

Foilmaker

V:1.5.2The Manual

Version:2001-08.01

Official Version

By Daniel Gagnon

Translated by Bob Finch & Peter Thomas

Distributed from: <http://www.foilmaker.co.uk>

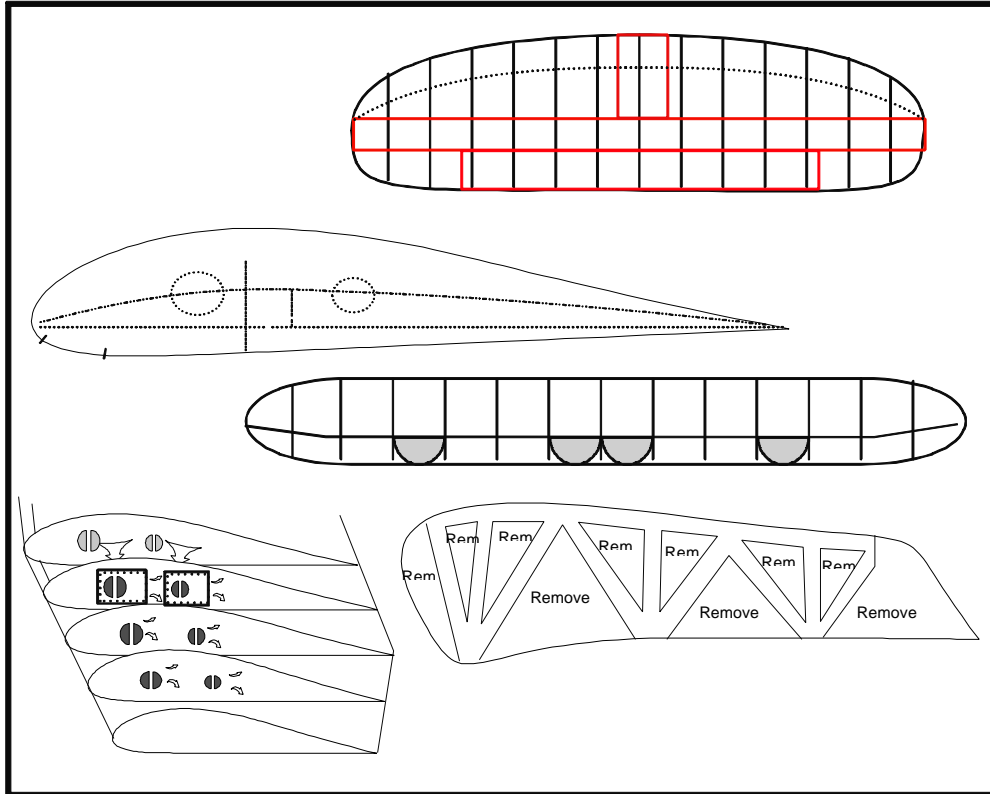


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Thank you to Simon Stapleton, Andy Beveridge, Andrew Beattie and Patrick Van Der Velde for sharing their numerous experiences.

Thank you to Bob Finch and Peter Thomas for this translation.

**This document is distributed freely for
instructive use only.**

Message from the Author

I decided to write an instruction manual in French for the Foilmaker software. I don't pretend to be an expert kitemaker, but my mistakes, and especially my frustration at not having any manual for this powerful and complex tool, have pushed me to share with you the knowledge that I have acquired on the construction of kites using Foilmaker. This document is distributed freely and free for instructive use only. (but please do not redistribute via the internet, keeping the update period to days will be impossible).

Note that most information is presented in the context of the construction or reproduction of foil-type kites and not of hybrid-type kites. However, FM can be easily be put to use for this kind of construction too.

Finally, constructing the kite is one thing, tuning it quite another. I recommend that you print a copy of *Appendix C: Symptoms and Remedies* and put it in your kite bag. It could save you a lot of headaches.

I invite you to visit the other part of this site dedicated to the same topic but in French. Nose about thoroughly, specially the new X-Rays buggy plans and the harness plan . The site is updated regularly so one should visit it often for more details.

This document is updated daily. If you have comments that you believe useful in the growing community of kitemakers, don't hesitate.

Web version and French version of this document:

http://members.tripod.com/daniel_gagnon0/index.htm

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English version of this document: <http://www.foilmaker.co.uk>

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Manual for Foilmaker v:1.5.2

Introduction.

You downloaded Foilmaker v:1.5.2 via the site <http://www.foilmaker.co.uk>. You enrolled with one or the other of the following egroups:

<http://www.egroups.com/foildesign> An English-speaking list discussing topics relating to the design & construction of traction kites. Approximately 344 world-wide users. Average message rate: 15 messages/day

<http://www.egroups.fr/group/leprofil> French-speaking list having topics relating to the manufacture of kites, accessories, buggies etc. About 190 world-wide users. Average message rate: 15 messages/day.

What an incentive! This document would not have been able to take shape without one or the other of these two discussion groups.

You will find at this address a copy in German of my manual as a website.

<http://home-3.worldonline.nl/~shoman/fm/index.htm> (currently unreachable)

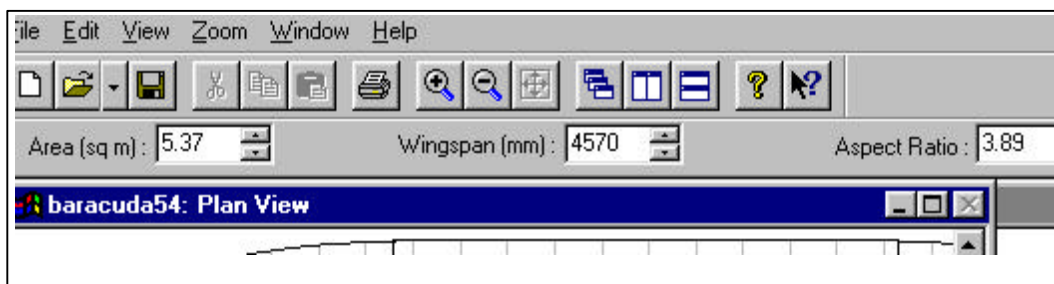
Starting the Application:

We begin a session with Foilmaker. The application opens up but with no kite anywhere to be seen. You have two choices:

1: You can begin a new project by clicking on the icon that looks like a clean sheet of paper. FM will open windows showing profiles for the Center (Center) and the tip of wing (Tip). The choice is bewildering. Load THE SAME PROFILE twice unless you know exactly what you want to make. If you took this document from my site, return there and download the file [pflchoice.zip](#), a collection of profiles that have proved themselves useful for traction. Then, once the two profiles have been loaded, a wing will be displayed and FM will initialise ALL parameters to their default values. (These values have been assigned arbitrarily by the programmer, Peter Thomas)

2: You can load an existing .kte file that is available on the web at various addresses. You use it, modify it and/or you save it for reference.

Main Window: Variable Parameters.



Displayed first: Area (sq m) The surface area in square meters.

Perhaps I don't give the surface area the importance it deserves – it's just that this parameter is VERY subjective. It implies a direct relationship between size and power. In practice with the large diversity of choices that are available after the initial choice of size, nothing could be more misleading. The camber of the wing reduces the 'in flight' (or 'projected') surface in relation to the 'flat' surface. Add to that that only 1/3 (the front third) of a sail does real work and that 2/3 of the surface serves only has re-establish the airflow behind the kite... The quantitative utility of the surface area in m² is far from clear.

Tip: If you want to change the surface area of a wing WITHOUT CHANGING ITS ASPECT RATIO (which is useful when one wants to create a complete range of kites), first enter the value wanted in the edit box, then double click on the diagram of the wing (but not inside the three rectangles). If it doesn't work, try a second time - normally this is sufficient. The chord and the span will be adjusted so as to not change the aspect ratio.

NB: a bug in the software often freezes the measurements of the span when we do this. To thaw the window, order a **Print Preview** and made Enclosed. The true value of span should be displayed.

Secondly: Wingspan (mm). The wingspan of the kite in mm.

The wingspan is a parameter that doesn't say anything clear about the behaviour of a wing, for an elementary rule of physics, that is: the larger the wing, the larger its turn radius. My biggest kite has an 8 meter wingspan... which gives it a minimum turn radius... of one horizon to the other. Keep the wingspan below 6 or 7 meters, even if it means decreasing the aspect ratio. Because high performance, although laudable, cannot change the laws of the physics!

Thirdly: Aspect Ratio (AR) the aspect ratio

NB: Changing the aspect ratio has major effects on the behaviour of a sail.

Here are the characteristics observed when changing the aspect ratio (tendencies):

In general, the higher the aspect ratio, the bigger the difference between the minimum traction (at low speed) and maximum traction (at full speed). The ratio between minimum & maximum traction is sometimes known as the 'MMR Ratio'.

In general, the higher the aspect ratio, the more efficient a wing will be for a given size, and therefore the more power it will generate at maximum speed.

In general, the higher the aspect ratio, the more unpredictable the handling of the kite will become, especially in turbulent conditions. High aspect ratio kites accelerate very quickly, have a high top speed and can change from zero power to uncontrollable power in an instant. High AR kites and gusty winds can be a dangerous combination.

So, depending of your area and the behaviour of the wind, you should need at least one low AR kite for those gusty day.

Plan View

We have the choice of three basic shapes for the construction: Rectangular, Rhombic and Bielliptic. The first shape, though the least aesthetically pleasing, offers the simplest construction and the best success rate for the new kitemaker.

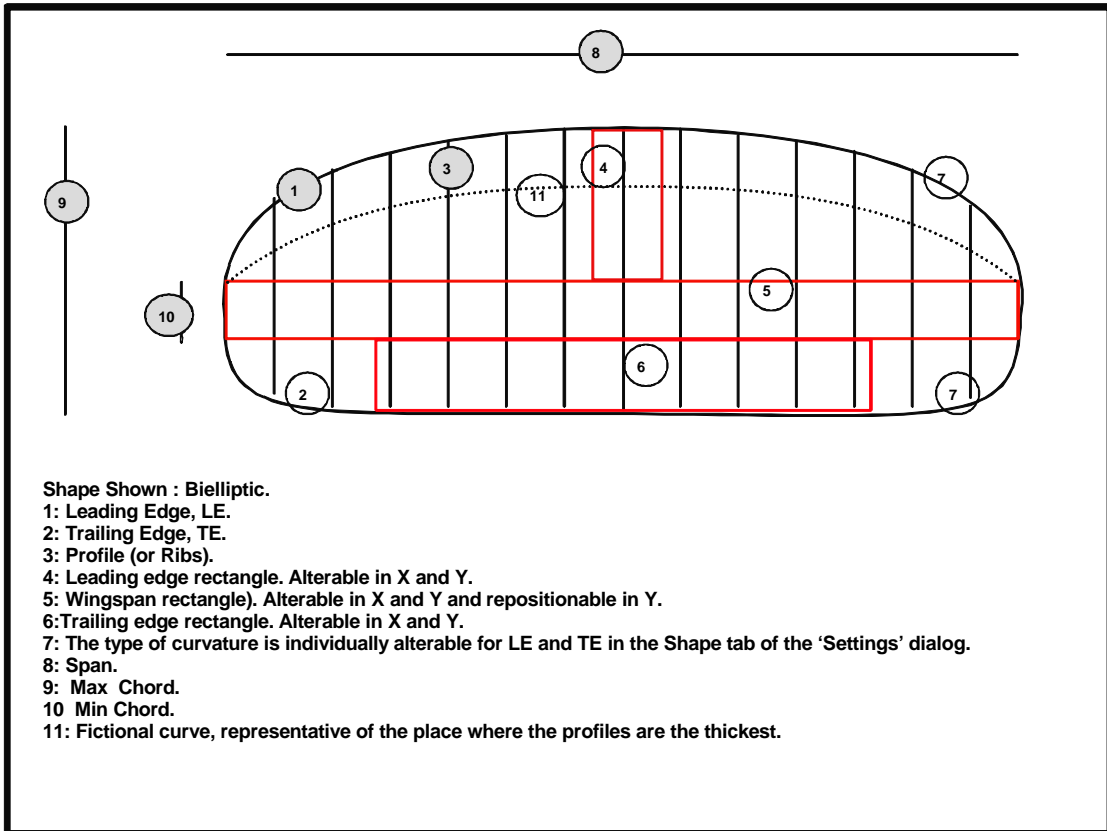
In fact, with a little ingenuity and manipulation, a multitude of shapes are possible with FM. When you are in the **Plan View** window, you can click on the illustration of the wing and drag different anchors that will affect the shape in three ways:

1: The upper rectangle determines the shape and anchor points of the front of the kite. Changes can be made in both X and Y directions. When you print (or print preview) the kite, the front-rear distance between front of the kite and the front of the wingtip in mm is printed . It is referred to as the **FRONT OFFSET**.

2: The centre rectangle determines the wingspan in one direction and the minimum chord in the other direction. This rectangle can be dragged vertically, which alters the offset values on the LE side AND the TE side. When you print the **preview**, the value of "X" is printed at the centre in mm and represents the span (**WINGSPAN**). The value of "Y" is printed at the right tip of the wing in mm and represents the chord of the profile at the wingtip (**MIN CHORD**).

3: The lower rectangle determines the shape and anchor points of the trailing edge. The change can be made to both "X" and "Y". When you print the preview, the value of "X" is printed below at the centre in mm, and the value of "Y" is printed below the right wingtip and is referred as the value: **REAR OFFSET**.

NB: The maximum total value of the chord (**Max. Chord**) is not printed on the diagram but is shown in the section; **Kite parameters**.



Front View

This window displays the front face of the wing. One can judge the thickness of the cells and the distance then between them. Does the kite have enough profiles? This window is also important for adjusting the curve of the wing finely. The bridles are also shown to help with your decision-making. The **D-Ribs** are also displayed. No printing function is possible with this window, which is a pity since some purists could use this diagram to calculate the bridle geometrically in a manual way. If the desire took you ([Even if it's just to help you to make the bridle](#)), to capture the screen as holding down the **WINDOWS** key and while pushing simultaneously on the **PRINT SCREEN** key. Open the **Paint** application then and in the **Edit** menu paste then print the part that shows the front face of the wing.

Centre Profile

This window displays the central profile. It is also when this window is active that you can print the templates of the kite. This window can have several uses at the time of construction and you should come back here often.

Here are the available options in the **Centre Profile** or **Tip Profile** windows :-

1: You can import or can export profiles.

2: You can edit a profile. Either by moving the anchor points, or by removing them or to adding to them.

2a: To remove an anchor point: hold driven the SHIFT key and double click on the unwanted anchor point.

2b: To add an anchor point: double click right side up on the profile or you want to add an anchorage.

NB: after having modified a profile, save it with **Profile Export**. Then, with the help of WORD PAD, you will be able to edit the name that appears in top of the window of the profile. (edit the first line only and protect UNDER.pfl). In Appendix D an exercise demonstrates how to write with WORD PAD a complete pfl file. The example concerns the profile:NACA4415.

3: To visualise the air entry points (the vents).

4: To visualise cross-vents (inter - cell ventilation holes).

5: To visualise the effect of a change in the maximal thickness on the profile.

6: To visualise the attachment points of the primary bridle (the features that form a zig zag line on the diagram).

7: To visualise the centre line or camber line of the profile (line bends in stretched out dotted line in the centre of the profile).

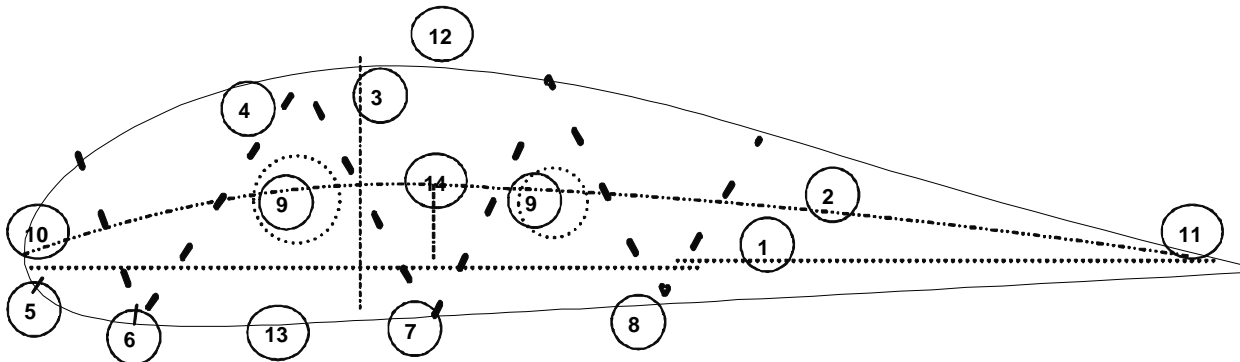
Tip Profile

The functions are identical to **Centre Profiles**.

Here is an explanatory diagram of the profile as seen by Foilmaker

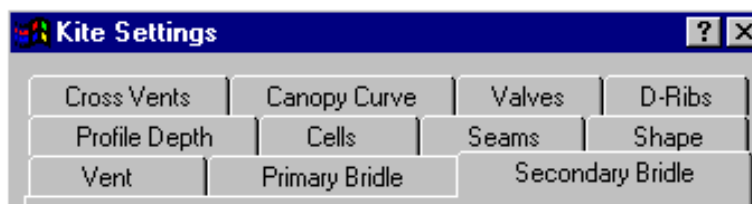
- 1: Chord (fictional line joining the side of attack very close to flight).
- 2: Chord average or camber.
- 3: Maximum thickness of the profile. (it is % of the length of chord from LE)
- 4: Zig-Zag reinforcement line (on bridled profiles only.) Shows the addition of a reinforcement line in "sewn V" on the profile. (Dacron 50kg)
- 5: Start point of the air entry (0.0 to 10% of the chord length) 0.4 to 1 recommended.
- 6: Double function. End of the air entry. (of 10mm to 200mm) to See section 9. Determines also the "A" attachment point of the primary
- 7: Point of "B" attachment of the primary bridle.
- 8: Point of "C" attachment of the primary bridle.
- 9: Position and dimension of the inter - cell holes.
- 10: Leading edge (LE).
- 11: Trailing edge (TE).
- 12: Upper skin.
- 13: Lower skin.
- 14 : Line of max camber.(doesn't appear on the FM diagram

NB: a file.pfl writes itself in the following direction: 11 =>13=>10=>12=>11.



The Settings Dialog

In the Edit Menu the **SETTINGS** option is found. After clicking on **SETTINGS** the KITE SETTINGS window appears. This window offers you 12 tabbed panes.



Profile Depth - Thickness of the Profile

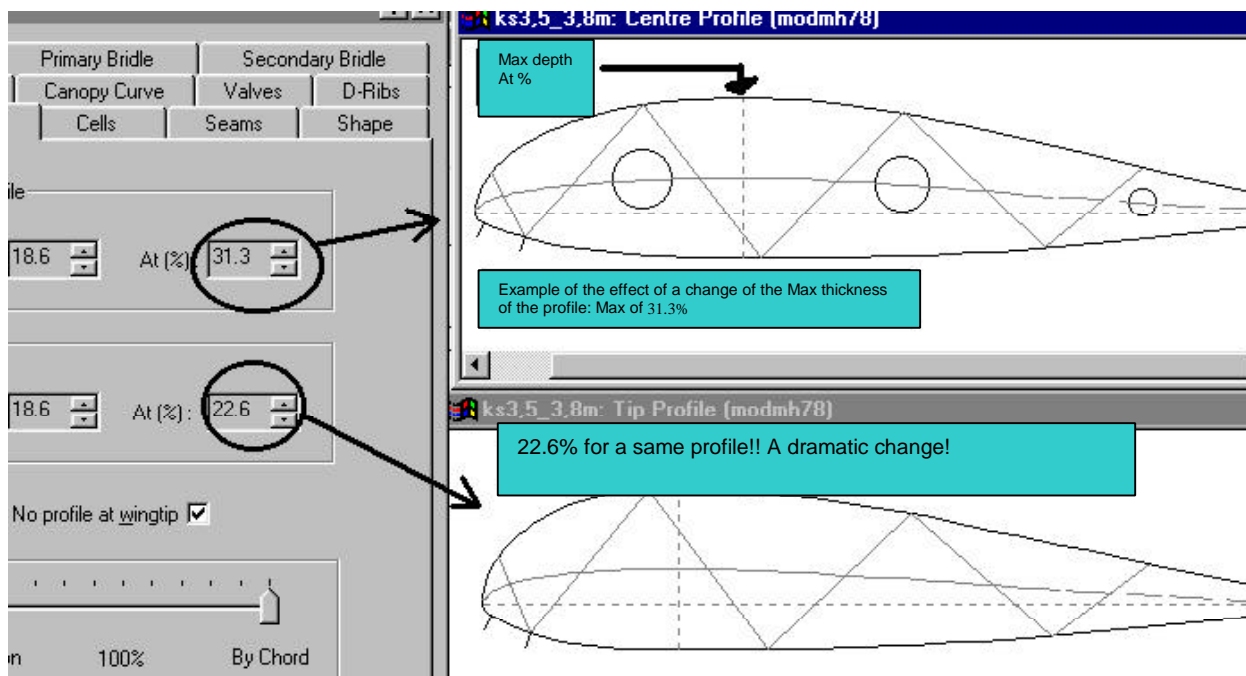
NB: Varying the profile depth greatly affects the behaviour of a kite.

In physics, a driving force has to compromise between two extremes. Strength or the speed. The thickness of your profile is the agent of this expression.

For a traction kite, the thickness of a profile should not be lower than 13% or higher than 21%.

Depth%: We can modify here the maximum thickness of the profile. This percentage is in relation with the length of the profile. The values proposed in Appendix A should work well with most 'normal' profiles and will ensure that your wing operates well within it's physical constraints.

AT%: We can change the maximum thickness point of the profile as a percentage of the profile chord. These adjustments are made INDEPENDENTLY for the centre profile and the tip profile. According to the profile, it is appropriate to place the maximum thickness between 20% and 30%. It greatly affects the camber of the profile and therefore its lift.



No profile at wing tip

This checkbox allows the high performance option: **No profile at wing tip**. This option is intended to reduce the parasitic drag at the wingtip. If you choose this option, no profile will be sewn in at the wingtip – the upper skin is sewn directly to the lower skin. (you may have to figure yourselves the bridle attachment placement)

Variation: By Position or By Chord.

(Has no effect if the values and measurements are the same for the tip and centre profiles)

One slider entitled Variation is shown at the bottom of the dialog. At one extremity is *By Position* and the other is *By Chord*.



By Position



By Chord

These diagrams are for an elliptical foil.

You have here the option to vary (morph) the profiles gradually between wingtip and centre (if they are different, and/or if you chose different thickness for **Centre** and **Tip**) according to their positions or their chord lengths. (It is a subtle nuance that only makes a significant difference in a few cases (almost oblong kites). And, in any doubt, position the slider at 100% by chord.

Cells

It is here that one determines the number of cells of the sail. The limits are between 3 and 50 cells.

There is no golden rule about the number of cells to use for a given sail. Every cell has

a cost in weight, construction time, bridles and total cost. On the other hand the fewer the cells the more the sail distorts itself, thickening in the centre of the cell and no longer representing the chosen profile. The more cells, the thinner the sail and the more accurate the actual profile shape, but it becomes heavy. There is a therefore a compromise to be made here.

We should introduce Cells Aspect Ratio as a guide here.

More on this later !

(cells width versus cells height)

A cell should very not be more than 1.5 time as width as its height.

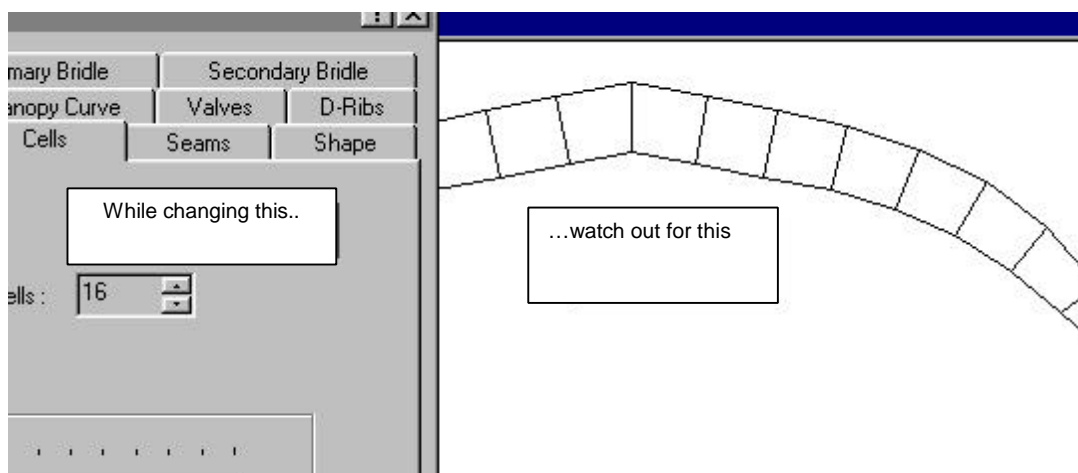
Normal is between .90 to 1.2 (enjoy!)

Spacing: Constant or Proportional Spacing

One slider allows fine adjustment of this parameter.

You have here the option to space your cells in a constant way, or to space them gradually according to the chord. The intent is to reduce the global distortion of the upper skin at the wingtip. Indeed, as the profiles shorten towards the wingtip the distortion of the upper skin becomes out of all proportion if the cell width is constant. If we reduce the distance between the profiles then things improve... in proportion. Between 70 and 80% **proportional** would be a good choice if you apply this function.

NB: If you change the number of cells AFTER having changed the canopy curvature, Foilmaker will remove some cells from the center of the wing. Therefore, the vertical sliders (In the dialog CANOPY CURVE ...EDIT) will disappear in turn, and you will get a bad curvature, that perhaps begins abrupt!



Seams: Seam Allowance.

Seam allowance in mm.

Single. Simple sewing:

Defaults to 7mm.

Double. Hem:

Defaults to 15mm.

This choice is up to you: it depends on your sewing machine and... on your cleverness. I advise you to set it to the width of the sewing guide on your machine which will ease the sewing task, give you confidence and greatly decrease the sewing time because cloths align automatically same with three thickness of spinnaker. If this manual was published by a publisher, I would see that a sewing guide was included with the book.



Singer ref: 161172

GT Britain.

\$6.95 can.

Shape General Form:

Available options are **Bielliptic**, **Rhombic** or **Rectangular**. We have the choice between these three shapes as the basis the construction. The available anchors in the **Plan View** window allow the basic shape to be modified to a shape more appropriate to your needs. To see the first part: **1.0 plan view** page 7-8. Be creative!

Two sliders are presented entitled: **Curvature % 0 <> 100**. These affect the curvature of the leading and trailing edges of the kite from 0% to 100%

The parameter: **Front curve** affects the curvature of the leading edge (LE) of a bielliptic kite.

The parameter: **Rear curve** affects the curvature of the trailing edge (TE) of a bielliptic kite.

Cross-Vents. Holes for Inter-Cell Ventilation

Here you can choose the number of inter-cell holes. 0, 1, 2 or 3 for each profile.

The percentage determines the depth of the hole in relation with the thickness of the profile.

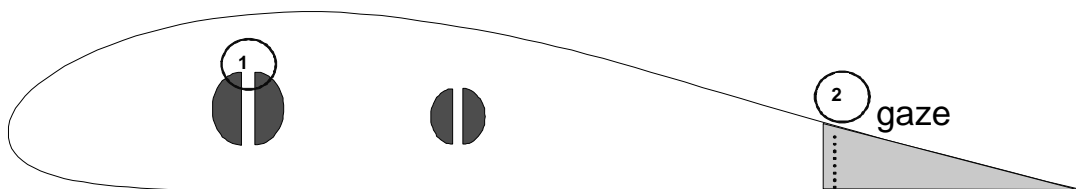
NB: Take note of Appendix B: Pocket Valve are explained.

Tip: Retain a narrow strip of cloth in the centre of the hole from bottom to top. You will therefore have this (||) as a hole.

The present tendency is for cross-ventilation in the trailing edge. Either one pierces a small hole many times with a soldering iron, or one sews in a section of gauze in the last few cm. then one cuts the gauze to match the measurements of the remaining triangle and one cuts away the spinnaker, keeping only the gauze like tip of profile in the trailing edge.

1: Strip of spinnaker left in the center of the cross-vent hole.

2: Gauze instead of third cross-vent hole.



Canopy Curve. ...Edit. Changing the Camber of the Wing

When you look at the **FRONT VIEW** window, you can see the curve of your wing. This curve is not a distortion imposed by the bridle, but a curve produced by the shapes of all the individual pieces of cloth. It affects performance. A flat sail like the Skytiger offers a better ratio of traction because all vectors of traction are oriented in the same direction. These kites tend to skid in turns and have frequent lateral drifts. [Hence the frequent addition of winglets on those flats foils.](#)

On the other hand a curved sail is more manageable and versatile. We sacrifice a part of the 'flat' surface area to improve the handling. The more pronounced the curve the bigger the difference between the 'flat' and 'projected' (or in-flight) areas.

Edit...Button.

When you click on Edit (button), you have access to a window with multiple vertical sliders. At the bottom of the window is a single horizontal slider.

One slider is shown for each cell in the half-sail. You can change the camber of the sail thus across the wingspan of the kite. The slider at the bottom allows the overall curvature to be changed without having to adjust each of the vertical sliders

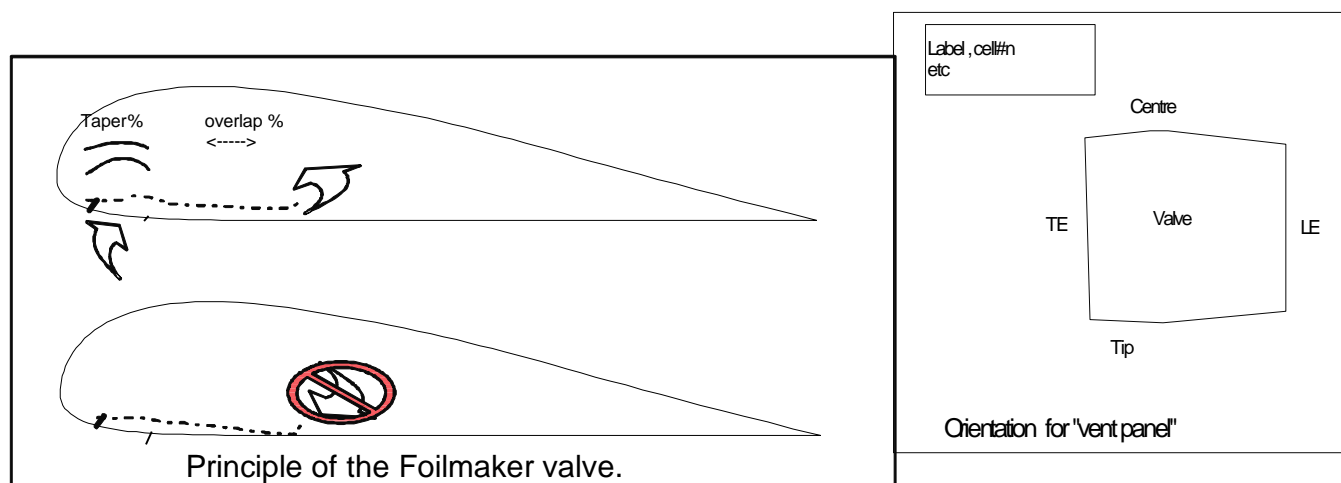
Tip: When you begin an editing session, place the horizontal slider to 80% of maximum. Then adjust the camber to your taste. That way, if you have to change the camber, either to lessen it, or to increase it, changing only the horizontal cursor should be sufficient.

NB: If you change number of cell AFTER having set the camber, Foilmaker will remove some cells from the centre of the wing. Therefore, the vertical cursors will disappear by turns, and you will get a bad curvature, that perhaps begins abruptly.

Valves. Air Entry Valves.

This is about oblong-type valves in the cloth. When the option **GENERATE VENT VALVES** is selected, FM calculates and prints a valve for each cell. The orientation of this one is arduous - a good method of labelling is required. The panel of the valve is first sewn to the upper skin WITH the panel of gauze (if used). The gauze is then sewn to the lower skin. The valve is finally sewn by stitching it to the seam when two adjacent cells are sewn together. Ensure that you leave some slack (taper) in the valve to allow easy entry of air when the pressure outside is greater than the pressure inside the kite. In the reverse situation the floating part of the valve closes, stopping air from escaping.

The following variables offer themselves to you: The taper in degrees and the overlap in %.



Changing the **taper** in degrees produces the necessary slackness in the valve to allow air to enter the kite. Indeed, the profiles are parallel whereas FM **generate** a slightly trapezoidal valve panel. The **overlap in %** determines how far the valve (floating part) **over** passes the entry of air toward the inside of the sail in direction of **the trailing edge**.

To help the alignment of the panels:

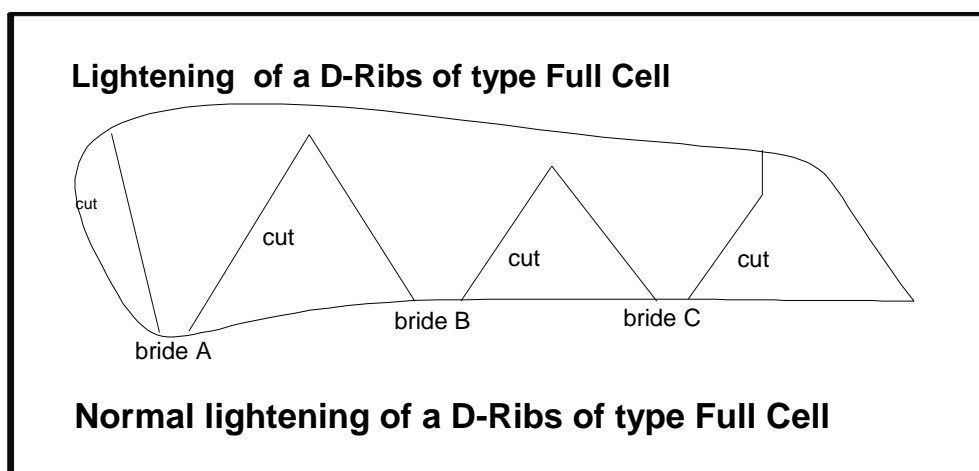
FM prints the pattern on the left with the label in top. From it:

A piece of cloths is drawn with the seam allowances. Before cutting the pattern, write down on the paper or cardboard the following marks: LE, TE, T, C.,

D-Ribs. (Diagonal Profiles).

You have the choice between: None, none, Half-cell, half cell, Full-cell complete cell. This is an option for the purist. The D-ribs manufactured by FM constitute a starting point for the manufacture of **D-ribs** better adapted and especially lighter. The use of the **D-ribs** doesn't simplify a sail!! They find their uses in the transverse integrity of the structure between two bridle points.

I'll explain myself. If you want to manufacture a sail of high performance with very little



drag, bridling every three profiles is sufficient. However to remove the spanwise distortion that follows because of the lack of support to the canopy, one fixes diagonal profiles to each bridled profile.

REMARK AND TIP:

Here is a rule of thumb to understand how the D-ribs printed by FM should be used. If you use the whole panel you will burden your kite with 35% extra weight, which won't constitute a big improvement, even with the reduction in the drag.

Vent: Entry of Air.

Options: Open or Gauzed.

Whilst the panel printed by FM can constitute a starting point for something better suited to your needs, I advise you to **always** print these panels. To make an enclosed cell, cut out and attach the vent template to the lower (or upper) skin template. *Appendix E: Ideas for Vent Openings* demonstrates some of the variations possible with a little care and imagination.

Tip profiles: position%. Position of the vent opening of the wingtip profile as %age of the chord length.

Allowable values: 0.0% to 10% of the chord. Default value: 1.0%

This value situates the leading edge of the air entry point on the profile.

From 0.4 to 1.4 recommended.

Marine Kite Closed with Valves: set the value to: 0.0

Tip Width (mm). Width in mm: This value positions the trailing edge of the air entry point. Allowable values are 10 to 200 mm. And Auto: Automatic fashion. In automatic fashion, FM varies the measurements of the entries of air of the centre opposite toward the tips of wings according to the position of the cursor: By position or by chord. For example, if your vent width is set at 80mm for the central profile, you have an elliptic sail, and you set the vent width of the wing tips to automatic, FM will decrease the width gradually, either according to the position of the profile, or according to its length.

Centre profiles position%. Position of the vent opening of the centre profile as %age of the chord length.

Allowable values: 0.0% to 10% of the chord. Default value: 1.0%

This value situates the leading edge of the air entry point on the profile.

From 0.4 to 1.4 recommended.

Marine Kite Closed with Valves: set the value to: 0.0

Centre Width(mm). This value positions the trailing edge of the air entry.

Allowable values: 10mm to 200mm. And Auto: Automatic fashion. I would not dare to place this value in automatic fashion. On the other hand as a guide, here are some commonly used values, according to the surface area of the wing. Either 5 to 6% of the chord length or:

Surface Area (m ²)	Vent Width (mm)
2.0	40 – 50
3.0	50 – 60
4.0	60 – 70
5.0	70 – 75
6.0	75 – 85
7.0	80 – 85

Variation By position or By chord. Variation by position or by length of chord.

As explained previously, this slider allows the vents to be morphed according to the position of the profile or its length of chord. (doesn't apply if the values and measurements are the same for tips and centre)

Primary Bridle

Primary Bridle settings have a major effect on the performance of the kite.

A short recap:

The bridle has three simultaneous roles to play :-

- 1:** To provide a rigid support for the canopy while retaining as far as possible its shape.
- 2:** To transmit the power to the pilot without compromising #1
- 3:** To transmit the orders of the pilot to the sail no matter the tension caused by #2 and still without compromising #1.

Bridle every 1-2-3 ribs. This choice offers different types of support to the canopy.

Bridling every profile is the **ideal** solution from the point of view of structure, but the large number of bridle lines produce a lot of drag. Use 75kg spectra/dyneema

Bridling every second profile is a good choice for the kites of medium performance. It offers a good compromise between the distortion of the canopy caused by the lack of

support to the unbridled profiles, and the lowering of the drag caused by the disappearance of 50% of the primary bridles. [Increasing the canopy curve accordingly will reduce the bad effect of this practice.](#)

Bridling every third profile is a choice that cannot be 100% efficient if it is done without transverse profiles (**D-Ribs**). Indeed an important distortion of the canopy would be caused by it because we would have two out of every three profiles with no support. Those that manufactured a Sputnik By the Book know the results of it. Therefore to benefit from a reduction of the drag of 66% (of the primary bridle), it is necessary to pay the price of adding more cloth and weight by the addition of **D-Ribs**.

Attachment points in%: Positions of attachments of bridles (A,B,C,D)%.

Here you choose the positions on the lower side of the profile where the attachments of bridles will be placed as a percentage of the profile chord length. For two-line kites there are four attachment points, for four-line kites there are three attachment points (the fourth is used for the brake bridle). The choice of a two-line kite or four-line kite is made in the **SECONDARY BRIDLE** dialog tab.

TIP:

If you want to create a four-line kite with 5 attachment points (4 power + 1 brake), create one design as a 2-line kite and one as a 4-line kite. Use the 2-line kite for positioning the A,B,C and D power lines and use the 4-line kite for the brake bridle.

Number of flying lines	2	2	4 / 3 points	4/ 3points	4/ 4points
A	Vent	Vent	Vent	Vent	Vent
B	25	22	30	33	22
C	50	44	60	66	44
D power	75	66	Nil		66
D brakes	Nil	nil	100	100	100

Commonly used values

(Primary) Tow point position%: Position of attachment (as % of the chord).

We have here two percentage measurements; " X " and " Y " for the Tip (tip) and Centre (central part) respectively. This percentage is again in proportion with the length of the chord.

Tip and Centre " X "%: Impact; Governs the angle of attack (AoA) of the profile and therefore of the wing. It is in fact the point of intersection of the primary bridles attached to the profile as a percentage of the chord from the leading edge. The ultimate perfect AoA is impossible to predict with certainty, because the AoA is a function of the drag and the centre of lift and therefore depends on the choice of the profile as well as the distance of the primary attachment point. The value defaults to 18%, but can go as high as 25% for certain kites. Use the default value for a prototype and use an adjustable bridle system using " V " or " T " sections so that you are able to adjust the angle of attack to your taste. There is a price to be paid for the construction of your own unique kite!!!!. With several copies you will be able to adjust this parameter with precision and so to eliminate the adjustable bridle system. Note that the final AoA depends to some extent on the thickness of the profile and the drag caused by other parameters chosen for the wing.

Tip and Centre " Y "%: Depth; Governs the distance below the canopy where the primary bridles will meet. This value is a percentage of the chord length.

The value of " Y " defaults to 100%, which is the normally used value. In practice it should never be lower than 60% nor higher than 200%. FM allows values between 50 and 150% for this parameter.

Lengthening the primary bridle increases the stability but, of course, some drag is caused by it. Shortening the primary bridle decreases the drag.

(Primary) Tow point Variation. Variation of the attachment points.

(doesn't apply if the values and measurements are the same for tips and centre)

As it is possible to place different values in " X " and " Y " for the **Tip** and the Centre, it is necessary that the transition occurs gradually. You have the choice therefore, to make this transition according to the position of the profile or the length of it.

To what does that serve? - to twist the wing tip.: To gimlet.

It is not rare to find kites that don't have the same angle of attack for the wingtips and the central part. The drag caused by the wingtips is in part person responsible for this phenomenon as well as the parasitic drag caused by the bridle. A good rule of thumb is to use the lowest angle of attack in the centre section that does not cause the nose to collapse at the top of the window, and to increase the angle of attack at the wingtips so as to keep them inflated at the edges of the window.

To gimlet a wing is not an issue in itself (I mean doing it before the first flight test). Its a correction imposed by test and error when the first test flight is not satisfying. See [Appendix C](#) for more details.

Secondary Bridle

Bridle every 1-2-3... primary tow points.

You have the choice here of having a separate secondary bridle line for each primary bridle, one secondary for every two primaries, or one secondary for every three primaries. Use the Front View window to make your decision. It may help to add or remove some cells to get a more consistent bridle – if you change the number of cells, don't forget to check the canopy curvature.

The strenght (in Kg) of the secondaries must be carefully choose in function of this very choice.

As a rule of thumb:

- every primary :75kg is enough
- every second: 125Kg recommended ,
- every third... 125 to 150 kg.

For Kite surf foil, think even bigger!

Control line: two, four.

It is here that you choose whether to control the kite with two or four flying lines. You should return to the PRIMARY BRIDLE tab to adjust the bridle attachment points.

Style: Split, Half Cross.

It is here that you choose the secondary bridle style. Both options have advantages and disadvantages. The secondary bridle is a compromise between retaining the shape of the kite in normal flight and during turns, whilst adding as little drag as possible. Here are the features of the two secondary bridle types offered by FM:

Split: Retains the shape in normal flight but causes distortion in turns. Offers the best ratio power/performance. If one of the two handles is released, the sail collapses completely, which offers a supplementary security level as a bonus. If you use four lines and you start your turns with the brakes you will get the maximum power from this configuration.

Half Cross: Retains the shape in both turns and normal flight. Offers a lower ratio of power/performance because several supplementary bridles are added. The maximal power occurs in turns. If you release a handle, the whole power is transferred to the remaining arm. The sail does not collapse but gets spiral madwoman* (*Couldn't resist leaving the automatic translation in – Peter*). It is the ideal choice for those that don't use the brakes except for... braking. This configuration causes more lateral compression on the profiles and tends to cause accordions in low winds.

*I have meant: Crazy Gimlet (Vrille Folle) ... Hé Hé -Dag.

(Secondary) Tow point position%: Position of the point of attachment of it%.

Distance of the secondary bridle attachment points as a percentage of the span.

Forehead " Y ": of 25 to 100% by default: 67%.

It is the distance between the top of the sail and the attachment point of the flying lines!

This distance is optimised for most wings. A pronounced canopy curvature could see this value decrease to 50%, on the other hand a flat wing could have this value increase to 75-80% in order to counter the accordions.

Rear " X ": of 0 to 50% by default to 50%

This value is only changed by those who would like a similar brake bridle to the JOJO kites. Place the value to 25% (which moves the attachment point towards the wingtips. (Advice: use the default value of 50%)

Rear " Y ": Allowable values are 25 to 100%. Default value is 67%:

This is the vertical distance between the top of the canopy and the attachment of the flying lines to the brake bridle.

Skin Tension

This new function, for those who want to use it, allows you to create a supplementary spanwise tension on the leading and trailing edges of the kite. In flight, this tension eliminates (or at least decreases) the 'sandbagging' and creases that often occur in kites. In fact the big commercial kite companies use darts in the leading and trailing edges to achieve the same effect.

Darts in the leading edge compensate for the stretch of cloth and the distortion caused by the inflation of the sail. Darts are an art that we all need to learn.

Be prudent with the leading edge – exercise moderation.

For the regulating parameters:

If you want not to use any supplementary skin tension:

Nose taper value: 0.0, Tail taper value: 0.0... so, the other values won't have any effect.

Upper skin (% Chord of):

Nose start: [10]: Starting point of the dart on the leading edge of the upper skin

Tail Start: [85]: Starting point of the dart on the trailing edge of the upper skin.

Nose Taper: [0.0-10.0%]: Width of the dart on the leading edge.

Tail Taper: [0.0-10.0%]: Width of the dart on the trailing edge.

(The taper values are common to both the lower and upper skins)

Lower skin (% of the chord):

Nose start: [15]: Starting point of the dart on the leading edge of the lower skin.

Tail Start: [75]: Starting point of the dart on the trailing edge of the lower skin.

The default values are conservative and can be used for all kites. Thanks to Paul Amiell , Paul Watson for these values, and Peter Thomas to have implemented em on FM by the way !

Export to VRML

Yours to discover!!!

Printing modes

Technical data impression:

When the **Plan View** window is active you can print the measurements of basis of the your wing. Three pages are printed.

Page 1: The goal of this page is to provide a hard copy of all parameters chosen for the kite so that you will be able to recreate it even if you lose the .kte file.

One recovers the big lines of your kite there.

Kite Parameters

Bridle

Centre Profiles

Tip Profile

Page 2: Shows information concerning the different pieces of cloth to cut to manufacture the sail. 2 sections:

Cutting list - Cells, Cutting list – Ribs

This page is a relic from the days before Foilmaker incorporated skin-shaping (originally only templates for the profiles were printed, the upper & lower skins were constructed from the measurements shown in this table). This information is now largely superfluous.

Page 3: Shows the measurement for the bridle.

Primary bridles (two of each required)

Split or Half-Cross secondary bridle (two required)

Printing the templates

When the **Centre or Tips Profile** windows are activated. While making **Print Preview**, all of the templates for the sail are shown on the screen. You can view the panels one by one, then print them together all or in part. (very convenient). There is some alignment marks in the four corners of the printed sheets. Use them to align the sheets carefully when creating the templates. I use a light-box to make it easier. I cut out the sheets for the template then attach the label to the panel with Scotch tape for identification. Then transfer these panels onto strong cardboard. If your spinnaker is translucent it is not even necessary to cut the panels, the spinnaker can be cut directly by transparency.

A new clever feature offer the choice to print the templates without the round dot anchor making the mathematical frame of the profile. Before printing the templates, when a profile window is active, Select the upper menu **VIEW** , and UNMARK the **WAYPOINTS** option. This feature is implemented for reducing INK needs as well as printing time. - (enjoy)

Appendix A: Specification for the sail (load sheet)

I desire as a feature: _____

To define the sail in a global way:

Parafoil(Tracor):___ All around:___ Racing:___

To define the Range of use:

Strong wind	Medium wind	Weak wind
1.3-2.8m ²	3.0-5.5m ²	5.5-10m ²

Approximate surface area: _____ m².

To define the shape: Rectangular:___ Rhombic:_____ Bielliptic:_____

Major details and tendencies:

	Tractor	All around	Racing	Wind condition
Aspect ratio	2.8-3.5	3.5-4.0	4.0-5.0	
Profile thickness:	16	15	14	Weak wind
Profile thickness:	17.5	16	15.5	Medium wind
Profile thickness:	19	18	17	Strong wind

Choice of **Aspect ratio**: _____

Choice of **profile thickness**: _____

Primary bridle: 1/1 1/1-1/2 1/1-1/3>>>> D-Ribs

Secondary bridle: 1/1 1/2 1/3

Split or Half cross: _____

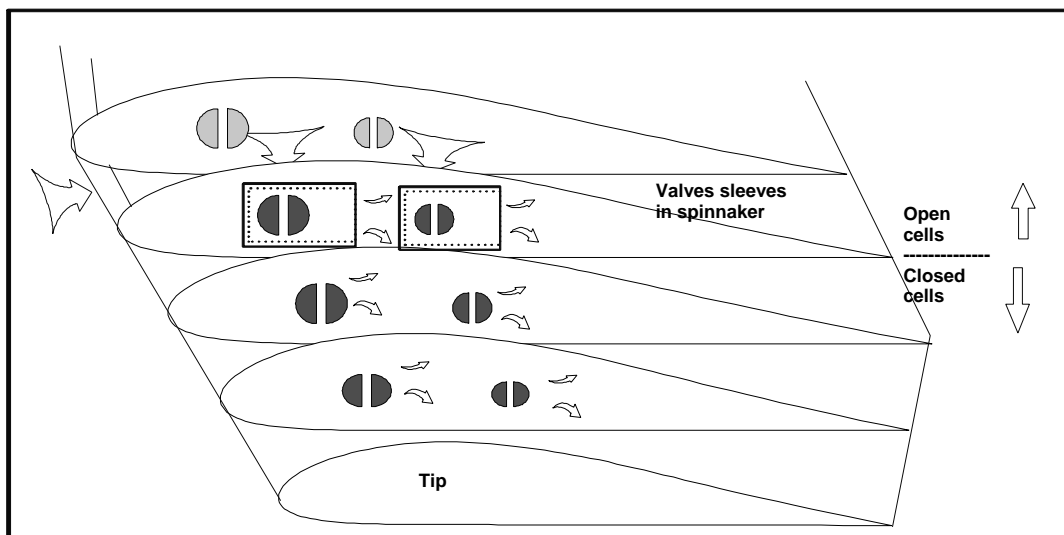
From :Homo-Patentus-Mosus web site

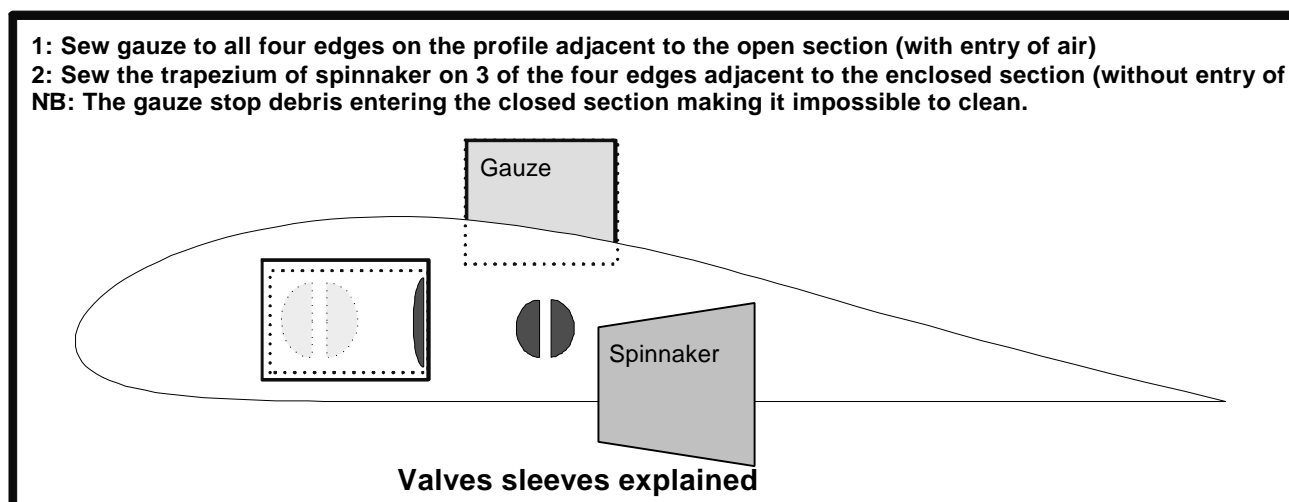
dag@bbsi.net

Appendix B: Pocket valve explained

You can also make kites that have 3, 4 or five enclosed cells at the wingtip. It offers the following advantages especially when a valve is included between the closed section and the centre section of the kite.

- 1: Rigidity of the wing is increased which limits the frequent accidental collapse of the tip sections at the edges of the window, especially in low winds.
- 2: Permits radical turns to be performed because the tips no longer deflate.
- 3: You won't finish your session with one kitefull of kelp, sand, branches, snow,...your choice according to your region.
- 4: Improved looks ... your kite won't look as though it was made at home on the kitchen table (even though it was!).





Appendix C: Symptoms and Remedies

We have some minor translation correction to do here please be patient.

Power:

To begin define a normal behaviour. A wing **used in its optimal wind conditions must be capable** of being positioned nearly overhead at 90° and wait there without constant manoeuvring by you. It is here that you will feel its minimal traction (minimal lift). When it tries to come out of this position you feel a significant increase in tension on the flying lines. You will notice that the length of your flying lines must be exactly equal if the wing is to stop at the zenith. **First note: the wing keeps the zenith.** While braking of a quoted you should be capable to hire the wing in the window of flight. Traction will be proportional to speed of the kite and it's position in the wind window. A pass through the horizontal will let you experience the maximum traction (MAX LIFT) of your wing. **Second note: the wing accelerates without distorting itself.** This moment occurs normally just before clearing the middle of the window on the horizon. You are therefore able to feel the difference in traction.

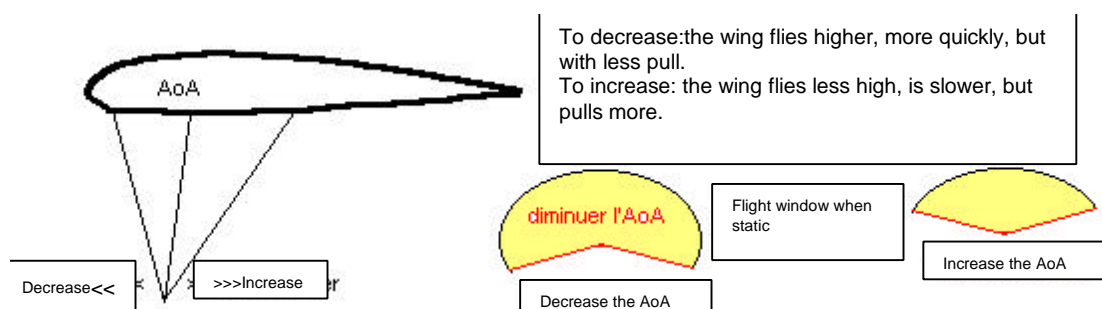
Brakes:

You should not experience any difficulties keeping the kite in flight. **Third note: the wing keeps its direction.** If your wing always turns in one direction when the tension of

the lines is equal and the brakes are slack that is not normal. You should see an identical (but opposite!) response from the kite when you apply the right brake and then the left brake. You should be able to slow down the wing slightly in order to reduce its power and without having difficulty keeping its shape. **Fourth note: the wing brakes (slow down)**. It is a simple security precaution! By applying the brakes harder you should be able to provoke a STOP (Stall) then resume forward flight. **Fifth note: the wing could stall**. You should be now able to brake abruptly and fly backwards. Although in this situation it can be very difficult to keep the kite stable.

You should be able to hold the wing stationary at the edge of the window without it stalling, collapsing or folding of the wingtips. It is in this bad position (for the wing) that you can judge its stability. **Sixth note: The wing stay steady (stationary) at the edge of the window**.

The window of flight judges itself in static and in the range of wind foreseen of the wing.



Small window of flight:

The wing doesn't go up to the zenith. Stalls frequently and is slow.

- Bridle stretch can be the cause. Verify that you have used adequate materials for the bridle. (150kg sheathed for the primaries and 220 kg sheathed for example for the secondary).
- Check the brake tension if nothing is stretched without reason. The brakes in flight must be loose and relaxed. The central brake bridles are not necessary.
- If the problem persists, it will be necessary to decrease the AoA.

Too big flight window:

the wing continues rising passed you to the zenith and falls behind your head. It gets close to the edge of the window then collapses unpredictably. (this is how I lose some hairs in the back of my head- Dag)

- The AoA is too low. (the profile is too effective for the drag imposed by the bridle)
- You have two choices. Either you increase the angle of attack by the same percentage over the whole wing
- Or you only increase the angle of attack at the wingtips of wings in order to preserve the speed of the kite. And when you learned to slow down a little when the edge of the window is approached you will have a powerful kite. But it will sometimes be unsteady, especially in gusty winds.

-

Frequent collapsing at the top and edges of the window:

Observe if the collapsing closing is frontal or at the wingtip. The remedy is different.

- Frontal closing. Increase the AoA or reduce the length of the "B" row primary bridle leg by a few mm. (5-8) for the kites smaller than 4 m², (7-10) for kites of 4 to 6m²... use your judgement. It distorts the profile a little but it is not catastrophic at this little an order.
- Collapsing following a closing of a wing tip: Bad AoA of the wing tips. It is necessary to increase the AoA gradually as one comes closer to the wingtips.

-

Doesn't keep its position:

- Check the length of your flying lines...Some times! Just in case!
- You have a bridle stuck and caught in the back of the canopy or in a knot of the secondary bridle or your adjustable bridle system (the most frequent reason).
- Your adjustable bridle has slipped because of the tension on it.
- A friend helped you to adjust the AoA and in fact did the opposite of you: he reduced the AoA and you increased it!! Or ... his centimetres are longer than yours...
- One or several of your bridle measurements are not left/right symmetrical.

-

Wingtip closes or folds when accelerating:

- Bad internal pressure of the cells. If your kite has closed sections at the tips, did you allow enough slack in the cross-vent valves?
- Bad AoA of the wing tips. It is necessary to increase the AoA gradually as one comes closer to the wingtips.

Stalling

- Too thick a profile! Decrease the angle of attack to improve things, but be careful not to pass the point instability at the zenith. This sail must be kept continually in movement.
- Too much brake even at rest. Loosen the brakes a little.
- The central brakes need not be installed. Foilmaker calculates them...but you don't need them. In fact they even harm the turn!!!

Unequal Left/Right turn

Verify the [knot rope tying placement](#) , handles and length of the flying lines.

- Verify for a bridle tangled on a knot
- Verify your measures of slings finally.
- Check your sewing. Did you sew any profiles upside-down?

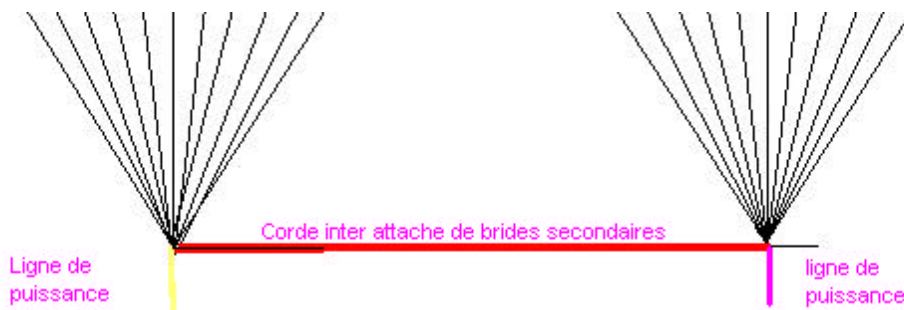
Over Steering:

The profile is too thin for the category and the surface used.

- Would be necessary to lengthen the secondary sling and to take the SPLIT fashion.

Under-steering: The profile may be too thick for the category and the surface used.

-
-



- One can either to use an inter - attachments chord of order lines in order to keep the pivots more toward the centre and to influence thus on the speed of the turn. To see sketch.

- Other solution: Shortening the secondary bridle and/or to take the HALF CROSS bridle configuration.

Skid at the end of turn:

The bridle doesn't have anything to matter there unfortunately has one could see. The sail is probably flat like a Tiger, therefore the solution is of quoted it of the lateral winglet addition.

Accordioning in the span axis:

The wing is flying under its wind range ?

- Too short secondary bridle.
- Insufficient air inlet; insufficient internal pressure. Enlarge the air inlet.

Accordioning in the chord axis:

- Too short primary bridle (< 60%???)
- Too weak internal pressure, add more air entries or enlarge the existing ones.
- Decrease the length of the sleeves of the enclosed valves. (2.5 to 3 times the length of the air entry is ample.

-

Excessive slowness:

Too thick profile? Excessive drag?

- Brakes permanently applied?
- Central brake bridles uselessly installed?
- Bad AoA? Reduce the AoA considerably (almost to the point of instability at the top of the window).

Excessive speed:

Overshoots the top of the window.

- Too thin profile?
- Increase the AoA.
- Shorten the brakes to keep them in tension.

Appendix D: Programming of a .pfl File

Using a text editor, create a text file and save it with the extension **.pfl**

The first line of the file is reserved for the title and comments.

The second line of the file is reserved for the chord length. It's easiest just to insert **1.000000** here.

After the second line, the coordinates are entered starting at the trailing edge, along the lower skin to the nose, then returning along the upper skin to the trailing edge.

Begin by entering the X coordinate. The value at the TE is always the chord length (usually **1.000000** – see above). Next to the X coordinate, enter the Y coordinate (Don't forget to put a minus sign " - " before the data if applicable).

Continue entering coordinates, one to each line, until you reach the nose. (**0.000000 0.000000**)

Finally, return along the upper skin to the trailing edge.

No value must be higher than 1.000000. Therefore the numbers, which are generally percentages, will be divided by 100. Eg. 95% will give: 0.950000 1.25% will give:0.012500 and so forth.

The file will look like this (bold types for end of clarification only):

Naca 4415 PARAGLIDERS (aerofoil)

1.000000

1.000000 -0.001600

0.950000 -0.003600

0.900000 -0.005700

0.800000 -0.010300

0.700000 -0.015500

0.600000 -0.023500

0.500000 -0.027200

0.400000 -0.032500

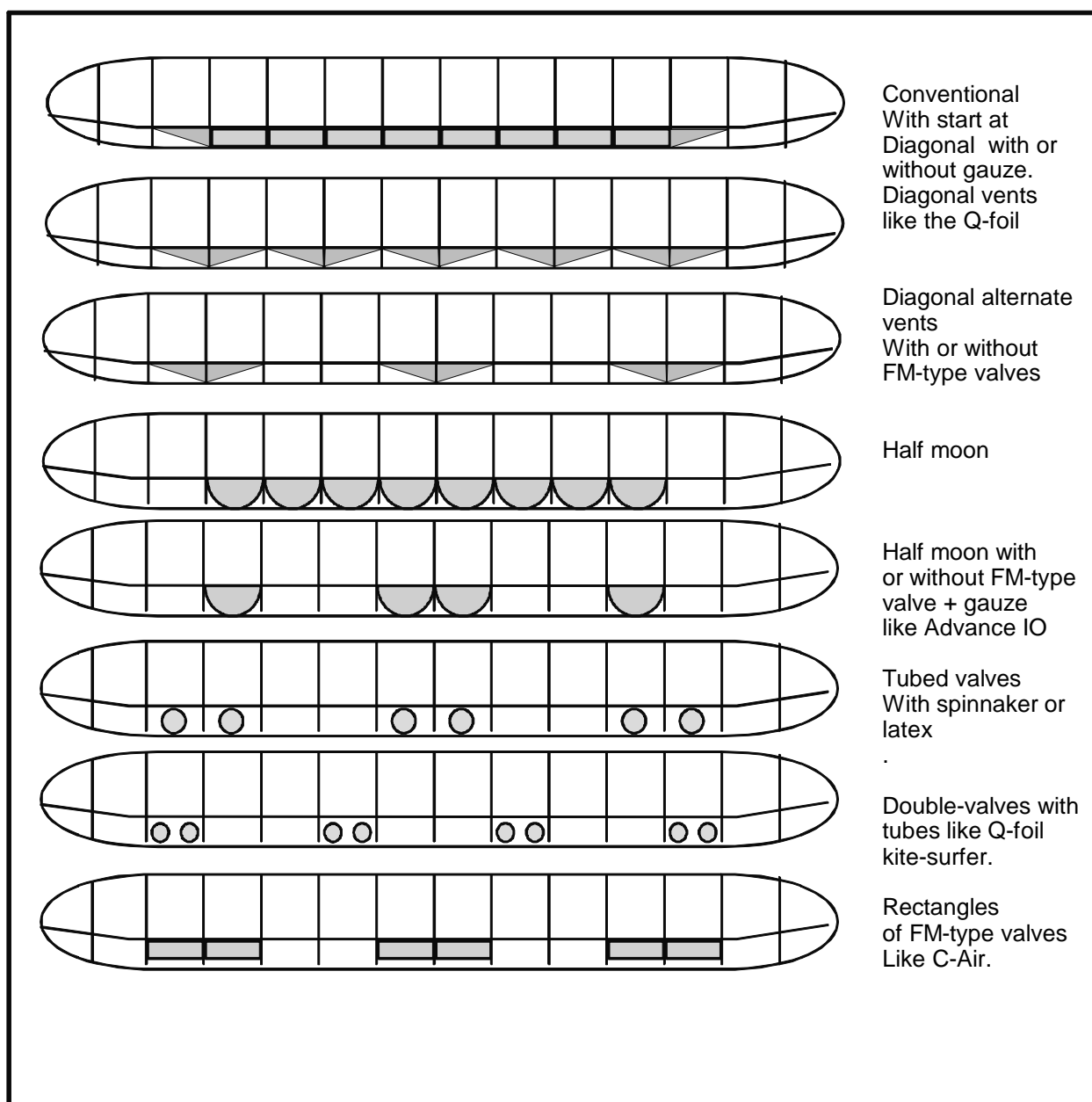
0.300000 -0.037500

0.250000	-0.039800
0.200000	-0.041500
0.150000	-0.041800
0.100000	-0.039800
0.075000	-0.037100
0.050000	-0.032700
0.025000	-0.024800
0.012500	-0.017900
0.000000	0.000000
0.012500	0.030700
0.025000	0.041700
0.050000	0.057400
0.075000	0.069100
0.100000	0.078400
0.150000	0.092700
0.200000	0.102500
0.250000	0.109200
0.300000	0.112500
0.400000	0.112500
0.500000	0.105300
0.600000	0.093000
0.700000	0.076300
0.800000	0.055500
0.900000	0.030800
0.950000	0.016700
1.000000	0.001600

Appendix E: Ideas for Vent Openings

Several variations can be considered for the vents: they can have rectangular openings, diagonal, half-moon, irregular. They can be on every cell, alternate cells or in groups. Be creative!

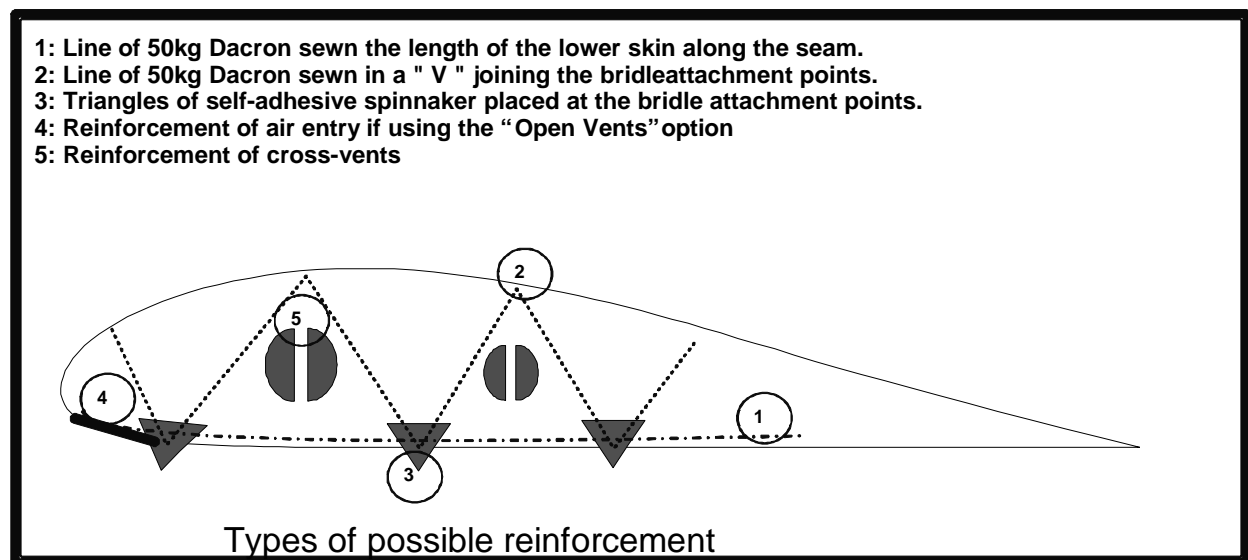
NB: Attach the **vent** panel first to the **lower panel**, then trim it to taste. The size will be reported on cloths and we will have whereas only one piece to cut and ...**sew**. If you understood well, the panels of the **Upper panel** remains unaltered no matter the choice of air entry. ...



Appendix F: Preparation of the Panels and Sewing

Preparation of the panels.

The zig-zag features on the profiles determine the bridle attachment points. You should transfer onto the profile and on the lower skin panels the place where the bridles are attached. The points at the beginning and end of the air entry will also be transferred onto the profile. Profiles for which the air entries are open (without gauze), should have a reinforcement added to the nose.(see sketch: Types of reinforcement below). If you want to make the cross-vent holes, also take note of this sketch. If you make a wing with irregular air entries, one profile out of two will have a reinforcement on the nose and the other none. The lower skin and upper skin panels will also need to be reinforced at the leading edge if the cells are open and un-gauzed. A Dacron ribbon of 2.5 cm folded in 3 will do the business (Cut the Dacron WITH A HOT IRON).



Now the Sewing

Method of sewing for wings with shaped-skin cells as produced by the Foilmaker software:

I begin by using a sewing guide to help accurate sewing and to align the spinnaker at the same time. In this way I NEVER have a mountain of cloth under the arm of the sewing machine..... or mountains of cloth to roll up. I adjust the guide distance in mm with the alignment of the needle. When my needle is to ==> (right), the stitches are 5mm from the edge of the cloth. When my needle is at the centre, I have a 7mm seam.

Personally, I prefer to proceed cell by cell, starting at the right extremity of the wing (view ventrally)

1: If the cell is closed or with gauze, I first sew the vent panel to the lower panel and then I sew both to the upper panel.

2: I do a first sewing pass on the two panels of the adjacent lower skin while inserting the bridle attachments into the seam and while ironing two times on the sewing in this place. I adjust my sewing guide to 5 mm for this first sewing.

3: I also do a first sewing pass on the two panels of the adjacent upper skin... again with a 5mm seam.

4: I position the nose of the profile so that the marks of the beginning of the vent opening are under the foot. I adjust the sewing guide to 7mm and I sew along the lower skin with a normal stitch except for a zig-zag section 2cm before, over, and after the bridle attachments. I continue in this way to the trailing edge.

5: I cut the threads and remove the sail.

6: Then I reposition the needle at the nose of the profile to tackle the most difficult part... the sewing of the upper skin and the profile. For the first few centimetres, I advance the sewing stitch-by-stitch by hand. Then, I continue along the upper skin to the trailing edge.

I continue like this cell-by-cell, taking the time to really verify the orientation of each of the parts. It is easy to get confused because the spinnaker does not have a front or back. Only a rigorous labelling method can help here. Wings with a lot of camber are difficult to sew in the wingtips.

You've reached the last cell – don't panic! You take the last 5 or 6 cells, roll them in spiral and Scotch tape a ribbon on the spiral to hold it together temporarily. You wrap the lower skin and the upper skin around the spiral while aligning them carefully. You place the bridle attachments (toward the inside this time because the sail will be reversed) and you sew a 7mm seam, with zig-zags at the bridle attachment points, to the trailing edge. You turn the last cell inside out like a sock and remove the Scotch tape from the spiral. You unwind and you admire your kite with a galls of 10 year old , port in your hand. What JOY!!!! If you were capable to continuing this project up to here, there are now no more problems for you.

You finish by cutting all along the trailing edge with a hot iron. It can happen that some panels are shorter or longer by about 1 centimetre. To make them all equal and to make a double hem, sew a ribbon of 2.5 centimetres folded in half sandwiching the sail. Remember to insert the bridle attachments and to sew them with a zig-zag.

I know that this method is different from the one often described, but it has the advantages that it makes EXTREMELY precise sewing possible and that there is NEVER a roll of material under the foot of the machine, and that, more often than not, causes imprecise sewing.

To come...appendix on the bridle and its formatting. (adjustable bases and all)...

Many thanks to Bob Finch and Peter Thomas for this translation!!!