Although the practice of safety wire itself is not particularly difficult, the chasm between casual practice and precision execution could easily fit a Boeing 747. Even the participants in our repairman workshops with aviation backgrounds often require many hours practice to master the basic do’s and don’ts of safety wire. And practice, practice, practice is the only solution for developing efficiency and that “attention to detail” type of craftsmanship which is essential in an award-winning aircraft. Even if you’re not looking to win the “Lindy” award, details like safety wire tell us a lot about the mindset of the aircraft builder or mechanic. Anecdotally, over the years, we have seen a very strong, positive correlation between safety, aircraft reliability and the builders who put the effort into the details.

More often than not, we see safety wire installations that in practice will probably work, but strictly speaking are done with poor execution. In researching for this article, we found more cases of improper safety wire procedures, than we found examples of safety wire done correctly. By definition, safetying is “Securing by various means any nut, bolt, turnbuckle etc., on the aircraft so that vibration will not cause it to loosen during operation.” This runs contrary to the mindset that the safety wire is used to hold the part from falling off of the aircraft after having come loose. Only proper technique can ensure that the fastener will not come loose during normal operation.

There are two methods of safety wiring; the first is the double-twist method. Figure: 1 & Figure: 2. This is most commonly used method of safety wiring. The second, and less often used method, the single-wire method. The primary downside to the single wire method is that a failure of the wire will affect all of the fasteners simultaneously. When using the single-wire method, use the largest safety wire consistent with the size of hole in the fastener to be safety wired. This would typically be used on screws, bolts, and/or nuts in a closely spaced or closed-geometrical pattern, or in
places that are difficult to reach.

**The Basics Rules for Safety Wire**

Before beginning the safety wire procedure check, ensure that the fasteners have been properly torqued. The prime directive regarding safety wire is that it must be installed in a manner that will prevent the tendency of the part to loosen. This includes ensuring that the safety wire is routed in such a fashion as to tighten the fastener. Remember “Lefty Loosey - Righty Tighty”. Figure: 4. Upon initial inspection, we can generally identify that the safety wire has been installed with the correct orientation (tightening direction) by the telltale reverse S.
tern of the safety wire. Safety wire must be pulled taut when being twisted, and maintain a light tension when secured. This serves the purpose of both preventing the part from loosening as well as preventing the failure of the safety wire due to rubbing or vibration. Although proper tension is of utmost importance, this is one area where you don’t want to become overzealous. Safety wire must never be overstressed. Safety wire will break under vibrations if twisted too tightly.

Do not reuse safety wire. Safety wire is cheap. Safety wire must not be nicked, kinked, or mutilated. This includes the damage that you do during the installation process. If you found that you messed up the safety wire during installation simply cut it off and start over again. Remember, the only way to not have a professional looking safety wire job is to give up and accept mediocrity before you achieve perfection.

Use the appropriate size of safety wire for the job at hand. If you own an airplane you should have at least the three, following, primary sizes of stainless steel safety wire in your toolbox. .020” used for small jobs. Things like electrical cannon plugs, and small accessories. .032 is the most common and widely used safety wire. And .041 for heavy-duty safety wiring used for items like prop bolts, internal engine components, primary flight controls, and exhaust springs on Rotax engines. Figure: 5

The Double Twist Method.

**STEP 1.** Figure: 6. Position the safety wire so that both of the non-twisted strands...
are pulling in the tightening direction. The single wire through the fastener and the loop around the perimeter should always be pulling in the tightening direction. The direction of twist is what determines to which side of the fastener the loop will naturally lie. This means that the first twist will always be a clockwise twist. The twist should begin precisely at the through hole in the fastener. This can be achieved by properly positioning the safety wire pliers approximately 75 to 80° from the through hole in the fastener before pinching the wires to begin the twist. **STEP 2.** Position the safety wire pliers so that the twisting will not extend beyond the next insertion hole. Now twist the safety wire pliers to achieve 6-8 twists per inch. **STEP 3.** Insert the single wire on the top of the twist through the bolt through hole. Wrap the lower wire around the perimeter of the bolt head so that both wires are pulling the bolt in the tightening direction. Now reposition the safety wire pliers to achieve the 75 to 80° angle from the through hole and begin twisting once again. This time, however, you will need to be twisting in a counterclockwise direction which will naturally tend to lay the loop around the perimeter of the bolt down against the base of the bolt head. The first twist will always be clockwise and the last twist will always be counterclockwise. In addition, the twisted wire will always start exactly at an exit hole and always end the twist exactly at the hole of the next fastener. A twisted wire not starting or stopping at an insertion hole is a clue that the technique was in error. **STEP 4.** We now need to cut the wire to the proper length. Professional safety wire pliers typically have a set of rubber jaws located adjacent to the cutter. These jaws clamp the remaining safety wire during the cutting process so that the ends do not get lost inside the aircraft. **STEP 5.** Safety-wire
ends must be bent under and inward toward the part to avoid sharp or projecting ends which might present a safety hazard. AC 43.13-1B (the FAA advisory circular for acceptable methods and practices) recommends a minimum of 4 to 6 complete turns for the cut off end. This is great if the ends do not need to be bent more than a few degrees. However, you will find a much cleaner product when you leave a longer tail when bending a tail 180° back onto itself as in shown in **STEP 6**.

**Tips and Tricks**

First Hole Cheat. On occasion you may have a hole in the head of the faster that seems just impossible to get access for safety wiring. If it is the first fastener in the series to be safety wired we can loosen that fastener, install the safety wire, and then re-torque the fastener into its proper position. This, of course, can only be done on the first fastener, but still, it provides an option with very difficult to reach fasteners.

Hardest first. This is also one of the reasons that we start the safety wire in the most difficult position and work our way out to the easiest access fastener to finish up the final twist.

The “Woop-Dee-Do” Maneuver. This is a great trick for getting that twist tightened up. This involves

*Figure: 6 “Double Twist” safety wire Procedures*
twisting the safety wire pliers 90° by hand while simultaneously making about a 2” circular motion with the tip of the safety wire pliers. This will force the twist to occur at the beginning of the twist near the exit hole rather than at the end of the twist where the wire pliers are located. Use this technique judiciously as overuse can easily over-stress the wire.

Thin Washers: Washers may be used to establish proper alignment. On occasion the safety wire holes just don’t align in such a way that is conducive to proper safety wiring. A good way to introduce a slightly different alignment is the use of AN960 washer with the letter “L” added to dash number (AN960-416L). This indicates light series or thin washer. Often times, simply trying another bolt will permit proper alignment while staying within the specified torque limits. You should stay away from under-torquing or over-torquing to achieve proper alignment.

Safety Wire Pliers. Although it is not necessary to own a pair of safety wire pliers in order to do a professional job of safety wiring, you will find them invaluable if you do much safety wire work. This is where quality is worth the cost. There’s nothing that will make you appreciate a good pair of safety wire pliers more than spending a couple of days working with a cheap pair. The small 6” safety wire pliers are really cute, but really only work well when using .020” safety wire. You will find the larger safety wire pliers much more versatile. A professional pair of safety wire pliers that are reversible and have the rubber insert in the jaw to catch the safety wire can easily run over $100. Worth every penny.

There is a lot of satisfaction with accomplishing any task that results in quality workmanship. Safety wiring skills are no exception. Perhaps a second look at your latest safety wire job is warranted. After all, Safe flying is NO accident!

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