

# CONTROL GAP SEALING

Tom Knauff

Sealing gaps where air can flow from a high pressure to a low pressure area during flight is very important for aircraft performance improvement.

The bottom surface of the wing is a high pressure area, and the top surface is an area of reduced air pressure. An open gap such as an aileron hinge line allows the air to flow from the bottom of the wing, through the gap and out the top side. If you could see this airflow, you might see a fountain of air all along the gap. This disrupts the flow of air over the top of the wing, and acts very much like an open dive brake. Since the ailerons are several feet long, this affects the performance of the glider very much.

Simply taping the gap with any tape will improve the performance greatly, and make the control work more efficiently.

There are different types of tape available. Many tapes shrink over a period of time, and should not be used. The shrinking is very slow, taking several weeks or even months to make a negative effect. The pilot may not notice the controls are no longer able to be deflected the full amount because of the tape that has shrunk. When preflighting your glider, be sure to notice if all of the controls are able to move the full deflection in each direction.

I know very little about the different materials used to manufacture the different tapes. Some shrink when exposed to heat, others shrink because of the ultra-violet light in sunlight. Many tapes that are com-

monly used for wing root sealing should never be used to seal control surfaces.

Cloth tape that is similar to medical tape has been used by the sailplane manufacturers for many years. This seems to work well, with little deterioration due to the elements. One problem is the tape has a tendency to develop a fold, or dimple that sucks up due to the airflow, and makes a fence, or spoiler several inches long and perhaps 3 or 4 millimeters high.

Many pilots now use a special tape to seal the gap, then place a stiff, curved mylar strip on top of the cloth tape to prevent this dimple from forming.

Modern sailplanes, such as Schempp-Hirth's Discus have a shallow recess on the wing forward of the aileron to allow the tape to be flush with the top of the wing once it is installed. You can use a router to make this same recess, however, I doubt if the drag from the leading edge of the tape is measurable. (The airflow is no longer laminar at this point.) You probably can better improve your own performance by spending this time improving your flying skills, or gaining more knowledge from reading.

To install this type of seal, first thoroughly clean the area where the seal will be installed. (Refer to Peter Masak's excellent article in the July/August 1988 issue of *Soaring Pilot Magazine*. Ed.) All wax residue must be removed so the glue that holds the tape will stick. After cleaning, you may want to sand with 400 grit sandpaper to provide a better

sticking surface. I use a rubber eraser for this job. It cleans and roughens the surface, and the bits of rubber wipe off easily.

To prevent cleaning and sanding an area larger than necessary, mark where the tape will be installed, and then mask the narrow area with masking tape before sanding.

If the tape you use to seal the gap doesn't have its own glue, you will have to place the glue (contact cement works well) on the surfaces before the tape. Most of us use self-sticking tape.

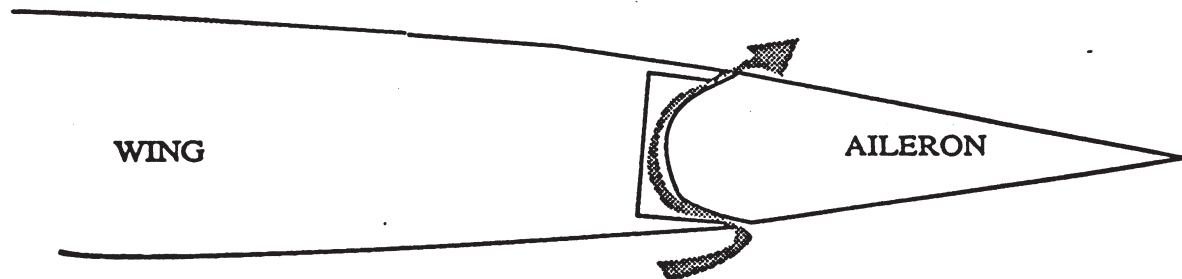
Mylar strips are available in different widths. It is available pre-curved, or flat. You can do a reasonable job of curving the flat mylar by squeezing it as you pull it between your finger and thumb. The curved mylar is more expensive, but it has a precise curve set into it.

The mylar is installed with a special transfer tape. Transfer tape is the sticky stuff with a paper, or plastic backing. You lay the tape on the surface, then peel off the backing, leaving only the adhesive. It is not the same as double sided sticky tape. A German company makes a superior transfer tape.

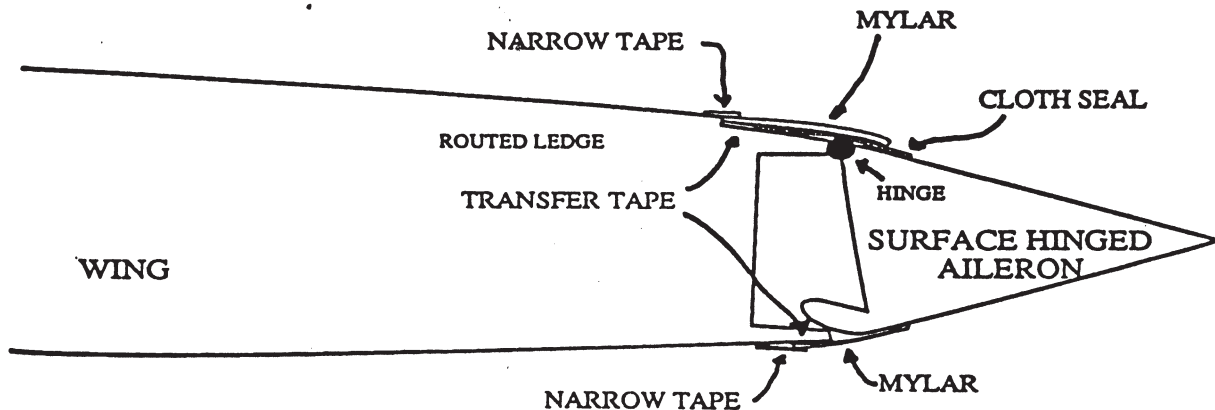
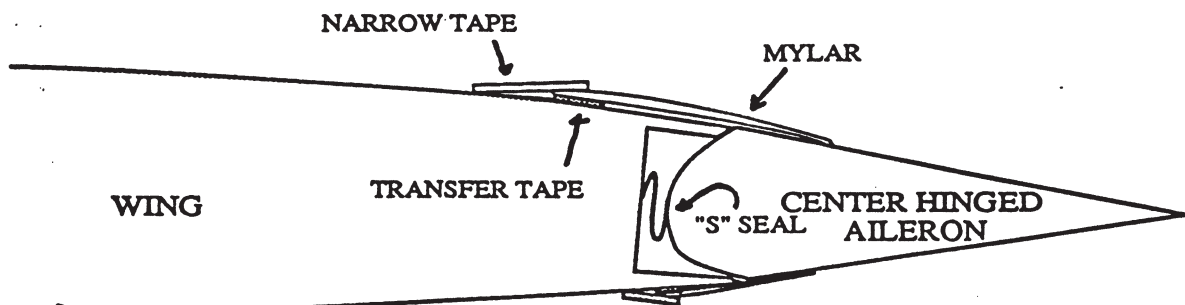
The transfer tape is installed just in front of the gap seal tape. Then, the mylar is laid on top of the transfer tape, so it overlaps the gap seal. The mylar prevents the airflow from sucking the gap seal up into the airflow, forming those drag producing dimples.

The leading edge of the mylar is subject to damage when cleaning

# Gaps



AIRFLOW ON AN UNSEALED CONTROL SURFACE



OBVIOUSLY NOT TO SCALE

## Gaps

the glider, and dirt tends to work its way under the edge of the mylar, lifting the edge, and making it unsightly. A narrow strip of white tape prevents this problem, and finishes the job.

Many control surfaces have an internal seal rather than the external cloth tape seal across a simple hinge line. The elevator, rudder, and many ailerons and flaps are sealed in this manner.

This kind of control surface can benefit from the mylar seal too. The mylar allows the airflow to smoothly cross the gap. In this case, a narrow strip of mylar is installed as described.

Mylar strips may be used on rudder and elevator joints too.



### SPECIAL SEALING TAPES FROM SCHEMPP-HIRTH

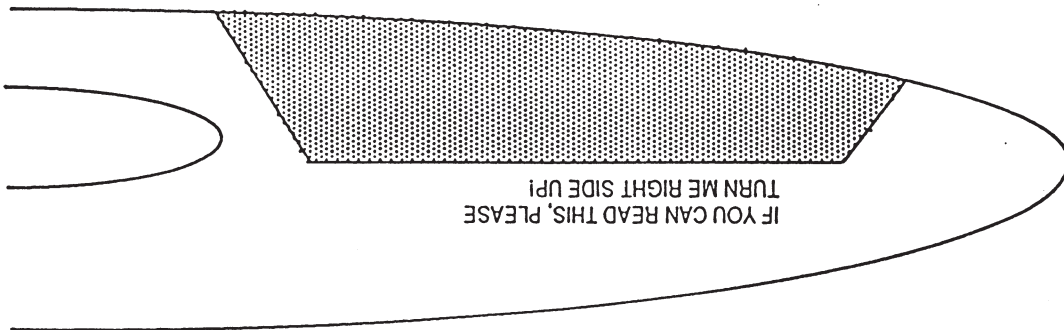
25 mm White cloth tape	<del>\$22.50</del>	<b>NEW PRICES</b>
38 mm White cloth tape	<del>\$28.75</del>	
50 mm White cloth tape	<del>\$42.00</del>	
Dimpled turbulator tape	<del>\$24.50</del>	
60° Zig Zag turbulator tape	<del>\$55.00 (14 meters)</del>	
22 mm Mylar pre-curved strip	<del>\$30.00 (\$2.00/meter)</del>	
30 mm Mylar pre-curved strip	<del>\$35.00 (\$3.00/meter)</del>	
12 mm White plastic tape	<del>\$ 8.50</del>	
12 mm Transfer tape	<del>\$12.50 (50 meters)</del>	
10 mm V seal tape	<del>\$12.50 (10 meters)</del>	

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# Gap Seals

*Michel Piers,  
Netherlands*

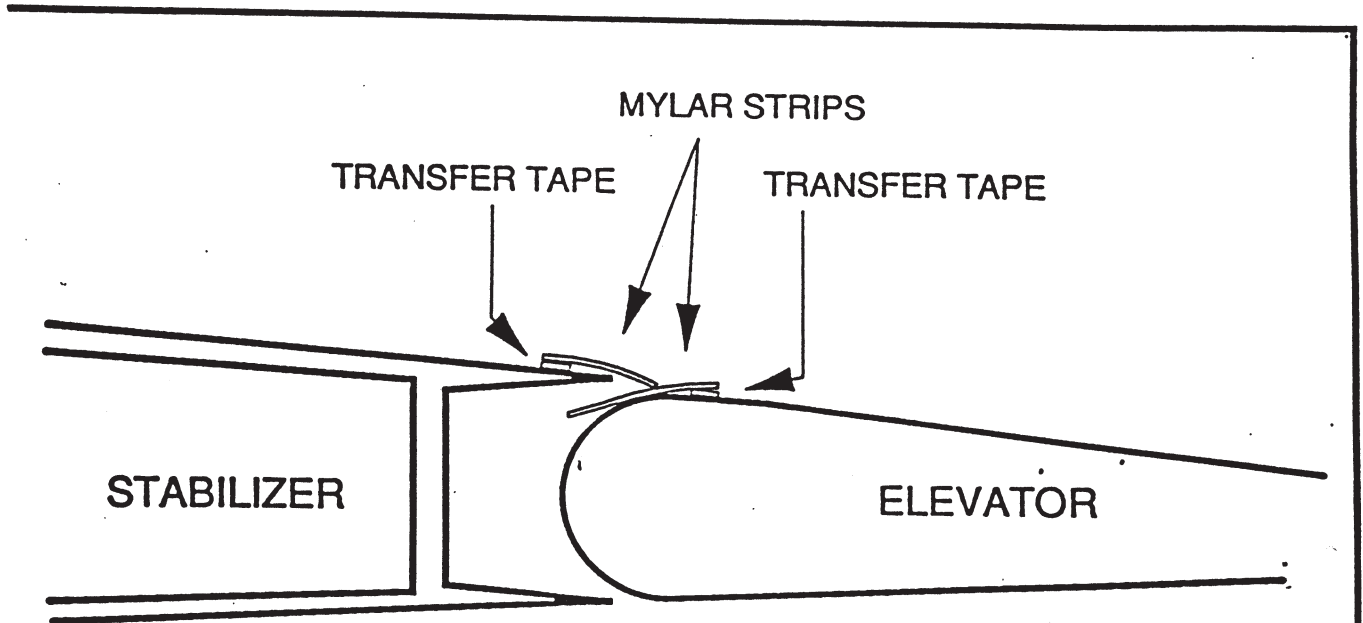


**SELF MADE GAP SEALS ..... SMALL EFFORT, BIG RISK!**

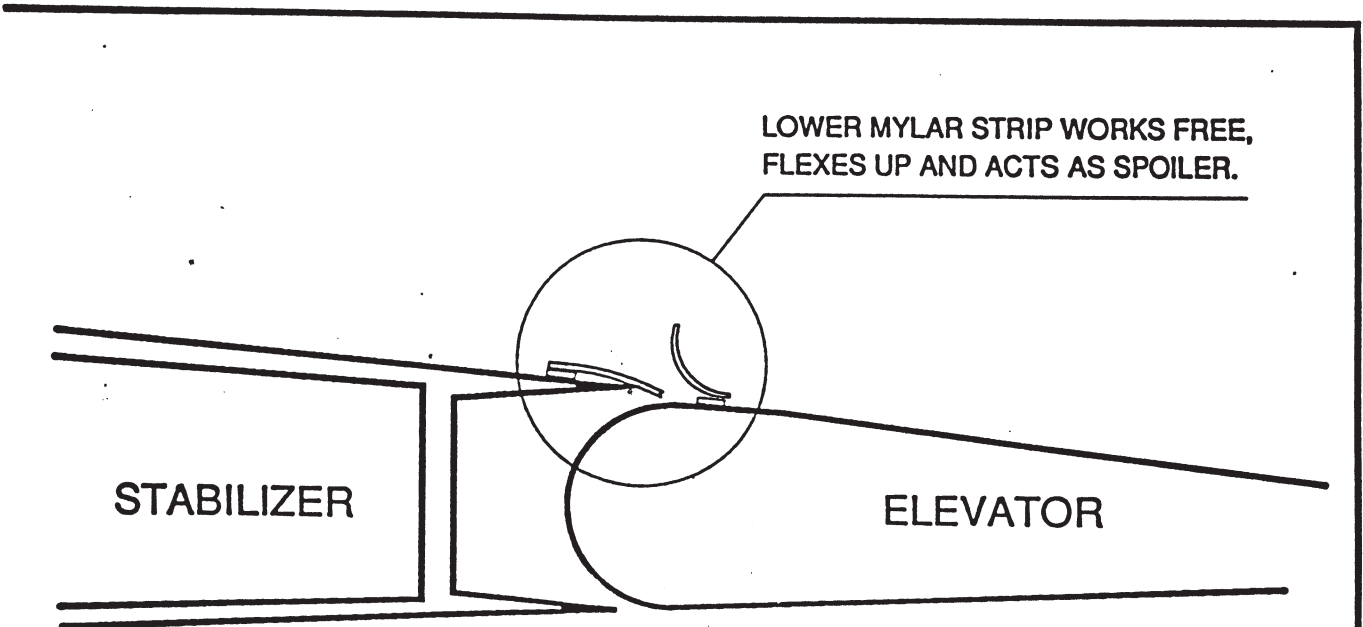
*This article was received just in time to make this issue. It is extremely timely, as most of you are thinking about things to do this winter. Before you embark on ambitious plans for your ship this winter, read this! Although this article refers to the current situation overseas, please re-read my warning beginning on the bottom of page 5 of the July/August '88 issue. Also, re read Dan Morris's excellent articles on maintenance regulations in this country, and pay particular attention to his article in our next issue. Ed.*

*Michel Piers holds a BS in Aeronautical Engineering. He is an experienced glider pilot, and is also licensed to fly power planes. He completed courses on Human Factors, Aircraft Accident Investigation and System Safety at the University of Southern California as well as at the Royal Institute of Technology of Stockholm. He is currently pursuing an M.S. degree in Psychology at the University of Amsterdam.*

Gap seals



DO NOT APPLY THIS GAP SEALING METHOD !



ACCIDENT SITUATION

## Gap seals

The majority of people suffering from the compulsive disorder called soaring want the best performance possible from their precious ship. No trouble is too much, every minute detail is attended to in order to prepare the fiberglass mistress for that record-breaking triangle they've been pursuing relentlessly since they soloed. One important aspect in this realm is the sealing of control gaps (refer to articles in August 88 and January 89 issues of *Soaring Pilot Magazine*). Since tape is to glider pilots what shoelaces are to Carl Lewis (according to those who didn't complete the task after forgetting to tape their wings), most custom gap seals are an ingenious tape-and-mylar miracle.

A method frequently used in situations where relatively large control deflections are possible, or in the case of controls with a low hinge line, utilizes two strips of mylar (figure 1). One strip is attached to the wing (or horizontal, or vertical stabilizer), the other is attached to the control surface or flap, as shown in the figure. The main advantage of this method over the single strip seal is that it keeps the gap closed over a large range of control deflections. Also, there is no tendency for air to leak as a result of the lifting up of the wing strip due to the pressure differential over the seal.

The performance gains claimed by advocates of this method are doubtful. Airfoils are inefficient at large deflections anyway, and large deflections are applied only during a very limited portion of the flight. Also, mylar seems stiff enough to keep the gap closed, even if only one strip is used.

Far more important, however, is a safety problem inherent to the double-strip sealing.

Recently, a Dutch Janus B took off on tow in Europe. Some time after take-off, the pilot of the glider experienced serious pitch control problems and released immediately. The Janus returned to the strip in a relatively normal fashion, but on final approach, pitch control was lost again. As a result, the glider stalled and crashed. The pilot sustained back injuries, while the glider was heavily damaged.

What happened? The horizontal tail of this aircraft had a gap seal, as shown in figure 1, which was installed by the owners. The accident investigation revealed that during the tow, the lower strip (attached to the elevator) worked free from under the upper strip (attached to the horizontal stabilizer), and flexed up into the airflow over the tail (figure 2). Due to the stiffness of the mylar strip, it maintained a position almost perpendicular to the airfoil, thus acting as a highly effective spoiler. This rendered the horizontal tail ineffective, as a result of which, the Janus pitched up, stalled and crashed. The failure of the gap sealing was possibly due to a combination of poor workmanship at the tips, aging of the mylar strips, material stiffness, turbulence induced deformation, turbulence effects, etc. A mandatory airworthiness directive was issued immediately that required all gap seals to be brought back to the configuration as installed by the manufacturer. Non-factory gap seals had to be removed before the next flight,

and are now prohibited in the Netherlands.

The fact that this particular type of seal should not be used is obvious from the above. Owners of gliders should be prudent about installing gap seals not furnished by the factory. In addition to problems described, flap seals installed by the manufacturer may, for example, be essential to flutter prevention. The owner is, in many cases, not in a position to judge how a home-made modification may influence the airworthiness of his ship, and is prohibited by law from carrying out such unauthorized modifications in the Netherlands.



NEWS FROM JAPAN indicates that they have 100 clubs - 3000 pilots - 250 sailplanes - 7 tugs - and 7 gliding sites. The bulk of the activity is on the island of Hokkaido.