

WINDOW WISDOM, WRAP-UP

BY DENNIS WOLTER, AIR MOD, CINCINNATI, OHIO

AFTER WRITING THE FOURTH—and what I had planned would be the final—installment on windows for the January 2005 issue, I really thought the subject had been thoroughly covered. But in the months following that last article, numerous phone calls with questions have come my way. So I decided to devote some time to the most common

questions involving windows. I will also cover the protection and maintenance of acrylic windows, as well as suggest some effective techniques and processes that can be used to extend the life of your existing windows. If my phone quiets down, I'll assume this article was probably a needed wrap-up to our "Window Wisdom" series.

MOST OF THE QUESTIONS FALL INTO THE FOLLOWING CATEGORIES:

- Standard versus modified installations
- Thickness
- Tinted versus clear
- Framed versus unframed
- Average installation times

STANDARD INSTALLATIONS –

Early nonsloped two-piece windshield with center post

ADVANTAGES

- costs less
- two-piece framed easiest to install
- reduced crack risk with a framed window
- can be enhanced thickness
- retains classic look of stock plane
- structural benefit of center post
- compass is mounted on center post away from radio and panel magnetic interference

DISADVANTAGES

- no removable glareshield
- less impact-resistant due to more acute angle
- less sound reduction due to more acute angle
- visual obstruction of post

MODIFIED INSTALLATIONS –

Sloped single-piece windshield with no center post

ADVANTAGES

- increased speed – sloped is more aerodynamic
- less acute angle more readily deflects impacting object
- removable glareshield for panel access
- as much as 2 db quieter for 3/8" or thicker
- better visibility with no center post

DISADVANTAGES

- 6-8 lbs heavier than nonsloped windshield
- higher cost
- some conversions must be frameless (mounting holes in window's edge increase crack potential)
- additional cost of glareshield/defroster conversion
- glareshield-mounted compass is closer to magnetic interference of radios and panel components

THICKER GLASS

ADVANTAGES

- stronger
- as much as 2 db quieter
- more UV reflection in tinted installations

DISADVANTAGES

- higher cost
- additional weight
 - 3/8" sloped windshield with glareshield and defroster 9 lbs heavier than original 3/16" 2-piece
 - 3/8" pilot & copilot vented side windows approx 4 lbs heavier than 3/16" standard
 - two 1/4" center-opening windows more than 2 lbs heavier than original 1/8" standard
- thicker 3rd or 4th windows don't appreciably reduce sound level
- 1/2" windows can have lensing effect producing peculiar reflections at night
- 1/2" windows can allow inner trim to stand off enough to look bad at window's edge

CLEAR GLASS

ADVANTAGES

- will last longer

DISADVANTAGES

- can allow more heat build-up in cabin, on radios, etc.
- increased UV light contributes to upholstery degradation
- increased UV light can cause eye strain

TINTED GLASS

ADVANTAGES

- reduces UV damage to eyes and interior
- reduces heat build-up in cabin and on avionics
- the right tint can complement aircraft's color scheme

DISADVANTAGES

- UV light degrades tinted glass more quickly

FRAMED WINDOWS

ADVANTAGES

- greatly reduces potential for cracking
- retains original appearance
- gives more pleasing appearance to window's edge and interior trim finish-out

- mounting hardware can be safely removed and reinstalled
- window can be safely removed and reinstalled
- mounts with screws or rivets

DISADVANTAGES

- about 1/2 lb additional weight of frame (admittedly, this isn't tremendous)
- 3/8" and 1/2" milled-edge windows cost more
- can require more fitting and trimming on some installations

UNFRAMED WINDOWS

ADVANTAGES

- no need for costlier milled-edge on 3/8" and 1/2" windows

- less weight without frame
- less trimming time on some installations
- mounting hardware accommodates full thickness of 3/8" or 1/2" windows for some strength enhancement

DISADVANTAGES

- every hole at edge of glass is possible source for a crack
- mounting hardware cannot be disturbed once sealer cures
- often an unsightly edge trim-out without installation of outer trim frame
- the reality is that this is only an option if original retainer frames are not available

INSTALLATION TIMES – Installation times quoted include all inner and outer painting, re-installing the outer frame trim and stress-relieving and polishing all mounting holes on frameless windows. A reality check: The time required to properly install a framed versus an unframed window is approximately the same. Correctly stress-relieving all 117 windshield mounting holes requires about the same amount of time as it takes to clean and fit the original mounting frame.

WINDSHIELD – Stock, standard thickness or 3/8" milled edge two-piece nonsloped framed stock-type 1946-67	12-14 hrs
one-piece nonsloped framed 1968-69	19-22 hrs
one-piece sloped framed 1970 & newer	24 hrs

WINDSHIELDS—CONVERTED, 1/4", 3/8" or 1/2" one-piece Beryl D'Shannon (includes in-house glare-shield upholstery & new defroster)	24 hrs
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Older nonslope windshield converted to factory sloped, using all factory parts to eliminate the use of D'Shannon cuff; looks and is exactly like later factory-sloped installation (requires approx \$800 in Beech factory parts)	
unframed	48 hrs
framed (must acquire a used frame from salvage yard)	50 hrs

Pilot's early-style outward-opening vented window with mounting frame, 3/16", 1/4", 3/8", or 1/2"	11 hrs
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Copilot's early-style framed door window 3/16", 1/4", 3/8" or 1/2"	10 hrs
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Pilot's late-style frameless window with inward-opening vent, includes filling in lower forward corner of outer trim frame	12 hrs
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Copilot's frameless door window - 1/4", 3/8" or 1/2"	10 hrs
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Two center opening windows - 1/4", 3/8" or 1/2"	12 hrs
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Two fixed center windows in early Debonairs	8 hrs
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Two early-style small 3rd windows any thickness	8 hrs
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Two 1961 & newer long 3rd windows any thickness	4 hrs
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A MAJOR CONTRIBUTOR TO THE PREMATURE FAILURE of plexiglas is improper maintenance, cleaning and protection of these acrylic windows. The problem is often as simple as using the wrong type of rag or the wrong polish.

Let's start with what you're trying to protect your windows from—the three big enemies of plexiglas: (1) ultraviolet light (primarily sunlight), (2) surface abrasion that causes scratches and (3) chemical attack.

ULTRAVIOLET LIGHT

Since the most pervasive of the three is ultraviolet light (sunlight), it's important to make every effort to protect your windows from this degrading energy. The most effective tool is a good hangar for your aircraft.

When on a trip, use quality UV-reflective external covers to keep sunlight from getting on the glass to begin with. It is very important that these external covers be made of a breathable nonabrasive, UV-reflective fabric that will not allow moisture to be trapped between the cover and the plexiglas. Trapped moisture can cause crazing on the outer surface of the window.

It is also important that these covers not be made of material that contains any PVCs (polyvinylchloride), specifically, vinyl covers. I know they're waterproof, and we all want to keep water out of the cabin because the doors tend to leak, but condensation will build under the vinyl cover and react with the PVC in the vinyl. In a very short time the result will be severe crazing of even the newest windows. The message here is: Buy a professionally made cover manufactured by a reputable company.

For years we have been using Bruce's Custom Covers (available through Sporty's Pilot Shop). These are easy-to-install, durable UV-reflective covers that fit securely on the aircraft without scratching the paint or flopping about and abrading the windows.

For those of you who live in or visit desert areas where blowing sand is common, the use of exterior covers is not a good idea. No matter how careful you are, sand will work its way under the cover and cause scratches on the windows. In this situation, the only real solution is a hangar.

A lot of owners are justifiably concerned about heat and sun damage to the interior of their airplanes, and choose to use interior sunshields that are temporarily installed on the inner side of the windows when the airplane is parked outside. These are an ideal way to protect the interior and radios when the aircraft must be temporarily stored outside. I do not, however, recommend continuous use of these interior sunshields for airplanes that are permanently stored outside. They do not protect the windows from sunlight, and in fact actually accelerate the ultraviolet degradation of the plexiglas by reflecting a great percentage of the sun's energy back through the plexiglas, giving the window a double whammy.

When plastics manufacturing companies want to test the sun's

ability to damage a clear plastic material, they set up the material on the roof of a building in the sunny southwest and put a very high-quality mirror underneath the test sample. This exposes the plastic to several years' worth of ultraviolet light in a year or less. You are doing the same thing with an interior reflective sunshield.

The point here is, with most things in aviation, you make an intelligent compromise. Use the sunshields when you have to if you're in a desert area with blowing sand. This will protect the interior and radios for the few days the airplane will be stored in this hostile environment.

SURFACE ABRASION

This problem can be easily managed with the right techniques and cleaning materials. Most scratches that we find on acrylic windows were caused by improper cleaning techniques. Correctly done, the cleaning process involves three steps: First, for lack of a better term, is grit removal; second, applying the polish; and third, buffing off the dried polish.

Before you begin polishing a window, make sure there is no grit on it or impregnated in any of the rags you plan to use. To ensure this, I strongly suggest you use only virgin soft cotton rags (T-shirt material) or special synthetic towels made specifically for cleaning acrylic windows. These are available from Sporty's Pilot Shop, LP Aero Plastics and other aircraft supply houses.

Such things as red shop towels are recycled and could contain small metal shavings or other contaminants left over from the previous user. When used with window polishes and cleaners, you will not notice the fine scratches you are putting on the surface of your new window until the polish is buffed off and the damage is done. Many paper towels are made from a pulp that is very abrasive to acrylic surfaces and will, over time, cause what appears to be a haze on the surface of the windows that is actually an intricate pattern of very fine scratches.

Before you start polishing the window, take the aforementioned cleaning rag, dampen it with water and wipe all the grit off the windshield. With that removed, take another fresh towel and use an approved polish that will help remove scratches and leave a protective wax-like finish on the window that aids in resisting future scratches.

Sporty's Pilot Shop sells a complete Windshield Care Kit (product #6182A) for cleaning and polishing acrylic windows. The anti-static windshield cleaner and polisher is ideal for both grit removal and polishing. The polish is thin enough to be used for initially removing the grit with the first towel and polishing with the second.

One spray can and two rags are all you need to clean your windows in the field. The kit also contains another product that I will cover in a minute. LP Aero's Acrylic Polish & Sealant is both a light scratch remover and a protective coating, and dries to a light powder that is then buffed much like car wax. However, it's too thick to be used as an effective grit remover, so you'll have to use water for the first step.

A word of caution: Never use a rag that has been dropped on the ground, hangar floor or even just the wing walk. All it takes is one minuscule piece of grit and it's scratch time. Most window manufacturers caution against using the all-popular Pledge on plexiglas, as it contains some unknown chemistry. (I will admit to having used it in a pinch!)

TREATMENT FOR OLDER WINDOWS

For older windows that have moderate scratches, LP Aero and Sporty's both sell a buffing compound called 210-Plus Plastic Scratch Remover that does a great job of removing some fairly pronounced scratches.

For those of you whose windows have attained "senior" status, with heavy scratching and light crazing, there's a system available known as micro-mesh. This method employs the use of several grades of sandpaper and water in progressive steps, going from rough to fine. Once the scratches are sanded out, a liquid buffing polish is used to restore the acrylic's surface to like-new. Properly done, this system will remove scratches that are deep enough to be felt with your fingernail.

It's important to follow the instructions carefully to avoid creating a visual distortion in the window. If too much material is removed in too small an area, you will end up with a concave surface that will cause distortion. You need to be patient with this system; it works well but takes time.

CRAZING

So much for scratches, what about crazing? I don't think it's a good idea to continue flying with a windshield that has begun to craze. The small cracks that identify crazing are an indication that the acrylic has become brittle. Remember, the windshield must be able to flex in order to deflect an impacting object (bird).

Crazing is a sure sign that the window has lost a substantial amount of its ability to flex. Since side windows are not vulnerable to this impact threat, it's OK to micro-mesh out the crazing and keep these windows in service as long as they don't impair the pilot's vision.

As plexiglas ages, the material itself begins to break down and can take on a milky appearance. Milky is actually a very accurate term to describe the phenomenon, because pouring a few drops of milk in a glass of water produces the same visual effect as the cloudy appearance of a UV-degraded window. This cloudiness goes completely through the plastic. Many people have tried to no avail to polish this out.

If your windows are in this condition, the only fix is replacement. This is especially important in the case of a windshield, because when the glass is cloudy, it's also brittle.

Several times a year I get a phone call from a distraught owner whose new windows have been damaged by a maintenance technician. The best advice I have is ask these people in advance to be careful with your windows. Most often the damage is the result of

working behind the panel during avionics maintenance and installations. Request that the inside of the windshield be covered with 2" wide masking tape. An ounce of prevention is worth a pound of cure.

Also, a mechanic's drop light containing anything more than a 25-watt bulb spells trouble for an acrylic window. Leave a drop light near a window for more than about 10 minutes and you will warp the window. I've replaced two of them at our expense over the past 30 years. (Ouch!) Ask your maintenance facility to use fluorescent shop lights when working near your windows.

CHEMICAL ATTACK

Acrylic plastic is easily damaged by direct contact with or the vapors from certain chemicals such as aviation fuels, some engine cleaning solvents, paint solvents and ammonia. (FYI, ammonia is an active ingredient in Windex, so while it may do a great job at your house, don't even begin to consider it for your airplane.)

It is important to cover the windshield with a plastic tarp when the engine is going to be sprayed down with degreasers. Never remove paint overspray or other tenacious contaminants with lacquer or paint thinners. I know, you'll be able to rub off the offending overspray with the paint thinner, and you're going to say that I'm full of hot air, as you won't see any immediate signs of damage. But over time that chemistry slowly breaks down the surface of the acrylic and shows up months later as crazing. The strongest thing that should be used to remove paint overspray from acrylic windows is isopropyl alcohol and a clean soft rag. Just be persistent; it will do the job.

The "safe versus unsafe" chemistry question can be summed up in this list of the good and the bad stuff to use on or around your acrylic windows.

GOOD STUFF

- 100% mineral spirits
- pure kerosene (don't use jet fuel – it's mixed with other ingredients)
- isopropyl alcohol

BAD STUFF

- denatured alcohol
- organic solvents (methyl-ethyl-ketone, lacquer thinner, ammonia)

The safest bet is to buy only acrylic plastic polish. Read the labels and follow the instructions.

I practice what I preach and have used the techniques described here for 25 years on my own Cessna 172 (sorry about that!). The cabin windows in my airplane are original 1973, and still look almost new.

I should also say that this airplane was stored outside for the first 20 years of its life, so I know the realities of outside storage and plexiglas. What this all adds up to is that your windows can last a long time with proper care; mine are at 32 years and counting.

ONE FINAL NOTE.

For those of you who have (or are considering purchasing) aftermarket inner windows, a bit of advice: These inner windows do perform as advertised, reducing cabin noise levels and heat build-up.

I would definitely, however, recommend the installation of all clear inner windows. Darker aft inner windows will trap heat between the two plexiglas surfaces when the aircraft is parked outside in very hot weather.

We have more than once replaced perfectly good outer windows that had become distorted by that intense heat build-up. Clear inner windows will not trap as much heat between the two windows. If you have the darker inner windows and are based in a hot climate,

I suggest religious use of UV-reflective outer covers.

Here's to blue skies and tailwinds—and great windows to help you enjoy the view!

ABS member Dennis Wolter started Air Mod in 1973 to bring innovative design and high quality renovations to the general aviation market. Dennis, his wife Cynthia and 10 dedicated employees complete about 40 renovations each year at their facility on the east side of Cincinnati. Dennis has a degree in industrial design from the University of Cincinnati. He is an A&P, IA and a 3,000-hour instrument-rated pilot.