure the diameter of the taper pin with calipers at the point where the small end will exit the engine mount. Make sure the tapered pin provides enough threads protruding for the castle nut and taper pin washer. You can set up the taper pin with the nut and washer on the threads, then line up the caliper next to the washer. For the initial match-drilling of the hole prior to reaming, use a drill bit slightly under this measurement as your initial drill size. The Matronics instructions say to use an “S” sized bit or 11/32-inch. It is always good to verify this size before you start cutting and drilling. For example, a 21/64-inch drill bit might be better.

For the initial, match-drilled hole, go slowly with the drill RPM's and use a lot of cutting oil or Boelube frequently to get the factory gear leg and engine mount holes aligned and enlarged (matched) before you begin reaming with the tapered reamer.

(3) Put the tapered reamer into a tap handle. Using generous amounts of cutting oil, begin turning the reamer in the cutting direction only. Do the reaming slowly by hand. You will need to push hard and turn at the same time, so it helps to have another person help with the reaming. Do not turn the reamer in the non-cutting direction, or you will dull the cutting edges. Always turn in the cutting direction only. Remove the reamer frequently and clean off the cutting edges and reapply the cutting oil generously.

Once the reamer starts producing chips, make sure to frequently measure the length of the reamer or taper pin protruding from the hole. The taper pin's grip shoulder must not protrude more than 1/16-inch beyond the engine mount, because the taper pin washer is actually a collar with a depth between 3/32 and 1/8-inch. Once the reaming process gets started, it will approach the proper taper pin depth very quickly so be observant. A few turns goes a long way to increase the cone depth of the tapered hole, so don't get too aggressive and go too fast once you are reaming the entire length of the hole or you will overshoot and go too far.

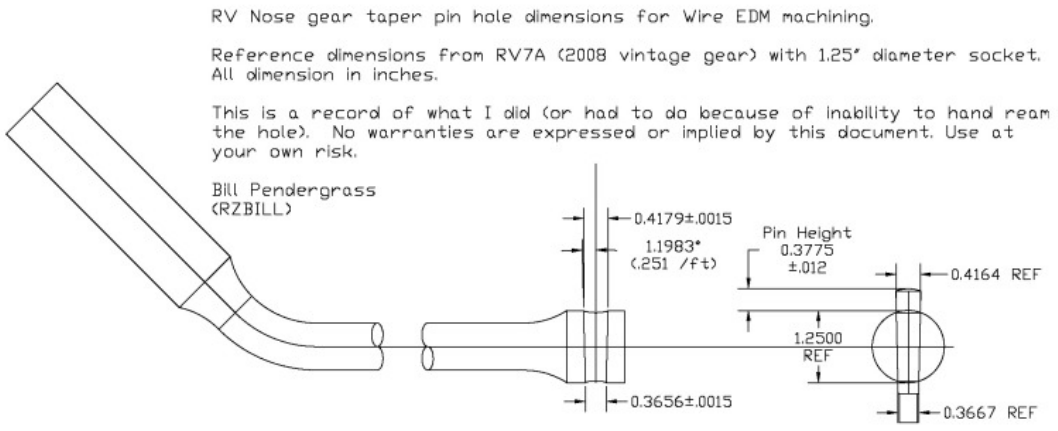
Considerable axial pressure must be continually applied to the reamer to keep the ream process going. Above all, take it slow and do not hurt yourself!

Notes: Some builders have had difficulty keeping the reamer sharp and have resorted to purchasing an additional reamer or two to complete the process. If the reamer is not making chips and has dulled, you can try lightly running a fine sharpening stone along the cutting flute interior edges to get them sharpened up again. One or two strokes of the sharpening stone is plenty. You just want to revive the cutting edge, not take any material off in the process. Also, using a drill for the reaming step is not recommended, because it will spin too fast; quickly dulling the reamer and thus burnishing (surface-hardening) the hole. Slow, manual reaming works best with plenty of cutting oil and steady pressure being used.

There are some good pictures of the process in this thread on VAF: http://www.vansairforce.com/communit...d.php?t=105870

b. Wire-EDM-Assisted Taper Pin Install (machine-ream the nose gear leg first and then manually ream the engine mount to match).

For those who have had difficulty with the manual reaming process or for those who feel more comfortable with professional tapering of the relatively hard nose gear leg, here is the drawing developed by Bill Pendergrass for Wire-EDM-machining (taper-reaming) of the nose gear leg hole:



Pros: Manually reaming the engine mount to match an already-machined (tapered) nose gear leg is relatively easy. The engine mount steel is soft in comparison. Also, the nose gear leg is relatively easy to vertically align at the machine shop.

Cons: Finding a reasonable Wire EDM machining shop nearby may not be easy or even possible. The machining cost is probably at least $250 for tapering one gear leg including the set-up cost. Finding several builders to spread the set-up cost over multiple gear legs might be a good idea.

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