Appendix 3.
How to use the Universal Round and Broadseam Calculator.

Despite a lot of effort to find a better alternative method, the spreadsheet still appears to be the simplest way to produce the numbers to build a cambered panel. It has been tidied up to make it extremely easy to use. Please download the file *'Universal Round & Broadseam Calculator.xls'*

Only 4 entries are needed to provide the data to build a parallelogram panel, and one of these is only the label. Simply fill in the top 4 boxes with the Blue Labels in each column. Please note that all measurements should be entered in millimetres, and the results will be in millimetres.

Please do not click below these cells as the rest of the spreadsheet is not (yet) protected, and can be corrupted. If you do damage it, simply download it again and start again.

The first box. Panel Number & Edge.
This is simply the label to help make sure the numbers don't get mixed up. Simply input the panel number and whether it is the U (upper) or L (Lower) batten you are referring to. If both battens are the same length then it can be marked U & L as the one set of numbers will cover both upper and lower edges. If the battens are different lengths then it is necessary to calculate a separate set of numbers for each edge.

The second box. Camber % C.
This is where you enter the percentage camber you want to use in the panel. Just enter the number to one place of decimals, such as 8.5 or 6.0. There is little point in using anything less than 6% camber even in the top fanned panels where even this amount will produce surprising little shape.

The third box. Finished length mm.
This refers to the designed length of the edge of the panel along the batten, and is entered as the length in millimetres. This is not the length of the batten, which will be discussed later.

The fourth box. Length of Flow mm.
In practice the wind does not blow horizontally from luff to leech, but as we are not able to accurately predict the direction we simply assume that it does blow horizontally and accept the errors. In the lower parallelogram panels with a batten angle of 10° or less then we consider that the air will flow along the full length of the panel, so the length of flow will be the same as the Finished Length in the box above.

The difficulty arises in assessing the Length of Flow for the upper fanned panels, due to the tapering of the panels and the steeper angle to the horizontal. To work with the table the following technique seems to give a satisfactory result.

On a scale drawing of the rig draw a centre line along the panel from the centre point of the luff and to the centre point of the leech of the panel in question. Mark the centre point of the resulting line. Now draw a horizontal line through this centre point so that it crosses both battens for that panel. Measure the distance along the line from one batten to the other and that is the figure used for Length of Flow for that panel. In some cases it may cross the leech and the top batten, so that is the length to enter.

With a high peaked yard the Length of Flow of the top panel may be little more than the distance between the battens at the centre of the panel.

Results.
Once these four boxes in the spreadsheet have been filled in the rest of the boxes should show the results. The following points should explain how to use the information.

Fifth Box. Batten Length.
This is simply a reminder that the batten will normally be longer than the planned length of the panel along the batten and a simple figure of 1% has been added to the panel length. Note that common sense will probably suggest a different figure which may depend on whether the battens are long or short. If the calculations are being done for the mainsail panels of a split rig then the batten length will obviously be completely different, and this box is irrelevant.

Sixth box. Camber Depth mm.
This figure is the depth of camber you should expect to find in the finished panel. It is a function of the percentage camber and the length of flow, and not the panel length, so will be quite small in the fanned panels.

Seventh box. Sail length Luff-leech.
As the length round a curve is longer than the straight-line length between two points, the actual sailcloth has to be longer than the planned length on the batten, or the Finished Length entered in box 3. When building the panel this is the length you need to draw along the batten line as the surplus material along the edge will be removed by the broadseam.

Eighth box. Round each Edge mm.
This is the maximum depth of the round to be drawn at the maximum camber point, and should be applied at each edge of the panel. If the battens are of different lengths then this figure will have to be calculated separately for the side toward each batten edge.

Ninth box. B-E = Broadseam mm.
This figure is the total amount of broadseam that has to be taken out of the edge of the panel to reduce the length of sailcloth around the edge of the round to fit the Finished Length without wrinkles. If using a soft cloth this can be ignored and the small wrinkles accepted as then really don't effect the performance of the sail, as Arne so clearly has demonstrated. However, if using a 'hard' material like polyester, which won't wrinkle easily, it is more important to use the broad-seam. Again this figure will be different for the top or bottom edge if the length along the battens are different. The amount to allocate to each seam is discussed elsewhere.

Tenth box. Depth of Broadseam.
This is simply a statement that when using broadseam that the seam should start getting broader from a point three times the depth of the 'round' at each seam from the edge of the panel. This should be illustrated in a diagram on building the panels.

Eleventh box. Max C from Luff mm.
This is simply a suggested position for placing the maximum camber point on each panel. It is based on a 37% position for the parallelogram panels and increases as the panels fan upwards to a maximum of 50% chord. Various builders may which to modify these positions.

Sample.
To illustrate the process the numbers for a parallelogram panel have been entered into the spread-sheet and show how the system works. They can be removed to provide more space simply by highlighting the first 4 boxes (**individually**, as there are hidden calculations in between) and de-leting them.