TISSUE OVER MYLAR
By the New England Wakefield Group

Tissue over Mylar ---- Tissue over Mylar is a method of applying a composite covering to the open framework of models. Its attraction is that the shortcomings of using either mylar or tissue alone are overcome. First you cover the airframe with mylar, tighten it, and finally use thin dope to attach some tissue on top of the Mylar.

Advantages of Tissue with Mylar ---- The big difference using Mylar is that the covering is already airtight before you have even applied any dope, so you really just need enough dope to stick the Tissue or Silk to the Mylar and you can leave it at that. It's quite a bit lighter than brushing several coats of dope, the end result is more stable, it's less likely to warp over time, although warps can be put in easily using a heat gun or hair dryer and twisting the surface. It is also less affected by damp, it won't go slack on wet days. It is a bit more puncture resistant, not a lot, don't expect a bullet proof finish!

Like many composite techniques, combining tissue and Mylar makes use of the benefits of both materials, while minimizing the disadvantages. Mylar is waterproof and light, but does not significantly add rigidity to the structure unless you use a thicker and therefore heavier grade. It does exhibit good puncture resistance. Somewhat the reverse is true for tissue as regards mechanical properties. When doped, it adds stiffness to the airframe, but to seal it for air and water, you will add a lot of weight with multiple coats of dope.

It is a useful technique for outdoor models in that even with just the one coat of dope, the combination doesn't go slack in the damp. The underlying Mylar also allows easy color changes between the structural elements of the model without doubling upon the tissue. Another advantage is that the mylar seals the inside of the tissue, preventing staining from rubber lube as the model ages. It also provides increased puncture resistance reducing the amount of needed patching as you fly. Both of these factors will help preserve the original appearance of your model.

What does it look like? ---- When adding tissue over clear Mylar, it should look like a well done covering job with tissue alone. With tissue on silver the paper looks solid. This is a real advantage for folks who want an opaque finish for a scale model. One difference in appearance is that you can easily make color changes between the structural elements of the model without doubling up on the tissue. Note that on my BA Parasol the red does not lay on top of the white tissue. There is only a small overlap to help keep the edges down. Without the mylar, this type of color scheme would have required adding weight with red paint, having two

layers of tissue under the color trim or laboriously joining the sheets of tissue before covering, and praying successfully that they would shrink at identical rates.

How Long Does it Take? ---- Don't listen to the comments about "covering it twice" taking too long. Much of the time taken to cover with Mylar is offset by the time saved not adding more coats of dope. Also, the tissue goes on the mylar faster than on the bare framework. If the end result is better (and it is) then it's worth a little extra time.

What does it weigh? ---- Here is a surprise, and a good one at that! Properly done, this technique should weigh less than covering with just tissue and dope. How does this work? Dope is really heavy. Several coats are required to fully seal for air and water resistance with just tissue. When adding tissue on top of a light Mylar film, just a single coat of very thin dope will do. The mylar provides all the air and water proofing while the doped tissue adds color and stiffnessMost modelers are using this technique on models to be flown outdoors. Indoor models are often not doped to keep them as light as possible. Adding Mylar will of course add weight.

Do I need to add the Tissue? ---- No, but... The tissue adds stiffness and colour. It also makes the model look "correct"!

What about warps? ---- Inevitably when covering a model, there are warps that you will want to remove, as well as some you will want to add. Although the film is more plastic than tissue, there is still a slight tendency for it to induce warps when covering. The solution to remove the warp is obvious. Just re-heat the film in the appropriate place, twist and reset the warp. The opposite works for applying warps for trim. Heat, twist and reset. If you have covered the model in aluminised film, because of reflections, it is sometimes very difficult to spot the warp. This is only a problem when straightening the wing before adding the tissue. A bit of persistance will pay off.

Cutting the Mylar ---- Cutting and trimming Mylar is best achieved using a sharp new blade, older dull blades may well tear the Mylar. The thinner the Mylar the worse the issue so be careful, but the key is a sharp and clean blade. Also far less tearing occurs you cut tissue or Mylar on one of those green, self healing graphic artist's cutting mats. A rotary knife is also worth a try if you have one. If you haven't got a cutting mat, go out and buy one. They are relatively cheap and will last for years even if you hack into 1/16 ply on them. You'll find your blades stay sharp for longer too.

Attaching the Mylar to the Airframe ---- This is straight forward and will seem pretty familiar to anyone who has used modern covering materials fron the R/C

side of the local hobby shop. First though, a little prep work is in order. Since the Mylar has no adhesive on it, some sort of adhesive needs to be applied to the airframe. Before painting on the adhesive, the airframe should be sealed with dope or sanding sealer. One thinned coat, sanded smooth, should suffice. We have found that various adhesives will secure the Mylar. All that is required is an adhesive that will dry then soften again when heat is applied. The adhesives used to attached standard iron film i.e. Balsaloc or Balsarite (fabric formulae) or SIG Stix-It are all suitable, as are many handyman contact cements, such as Evostick or Weldwood Contact Cement. Some glue sticks are also suitable so try your favourite adhesive. It may be OK.

Many of these products are far too thick and need to be thinned down before application. The adhesive should be thinned down to the consistency of dope. This will allow the adhesive to be brushed onto the structure without stringing. If the adhesive strings, it is still too thick. Just dilute with more solvent. You may find it easier and better if two thin coats of adhesive are applied rather one thicker coat. After coating the airframe check that there are no lumps in the adhesive before covering. you might want to lightly sand before attaching the Mylar. Apply the adhesive to all the areas that the Mylar will touch. This means leading edge, trailing edge, ribs, spars, gussets, everything. Once the adhesive is dry, covering can commence. Because the adhesive has been thinned, it will dry within minutes so there is no long wait before covering can commence. If one is using Mylar in a lightly loaded environment i.e. indoor, the aerosol spray-on adhesives can be used. The airframe can be coated with a sprayed on adhesive, the majority of the adhesive will be wasted on open structures but this is a way to apply a thin and light layer of adhesive. Once sprayed on the covering process is as above. If you go down this route cover up well to avoid the messy over spray!

Covering the model Cut a piece of film slightly oversized. With the aluminised finish, in order to protect the finish, the aluminium should be on the inside rather than the outside. It is easy to recognise the aluminised surface as it is slightly shinier, if in doubt, rub gently with thinners to test. Lay the structure onto the film, rather than the film onto the structure. Although the heat shrinking will remove the wrinkles, try to get the film on as neatly as possible. Gentle finger pressure will insure that the film attaches to the structure.

You may find it helpful to use a spot or two of fresh adhesive to tack the film in place before activating the dried adhesive with the iron. Re-heat the glue to make the Mylar attach to the structure. A small trim type covering iron is best, as it is very light and damaging the framework is less likely. Gently work around the edges of the structures heating the Mylar and softening the adhesive so that the

film attaches. Once you are happy that the edges are firmly in place, trim back the surplus and seal the edges.

With some more of the thinned down Evostick, paint around the edges where there will be any overlap and apply the other surface. Cut another piece of Mylar to size for the top surface. Lay this in place and attach as for the lower surface. Trim off the edges, wrap around and seal. Trimming is best achieved using a sharp new blade, older dull blades may well tear the Mylar. The thinner the Mylar the worse the issue so be careful, but the key is a sharp and clean blade. If care is taken the surplus can be removed with sandpaper, this method needs practice to get a good result. Now, slowly and carefully, working both top and bottom surfaces, use the iron to melt the adhesive on the rest of the structure and attach the film.
Once all the structure has been attached to the film, shrinking can take place. Slowly and carefully shrink the film into position, ironing the wrinkles out to the edge. The adhesive will melt and the film will move to get rid of any wrinkles around the edges. One of the problems you will observe is the air expanding inside the structure and causing the film to "balloon". You can either ventilate by making pin holes in the covering or put up with the problem because as the film slowly shrinks into place, the "ballooning" will reduce. Beware though that these pin holes give an opportunity at a later date for tears to take place. Perhaps the best solution is to "vent" each rib bay with small holes in the ribs. A last small hole in the center sheeting will allow the wing to breathe.

A few points:-

1. Any joints you are covering, overlap a reasonable amount, at least 1/8".
2. Undercamber is not a problem. Just make sure all the structure has adhesive on it, and carefully attach the film to the ribs.
3. The heavier grades of film shrink less than the lighter grades.
4. Make sure that all edges and joints are fully sealed. If opened to the air flow, the air can get in and cause the film to lift away from the structure.
5. Clean the finished covering and remove any adhesive that is on the surface with a small amount of solvent. Not only will the covering look better it will also prevent dirt attaching itself to the model when it is out in the fields.

Before heat shrinking the film, a quick test will find if your iron turned up to maximum heat will melt the Mylar. Howver, be aware that if attaching aluminised film to carbon, heat can build up in the structure and spoil the aluminised finish. Also keep the shoe of the iron clean free of adhesive and dust, a quick wipe with solvent will do the job. Adhesive on the shoe will attract dirt which may scratch or even tear the film.

Recovery ----Sometimes, even after much effort, wrinkles still remain. If this is the case try leaving the offending item for 24 hours then try again. It seems that if it is left Mylar will recover its shrinking powers and a wrinkled covering job can be ironed out.

Securing the Tissue ---- When applying the tisue or silk, it should be damp so as to conform more easily to the undulations and curves of the mylar surface. Once it is positioned as desired, flow on a thin coat of Nitrate dope cut to 50:50 or more. Once this coat dries, it is likely that the dope will have "blushed" a bit. The offending whiteness is a result of the moisture in the covering, and is easily removed by wiping on another light coat of dope, or even just making a pass with thinners. For rubber models and gliders a second coat after a bit of sanding is all you need. Glow and diesel models might need another coat or two to protect the tissue from the fuel and exhaust. Since you are using a highly thinned dope, the weight gain will be minimal.

Working With Silk ---- Silk on Mylar also works well, and is very popular with some folks looking for a lighter covering for their models when silk is required. As mentioned above, it should also be applied while damp.

Sources for Mylar ---- Suitable Mylar is available from many sources. See the addresses below. **Mylar** is the trade name given by DuPont of the U.S.A. to a polyester film. Mylar is also sold under other trade names such as Melinex. The film is unaffected by moisture and most other common chemicals. It is also temperature stable unless heated to around 200°C+ when it will shrink. The film can be attached as a covering and then shrunk to give a smooth and tight finish. The film is available in both clear and aluminised finishes. The aluminisation of the film makes it gas tight due to the size of the molecules of aluminium even helium cannot get through. Remember that the aluminisation process of the Mylar reduces to some extent its ability to shrink under heat. The best Mylar to use on all sizes of models is the thinnest, 5 micron. It is really only there to avoid the use of excessive amounts of dope to seal the tissue, and to give a degree of stability to the covering, using thicker Mylar adds some rigidity, but I think this is better achieved by using a heavier grade of tissue, or using Silk. Thicker Mylar is harder to work around curves, and appears to delaminate easier being less flexible.

Here are the names, email addresses and web sites for the modelers who shared the information that became this guide.
Note that Michael J Woodhouse sells FF supplies, including Mylar.

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TISSUE ON MYLAR COVERING
More and more people have been converting to the "tissue over mylar" finish over the last 12 months or so, and all but one is delighted. The odd one out had a nightmare and just could not get to grips with it at all; I cannot account for this, maybe it is just the same syndrome which seems to afflict some modellers when they try to solder - once you have mastered it you wonder why you ever had any trouble. When trying any new technique for the first time I tend to proceed at a snails pace, taking what might appear at first to be excessive care; slows you down, but I find it is better in the long run.

My preferred technique is to cover ONLY the open frame areas of the structure with Mylar. For attaching the Mylar to the frame, I used to use Evostick, thinned with Evostick solvent. However, this is largely toluene, which posed an obvious health risk, and it was subsequently withdrawn from the market. I now use either Balsaloc or the German equivalent supplied by RCS-Technik, the indoor specialists, either of which works well and can be thinned to a suitable consistency with water. This is applied in a thin (1/8 inch wide) band around the open area and onto the ribs with a small paintbrush. No doubt other heat sensitive adhesives suitably thinned would work equally well.
Cutting the Mylar to size is the next job, and it is a **xx?!!**. Five micron mylar is VERY thin (not as thin of course as the 2.5 micron we use on some indoor R/C models, but thin enough), picks up static, sticks to everything and is generally a brute to handle. The best way I have found is to cut out a card template which is just the required size - i.e. 1/8 - 3/16 inch bigger than the open area all round. I then lay out as many layers of Mylar as I require on my cutting mat, press down the card template on top and cut round it with a brand new scalpel blade.

The adhesive line being completely dry, the mylar is now laid in position over open area, and tacked down to the adhesive using an iron set to the normal sort of temperature which is used for attaching Solarfilm. (Actually, you will find that just finger pressure of the Mylar on the apparently completely dry adhesive will cause it to "stick" a little before the heat is applied). Frankly, this is a bit like Mrs. Beeton's "first catch your rabbit"; care and patience is the order of the day, tacking, gently stretching and tacking again. The aim is not to get it drum tight, but to get it EVENLY stretched.
When working on the top cambered surface of a wing, especially one without leading edge sheeting, it is almost impossible to avoid SOME wrinkles in the corner of the panels. Do not worry about these too much, the only penalty on the final finish will be an aesthetic one, as the tissue will stick to the TOP of the wrinkles, not follow their contours.
Now iron the Mylar down onto each rib. The iron can now be turned way up to shrink the Mylar – it will tolerate a MUCH higher temperature than normal modelling covering films, and for this reason I use an old domestic iron rather than a specialist film covering one. If any really bad wrinkles are present, the adhesive can be softened by the application of more heat and the Mylar repositioned, but try not to mess about with it too much.
I don't personally use a heat gun, but this might be a very good way to do the final shrinking, although, once again, a rather higher temperature than normally used might be required.
Attaching the Mylar is definitely the hardest part of the whole procedure to get right, so don't rush at it. Don't expect the Mylar to impart any rigidity to the wing at this stage; it won't, as even when tight it is "soft"; rigidity is the job of the tissue, the Mylar is to give the tissue puncture resistance.

Regarding use on the bottom of under-cambered wing sections; I have no experience with these just yet, but since the Europeans use it on modern A/2s and Wakes which feature thin highly cambered sections, they must find it satisfactory.

Now for the tissue covering. For thirty years I have always tissue covered wet, and use the doped airframe/brush through with thinners method. Naturally, I also use this technique (which does, of course, require the use of a "wet strength" tissue) over the Mylar and it has proved fine so far.
WORD OF WARNING: I IMAGINE this MIGHT cause problems with the bottom of an under-cambered wing, perhaps it may be necessary to cover these dry. As I say, I have not tried it for myself yet on a cambered under surface. Using my technique, the airframe is prepared by doping two coats minimum (50:50 dope/thinners) and lightly rubbing down with very fine sandpaper before the Evostick and Mylar is applied. The tissue is cut oversize, one side is wet by drawing it over a shallow water bath, and the tissue "flopped" onto the wing wet

side down smoothed and stretched into place and then thinners are brushed through it around the edges. As an alternative, it is equally satisfactory to lay the tissue in place dry and spray it with a fine water spray. (The spray "guns" in which many of the current anti-bacterial kitchen surface cleaners come are ideal!). Edges are trimmed and doped down, and when the tissue is dry it is doped normally.

NOTE: even when carried out in a dry atmosphere, Some “blushing” – white marks on the tissue – will occur at this stage. These vanish with subsequent doping. Blushing is minimised by working in a warm, dry, atmosphere and by using the best quality thinners. Auto accessory shops sell three grades of cellulose thinners normally distinguished by the colour of the tins. The top, or “premium” grade (blue tin) is the one to buy – and buying it this way in a five litre tin is infinitely cheaper than buying in little “model shop sized” tins.

A club mate of mine has applied the tissue by doping the Mylar first rather than flopping the tissue onto it. He reckons it works fine, and the results produced certainly appear to be perfect, but I have not tried it myself. Maybe this might be the preferred technique for dealing with undercamber?

It is comforting to note how the tissue and Mylar bond beautifully during the doping process - using 5 micron Mylar under the lightest superfine Esaki tissue the result is VERY light, yet imparts great rigidity to the wing. I did wonder at first how well the tissue bonded to the mylar – it just seemed all "wrong" doping tissue down onto what is, after all, an impervious plastic surface. I therefore arranged to have some samples to examine, by the simple expedient of dropping my tool box onto an open model wing! Examination of the two damaged panels which had to be cut out and replaced showed the bond to be total - I could not separate the two layers no matter how hard I tried.

Benefits? ---- The "stressed skin" rigidity of tissue with a high degree of puncture resistance and (particularly if using a "hard" finish tissue such as Esaki), very light weight. A sharp object WILL puncture it, but even the 5 micron/light Esaki combination is pretty good, whilst 10 micron with light or heavy Modelspan (or equivalent) would be very tough indeed, albeit heavier due mainly to the much greater dope uptake of the tissue.
Whilst the puncture resistance is not as high as film, it is very much greater than tissue - even heavyweight tissue - alone, and the torsional rigidity is immensely superior to ANY film - they are just not in the same league in this respect, although admittedly quicker and easier to apply.

Problems? ---- Undercamber may need special care as mentioned. Frameworks with very thin peripheral members which do not leave a "free" wood area beyond the mylar for doping down the tissue MAY be problematic, but the way in which the

tissue bonds to the mylar with dope leads me to believe they will be OK. As always, care is required to avoid warping on light frameworks as the tissue shrinks.
Any problems can be minimised by careful design of the structure, use of well thinned dope (I use 30% dope/70% thinners for doping Esaki tissue) and doping top and bottom panels alternately. I have never had to resort to pinning structures down after doping, but always like to let the finished airframe “settle” for a few days and then do a rigorous alignment check and remove any warps which have crept in by steaming or heat gun.