TO COVER OR NOT TO COVER...

Potential benefits and problems of windshield covers explored

by A. T. STRETCH / AOPA 55462

■■ In earlier issues of The PILOT this year, a controversy raged in the Vox Pilot Department on the pros and cons of windshield covers. It brought to my mind a human frailty: When you get sick, you listen to a dozen friends who will give you their well-meant opinions as to how you caught it, whatever it is, and how to cure it. It's a sure bet that no two opinions nor cures will ever agree. The free information is usually worth about what it cost.

The subject of windshield covers is of interest to me, as my company, Airtex Products, has manufactured many thousands of windshield and canopy covers during the past 23 years. Experience gained during this time has developed the following facts, which are definitely favorable to properly designed covers made of the right material.

Consultation with H. L. Redfoot, plastics engineer of the Rohm & Haas Company, manufacturers of Plexiglas, the acrylic plastic from which most lightplane windshields are made, verifies the Airtex findings.

Among the "old wives' tales" heard in the field, it is said that moisture will attack windshields when trapped by a cover. A report by Redfoot says: "Of and by itself, water is not harmful to Plexiglas." In other words, moisture will not deteriorate acrylic plastic. It does have a certain moisture absorption factor, but once an equilibrium has been reached, no injurious effect occurs.

The initial absorption of moisture on the surface of the windshield causes an almost imperceptible swelling, resulting in surface compression stresses. This can happen in a rainstorm or when dew forms on the surface, and compression increases until an equilibrium is reached. When drying occurs, tension stresses are set up on the drying surface until an equilibrium is again established. Excess humidity inside a closed airplane that is tied down outside will cause a similar condition, but in reverse. When the weather improves, the acrylic tends to dry faster on the outside surface, setting up tension stresses on the outer surface.

Again quoting Mr. Redfoot: "Compressive stresses are set up when water is entering Plexiglas, and tension stresses occur when it is leaving." Therefore, the less variation and the slower the transition, the better. A windshield cover (or canopy cover) made of a breathe-able material tends to equalize extremes of rapid drying and wetting, thus preventing extremes in stresses during the resultant longer transitional periods.

Normally, acrylics are unaffected, in any permanent sense, by moisture. The danger is during these transitional periods, as the surface under tension stress is more vulnerable to fracture through rough handling, bending and scratching, or from contact with chemicals, such as alcohol. Alcohol absorbs water at a terrific rate and evaporates rapidly, setting up high tension stresses in acrylics.

While acrylic plastics are formulated without the use of softening plasticizers, they do have an affinity for certain plasticizers, such as are used in vinyl plastics for coating fabric. Under elevated temperatures, vinyl plasticizers in coated windshield-cover fabrics will migrate into the windshield, causing milkiness, and possibly crazing. Such a cover does more harm than good.

Unfortunately, the old Army Air Corps came out with a specification for a protective cover material that was made of napped-back cotton fabric, coated with an aluminized vinyl plastic. Its use was discontinued by the Air Corps when it was discovered that plasticizer migration affected the clarity of acrylic windshields. It was also found that the soft-napped inner surface collected grit, defeating the purpose of the soft surface. Besides that, the specifications for the cover did not provide for a mildew-repellent treatment, and mildew occurred when the cover was stored damp.

When vinyl-coated covers are used in wet weather, damp air naturally gets under the cover. When the temperature drops, condensation takes place and the vinyl coating traps the moisture, and the cover remains wet. This, in itself, is not injurious, but the resultant mildew soon rots the cover. When the cover is carried in the aircraft, the odor is objectionable and the generation of mildew spoors is detrimental to upholstery and cotton airplane fabric, as they are ripe for more mildew planted by the spoors.

Another fault with the aluminized vinyl-coated covering was that the reflective surface soon lost its brillance and absorbed heat from the sun, instead of reflecting it. Heat, in itself, within the range likely to be encountered under a white covering, is not injurious to acrylics. Ultraviolet light is the culprit!

Ultraviolet light is destructive to practically all materials. It's in this area where a good windshield cover pays off. Ultraviolet light hastens the aging of acrylics, attacks natural and synthetic fabrics and vinyls and it bleaches colors from upholstery and finishes. Direct sunlight produces heat in the cabin that can reach temperatures of 150 degrees or more on dark-colored vinyl upholstery surfaces. This boils out the plasticizers, causing early brittleness of the vinyl. Cements used in fabricating foam cushions break down under such high temperatures, releasing an acid gas, which attacks the upholstery fabrics.

Two factors are responsible for the mistaken idea that protective covers do more harm than good. One is the fact that a lot of covers have been made from vinyl-coated fabric. Secondly, improper or careless attachment of protective covers has resulted in the scratching of windshields due to the cover flapping in the wind.

What, then, is a suitable material and cover design?

Airtex Products has researched this problem and found that a double-filled unbleached cotton duck, preshrunk and treated for mildew and water repellency, is by far, the best protective fabric for acrylic windshield and window protection. It contains no chemicals nor plasticizers injurious to acrylics and, since cotton is softer than acrylics, it cannot scratch (if the cover is properly designed and secured). Because of the water-repellent treatment, this type of cover sheds water. The fabric is "breathe-able," so that any condensation evaporates through the cover. The mildew-inhibiting treatment discourages the growth of mildew, even if the cover is stored damp. Also, the cotton material tends to bleach whiter under exposure to sunlight, increasing its reflectivity of heat.

The attachment problem is dealt with by carefully tailoring the wind-

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shield covers to closely follow the contour of the windshields. The edges of Airtex's covers, for example, are provided with snap buttons that engage appropriately located snap studs screwed into the plane. Canopy covers that cover the entire cabin are equipped with a nylon draw-cord in the hemmed edges. This snugs down all edges when tension is applied at the four corners of the cover and it prevents flapping or ballooning. The cover is secured with either tie-cords under the fuselage, or with optional adjustable snap tabs. Careful contouring of the cover shape, it can be seen, assures against relative motion.

Reasonable care in handling protective covers is important and cleanliness is desirable. Don't forget that a cover dropped on the ground could pick up grit. The washing of a cover is ill-advised, because the mildew- and water-repellent treatment can be washed out of the fabric. A cover should never, repeat *never*, be put through a washing machine! In time, reduced water repellency can be restored with a spray can of silicone.

Exposed to the elements as they are, no cover will last forever. Under ideal conditions of unpolluted atmosphere, a cover will last many years. Unfortunately, in areas of industrial air pollution, sulphur dioxide combines with moisture, forming a sulphuric acid reaction that destroys most fabrics in as little as a year or two.

To sum up the whole subject, the Rohm & Haas Company engineer concludes that ". . . a cover made of harmless materials will do more good protecting the Plexiglas and the interior of the plane than any possible additional water stresses set up due to using the cover." □

THE AUTHOR

A. T. Stretch (AOPA 55462) started flying in the mid-1930's and he is a former member of the OX-5 Club. He has flown about 20 different types of aircraft and has owned a Luscombe 8A and a Cessna 170B. Though he has logged about 2,000 hours, he says his son is the pilot in the family these days. As a movie cameraman in 1934, Stretch was one of the first to make a newsreel while parachuting from an aircraft. He subsequently worked for a parachute manufacturer and invented the Switlik Chair Chute —"the first static-line-operated parachute for commercial use." His work in the parachute manufacturing field was the start of his interest in aircraft interiors, he reports. The author's firm, Airtex Products, is located in Morrisville, Pa.