

WHAT YOU SHOULD KNOW ABOUT CANOPIES

Once in a while a builder will express dissatisfaction with the type of canopy recommended for the particular airplane he is building. However, more often than not, if he is building from a kit, he will usually go ahead and use the canopy sent him.

Rest assured, the canopy design selected by the aircraft designer is one he feels to be the best all around installation.

Without a doubt, the designer has agonized over the options he had available. He most certainly would have considered the overall appearance, head room, ease of installation, safety of the installation in regards to canopy security, as well as the ease of entry and egress to and from the cockpit.

Many builders who think they can improve the designed canopy installation are usually motivated by some impulsive personal whim. More often than not, that builder will not have considered a number of factors already evaluated by the aircraft designer in the first place.

This is not to infer that only one type or style of canopy is the best for a particular airplane . . . would that the selection of a canopy design be that simple.

I'm sure you realize that installing a canopy you can easily open and close can be a problem . . . for that matter, it always has been a problem for builders.

It is not surprising, therefore, that we see so many differences in canopy shapes and in canopy installations.

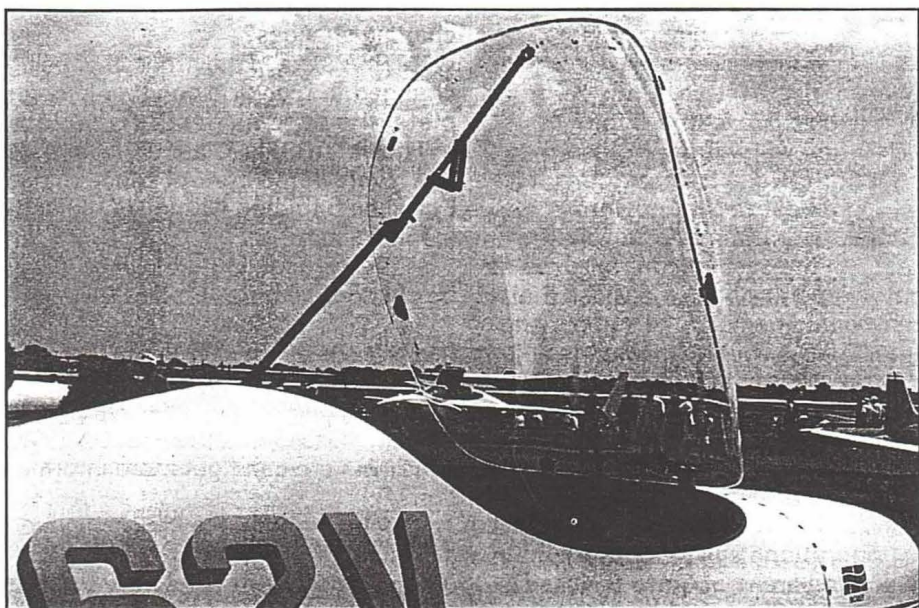
Canopies In General

Canopies can be divided into two basic categories.

1. The one-piece bubble canopy installation.
2. The separate windshield/canopy installation.

The spin-off from these two basic types includes a variety of installations that are better recognized by the method used to attach the canopy to the aircraft structure. This, in turn, determines the way the canopy is opened, closed and secured.

Regardless of the type canopy you install, the most important consideration is that your canopy will allow you sufficient headroom. This is more important than striving for that elu-



Would you believe it? A large front hinged canopy without a frame . . . on a 300 mph airplane? It's all in the design. I understand 6 latches are used to secure it in the closed position.

sive long, low, streamlined look.

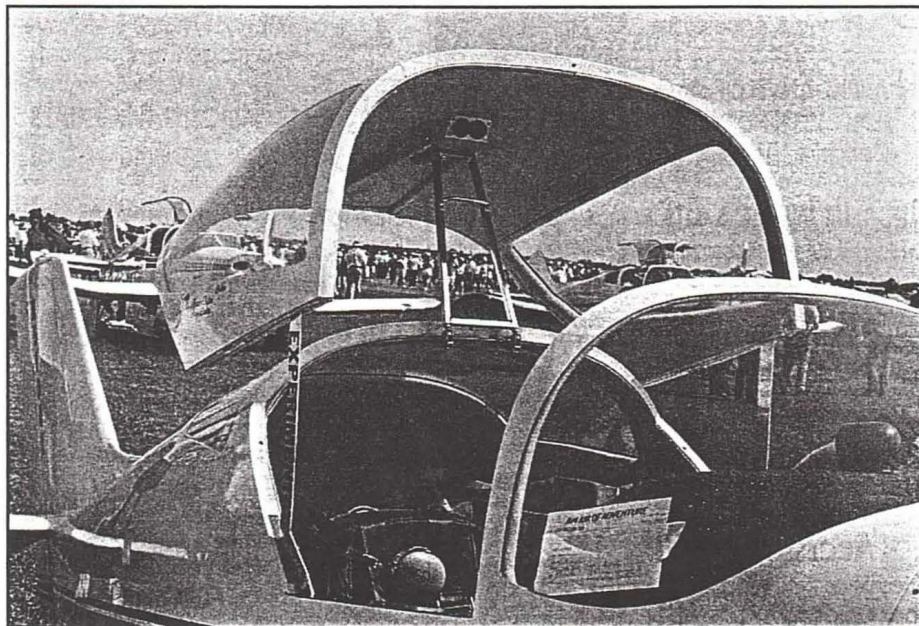
Most large canopies are vacuum formed, in an oven, of 3/16" plexiglass although some windshield sections for the faster homebuilts may be as thick as 1/2" to provide additional safety and to reduce wind noise.

Unfortunately, many large vacuum molded canopies do not have the excellent optics that most smaller free-formed vacuum drawn bubble canopies have. These minor optical distortions are most often

picked up during the vacuum forming from a poorly prepared mold.

The localized distortions can be very irritating to a few pilots, especially when a blemish happens to be within the pilot's normal line of sight.

Fortunately, such distortions are, ordinarily, confined to a few very small localized areas. They can, therefore, be dressed down and removed using the well-known Micromesh plexiglass polishing kit (obtainable from most any aircraft supply source).



This canopy swings up and backward on stilt-like supports. The idea is clever but too radical for most builders. That is a lot of canopy weight to raise and support.

A Separate Windshield?

A canopy installation that utilizes a separate windshield is, by far, the safest type of installation because the windshield also serves as a turnover structure. Furthermore, in the event the canopy accidentally comes open, or blows away, the permanently installed windshield will protect the pilot from the blinding slipstream.

On the minus side, a windshield frame does obstruct the pilot's vision to a minor degree.

Some builders may consider a separate windshield installation to be a bit more difficult to fit and install than a single piece canopy, but this is not always the case.

The Front Hinged Tilt-Up Canopy

A one-piece bubble canopy is the most aerodynamically efficient installation you can make for your airplane. However, this efficiency may be diminished by the time you have figured out the best way to attach it securely and yet ensure easy access to the cockpit.

One way to do this is by hinging the front end of the canopy so that the aft end of the canopy can be raised enough to provide the needed cockpit access.

Tilt-up canopies are commonly installed on two seater side-by-side aircraft such as the Dragonfly, Q200, RV-6, Swearingen SX300 and the Venture, to name a few.

The visibility in all directions from inside a one-piece tilt-up canopy is superb.

Some builders may find this one type of canopy easier to install than a sliding canopy because there is no need to cut, fit and match a separate windshield to the canopy frame.

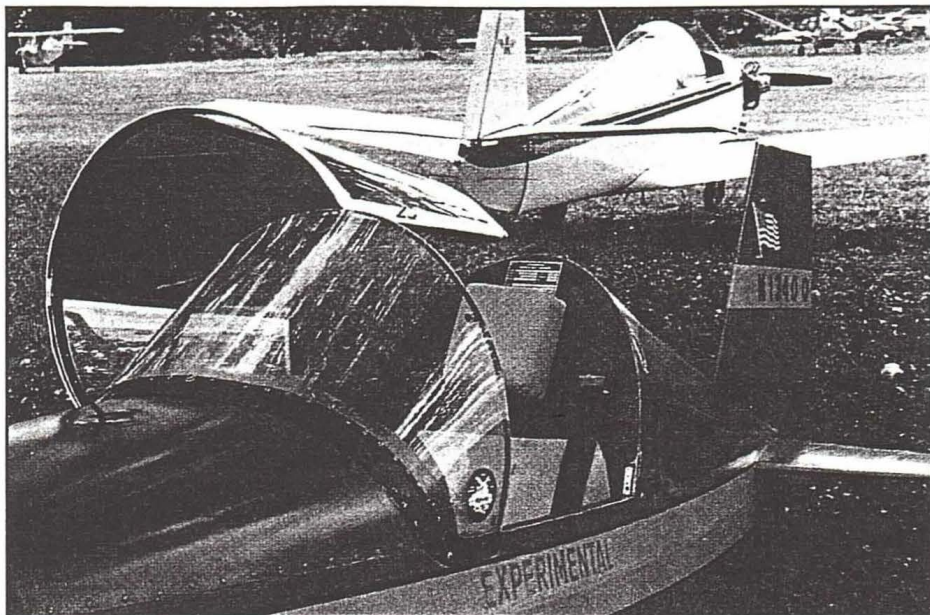
However, fitting and aligning a huge one-piece plexiglass bubble to the fuselage, while installing the support hinges is not exactly a picnic either . . . by all means, try to get some help.

The tilt-up canopy has a couple of drawbacks peculiar to its installation.

The forward hinged position is rather difficult to install so that it doesn't leak.

Obviously, a leaky canopy is pretty hard to put up with. Even if your airplane is always hangared and you don't fly in rain, sooner or later you will wash it and get water inside the cockpit . . . and that can be just as bad for your radios.

A tilt-up canopy, like a few other designs, can be readily hinged so



Canopy installation on a single seater is a simple matter with a variety of options available. One of the simplest is the fixed windshield and the side-hinged canopy.

that the canopy can be jettisoned in an emergency. However . . . it is most unlikely that anyone would dare jettison such a large canopy (or even a small one) in flight because:

1. Most of us don't wear a 'chute.
2. Cutting that big thing loose from its hinges in flight will almost certainly destroy the entire tail assembly as it leaves the aircraft. Even if it didn't the pilot would be left with no protection from the high velocity slipstream.

A one-piece tilt-up canopy is an awesome sight when it is opened. This makes it very vulnerable to damage from winds and from the propwash churned up by unmanned pilots.

These canopies can also be diffi-

cult to raise in a strong wind.

In flight, that huge bubble seems to magnify the sun's rays, turning the cockpit into a hot box.

On the other hand, it is great in the winter time because on sunny days no cabin heat is needed . . . if you don't mind the cold feet.

Installing an automotive type compression strut on each side of a tilt-up canopy will stabilize it considerably and reduce its vulnerability to the effects of wind gusts while open.

The Rear Hinged Tilt-Up Canopy

There are very few examples of the rear hinged military style tilt-up canopy among homebuilts. However, this type of installation is



This huge side-hinged canopy was economically fabricated using flat plexiglass panels. However, the Dyke Delta wing imposed unusual access problems which the builder overcame with the aid of a step ladder and a fuselage panel opening.

an ideal solution for anyone building an amphibian. This is because a rear hinged tilt-up canopy, when fully opened, enables the pilot to handle the docking chores more easily. Typical examples of the rear hinged tilt-up canopy may be seen on the Osprey 2 and Seahawker amphibians.

Just about everything said about the front hinged canopy applies to the rear hinged installations.

The most important consideration for this type of installation is that the canopy latching system be positive and foolproof. The canopy must seal tightly so that no air can enter regardless of the airspeed.

Can you imagine what could happen to that canopy on its first test flight if the front edge wasn't close fitting and latched tightly to the fuselage?

The Side-Hinged Canopies

This type of canopy installation is the most popular, by far, with builders who are building single seater aircraft or two seater tandem designs.

The side-hinged canopies are quite versatile in that they may be installed as a one-piece unit or with a separate windshield.

The one-piece canopy does result in a more rigid installation although it, like the tilt-up installation previously described, harbors a greater risk to the pilot in the event the canopy becomes unlatched in flight.

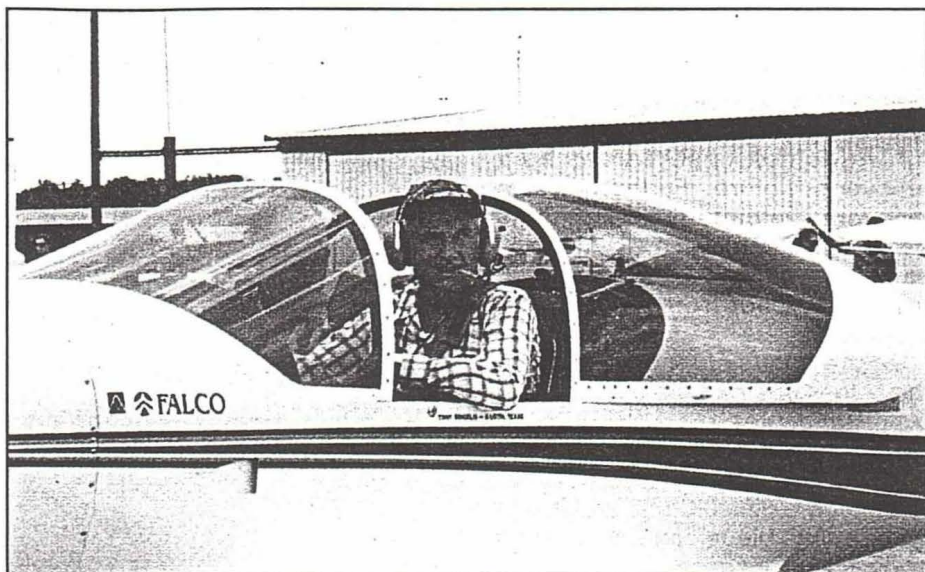
If the fuselage sides are straight in the area where the canopy is to be mounted, the installation is simple to make using a long piano hinge as the means of attachment.

For access to the cockpit it will be necessary to restrain the canopy from swinging open too far, otherwise the hinge might be torn loose or the canopy plexiglass may be damaged.

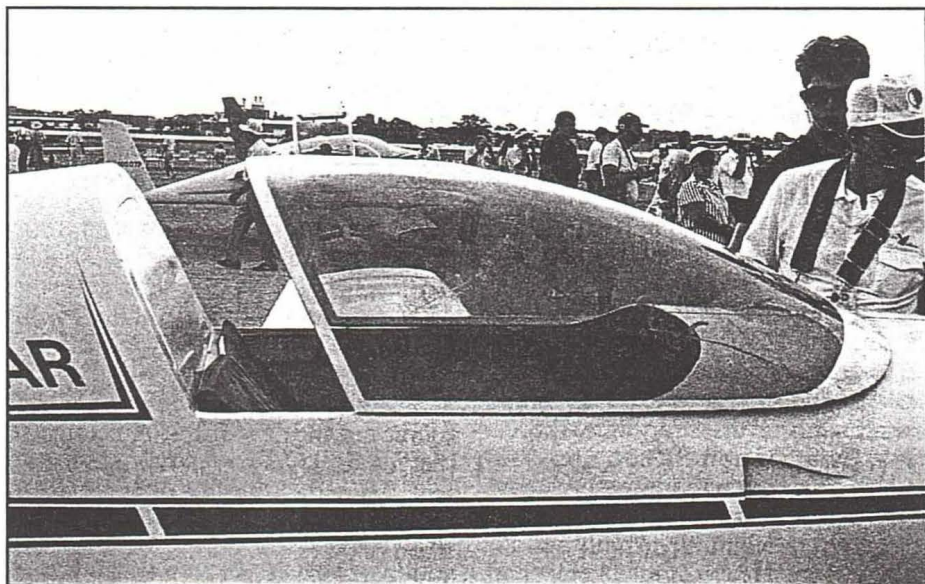
A simple restraining cord, or a light chain, is not a satisfactory way to restrain the canopy in its open position as wind gusts may cause the canopy to bounce and self destruct. Some type of a rigid strut or a spring loaded compression strut would be a better solution.

This same side-hinged type of installation is not generally as effective for side-by-side aircraft.

The big wide canopy would have to be attached to an equally wide fuselage where there will undoubtedly be considerable curvature. This would make the use of a long piano hinge impossible.



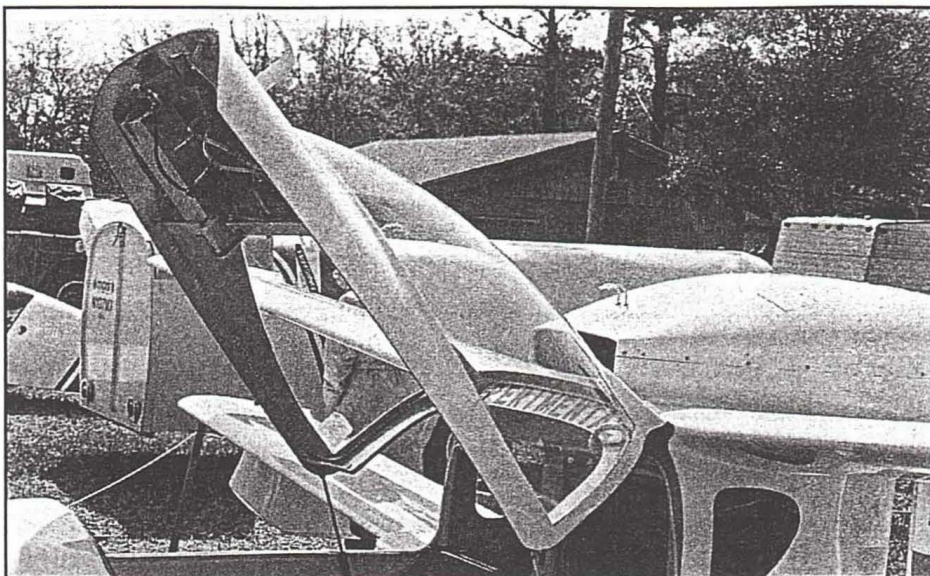
A sliding canopy is the ultimate experience for the macho pilot. Imagine yourself taxiing up to the crowded parking area with the canopy open and your elbow nonchalantly propped in the opening? Machismo!



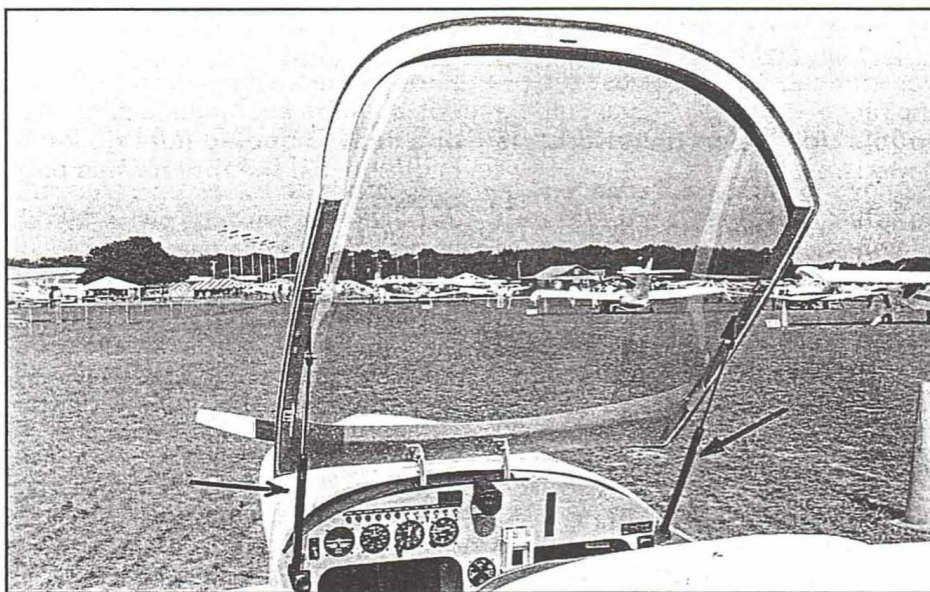
One of the best forward sliding canopy designs may be seen on any Pulsar.



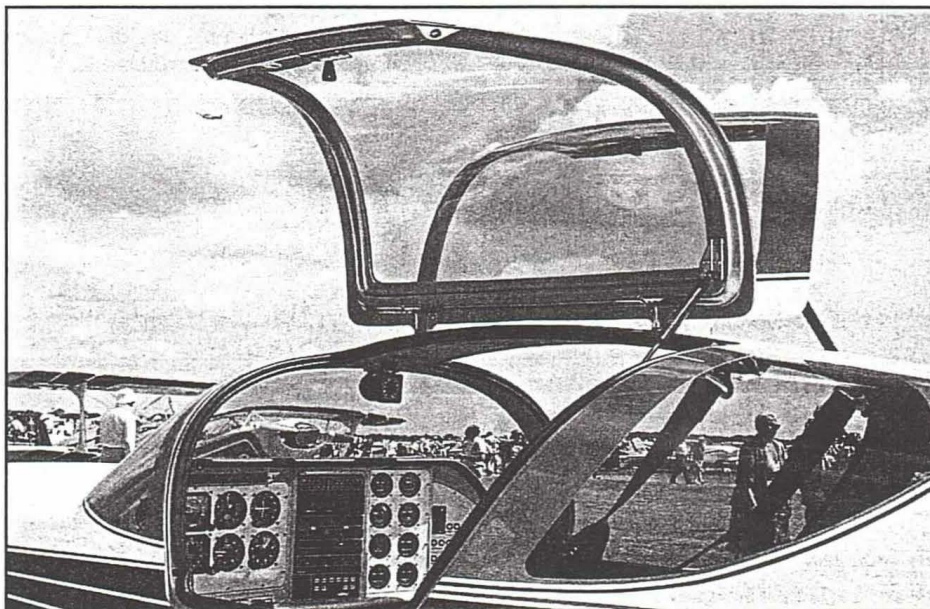
Here's a clever solution for a large tandem canopy to make it easier to handle. Simply make the front portion a flip-up installation and the aft canopy a flip-over, side hinged arrangement.



This rear hinged flip-up canopy is ideally suited for an amphibian as it permits easier docking.



The large front hinged flip-up canopies are awesome when open and need the additional support that can be provided by automotive type tailgate struts. This type of canopy should never be left unattended when open.



Gull-winged hatches are popular fixtures on some high performance aircraft. The two point hinge design is critical. The frame and plexiglass must fit the opening perfectly to be assured of a leak proof installation.

The mounting of the canopy would then entail using two separate extra strong hinges to accommodate the curvature of the canopy and fuselage. This, in turn, would present a greater challenge for securing the large canopy in its open position.

One advantage to any side opening canopy installation is that entry to the cockpit must be from one side only. That means a protective wing walk need only be installed on one side.

The Sliding Canopy

This canopy is seen most frequently on Falcos, T-18s and is beginning to appear on RV-6s and RV-6As. The best example of a sliding canopy installation on certificated aircraft is that used on the popular 4-place Grumman Tiger/Cougar.

Homebuilt aircraft, especially low wing, are not the easiest to get in and out of. However, with a sliding canopy access to the cockpit is about as easy as it gets because you simply step into it and lower yourself into your seat.

Although some sliding canopy installations are not designed to be opened in flight, they certainly can be slid open immediately after landing to provide plenty of cooling air while taxiing on a hot day.

In the event of an electrical fire with smoke in the cockpit, sliding the canopy open a bit would at least give you some fresh air to breathe.

Actually, taking off with a sliding canopy unlatched is not as serious a matter as it is with other types of canopy installations. The reason being that a sliding canopy will tend to slide shut by itself during takeoff. Actually, most sliding canopies are difficult to pull open the first few inches in flight because of the aerodynamic shape of the canopy.

The worst thing said about sliding canopies is that when it is raining the cockpit seats will get wet. Well, wouldn't this also be true of any low wing aircraft regardless of the way the canopy opens?

Another nice feature of the sliding canopy is that it may be quickly removed to provide unlimited access to the cockpit for maintenance. For example, a sliding canopy on the RV-6/RV-6A can be removed by simply taking out two bolts and sliding the canopy back and lifting it off its rear track. When removed, you can also clean and polish the plexiglass easily, inside and out, without having to work on it upside down.

The Forward Sliding Canopy

The installations, like those on the Pulsar and the various Zenith models, slide forward on tracks fitted to the fuselage.

Other aircraft like the Lancairs utilize parallel struts which permit the canopy to be raised up and swung forward.

In either event, the forward sliding canopies, like those tilt-up aft hinged ones, do require a very good fitting positive latching system to keep the wind and wind noise from getting under the canopy and into the cockpit.

Canopy Door Installations

Canopy doors are often not as large as one would like them to be. This may make entry into the cockpit a bit more restrictive than it is with other installations.

Making and installing two separate beautifully contoured doors, as installed in the original Emeraudes, demands considerable patience and skill.

Having separate canopy doors is as much a nuisance as it is a convenience. This means that both doors would have to be closed and secured for flight.

In flight, the bulged plexiglass windows, like other bubble installations, produce "lift" that tends to suck the doors open. Special latches must, therefore, be devised to cure this tendency.

On the ground, especially at fly-ins, there is the problem of locking two doors to keep out unwelcome "investigators."

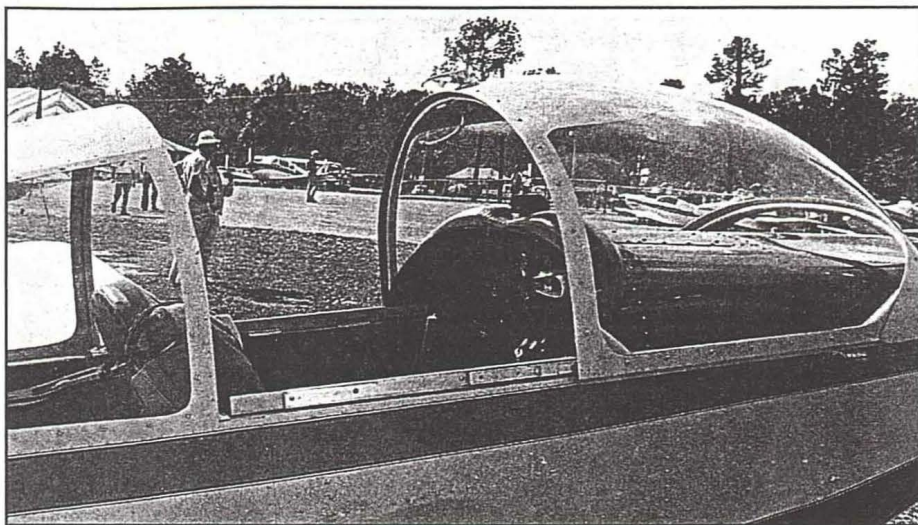
And last but not the least important, two doors are quite difficult to weatherstrip effectively.

On rereading this, I can only conclude that installing two separate doors in a canopy may be the least desirable option of all.

Gull Wing Hatches

Gull wing hatches are very much like having two doors that are mounted higher up on the canopy. If they are large enough and open wide enough access to the cockpit is fairly good . . . otherwise, a bit of squirming will be required.

When a separate hatch is to be installed on each side of the canopy, a sufficiently wide space must be provided between the two so that both hatches may be opened fully at the same time. You cannot use a one-piece piano hinge to mount the



A forward sliding canopy or one that opens up front requires positive latches to ensure that the wind will not get under it and force it open in flight.

hatch because the canopy roof is contoured with a definite curvature.

On the other hand, if the roof line was straight, you could install a piano hinge - but the effect would be double ugly when the aircraft is viewed from the side.

Weatherstripping

Weatherstripping should always be installed in a single length to force water to flow along its edges and not take a short cut into the cockpit around the hinges.

Remember, weatherstripping will also keep out wind noise.

Emergency Egress

In the event of an accident where the airplane flips over, most canopies and hatches will entrap the occupants in the aircraft because the canopy cannot be opened.

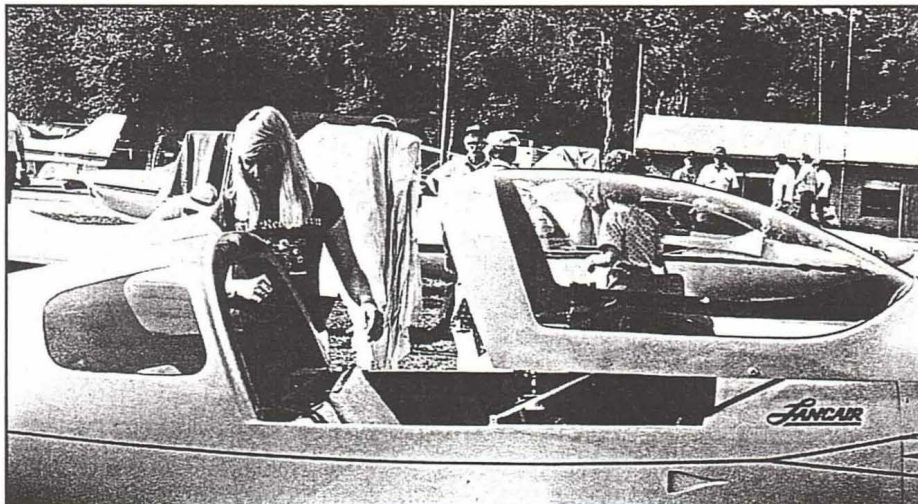
The occupants will remain trapped under the airplane until res-

cued or until the pilot, using some kind of emergency tool, can smash the plexiglass or chip his way through the fuselage skin. A small combination axe/hammer/crowbar or a heavy handled hunting knife might be just the tool for this purpose.

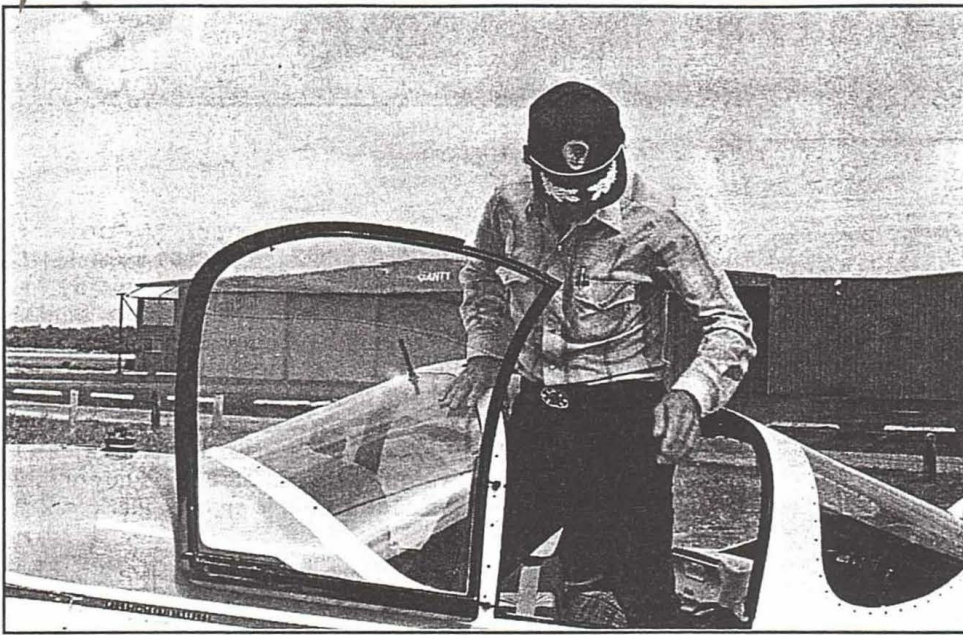
For the Sake of Creature Comfort

I believe all canopies, especially the larger bubble type, should have a sun screen of some sort. This may be in the form of a painted center strip or a plastic sun shade stuck to the canopy roof.

Painting a 12" wide center strip on the canopy is an effective way to block out some of the hot sun. This painting may be done on the outside or the inside of the canopy. Painting the canopy on the inside is a very effective and attractive way to do it. Try it and see. However, since paint is not transparent, your vision will be completely blocked in that area.



Lancair's up and over forward sliding canopy is effective and practical although some builders admit that access to the cockpit is a bit difficult for some not so svelte pilots.



The canopy doors as used in the early model Emeraude designs were very practical. They afforded easy access to the cockpit and could be jettisoned if necessary.

A better way, I believe, is with the installation of a perforated black vinyl Truck Blackout Window Screen. It is removable and reusable. No adhesive is required as it clings to the static charged canopy without help. Don't confuse this sun screen with that ugly plastic stuff that wrinkles when you try to get it to stay on curved surfaces.

The Truck Blackout Window Screen will conform to your canopy curvature quite well. Simply cut it to size and smooth it in place. If too much of your vision is obscured in a banked turn, simply trim off a bit more with a pair of scissors. (It's called Truck Blackout Window Screen and is sold by Wal-Mart and Western Auto.)

Ventilation

The same kind of inflight ventilation system may be installed regardless of the type of canopy installation you have.

Most of these ventilators don't work too well on the ground because their effectiveness depends on air-speed in most cases. It is therefore necessary to provide for some extra ventilation while on the ground.

Obviously, an opened sliding canopy provides the best ventilation on the ground - but what about the other canopies?

The usual solution is to provide an intermediate latching position that holds the canopy partially open while

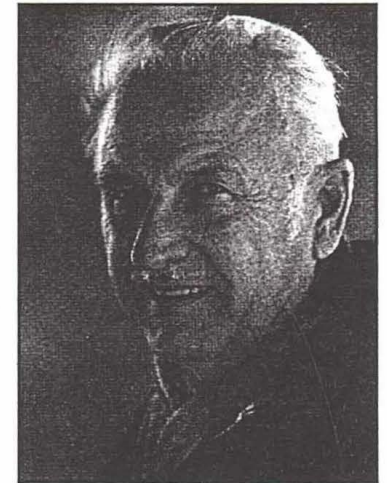
taxiing. This, of course, calls for a little more complexity in the installation.

In Summary

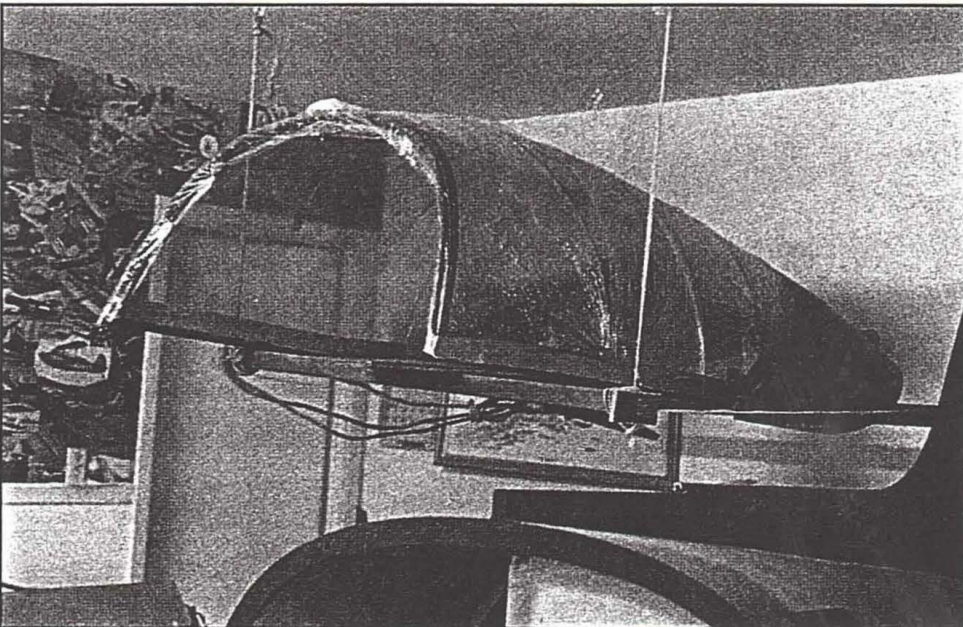
The ideal canopy will have plenty of headroom. It will have good optics. The canopy will be installed so that entry to and exit from the cockpit can be made easily and with dignity.

The canopy should be leakproof and easy to weatherstrip effectively.

Finally, security in flight must be assured and a secondary fail-safe latching system is highly recommended.



If you wish to contact the author of this column for additional information, please send a SASE to Tony Bingelis, 8509 Greenflint Ln., Austin, TX 78759.



To keep your canopy out of harms way during construction consider suspending it as shown. Because a large canopy will take up most of your bench space it will be constantly exposed to possible damage.

BOOKS BY TONY

The following books by Tony Bingelis are available from the EAA Aviation Foundation, EAA Aviation Center, Box 3086, Oshkosh, WI 54903-3086, 1-800/843-3612, in WI 1-800/236-4800, in Canada 414/426-4800. Major credit cards accepted.

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