INTERNATIONAL 420 CLASS ASSOCIATION

HULL APPENDAGES INSPECTION GUIDE

Ver. 1 - 07/2008

INTRODUCTION

This guide is meant to help standardizing the inspection process at the 420 Class main events. Class Measurers are encouraged to improve on the described process, but at least they should follow this basic pattern to ensure that centerboard/rudder inspection is done properly and on the same quality level each and every time. It is essential that the required steps are explained clearly to the assistants who do the job, and this guide is made with that task in mind.

SETUP

Inspection can be done using either separate tables or a single one, big enough for both centerboard and rudder templates to fit inside. A simple supporting structure with a separate panel for our template is enough, although sometimes a table is provided as is. Optimum material for the template is a melamine-coated panel, which provides us with an excellent flat surface, erasable, and probably less expensive than plywood. In the major class events there is always the class-owned rudder template so only the centerboard one needs to be made.

Tools needed:
A good big carpenter's square, 1m ruler, small (20-30cm) ruler, pencil (0.35mm works really nice), color pens, eraser, clear tape, and rules. Three devices about 25mm long are also needed (small black cylinders in the figures) to put at points A, B and C. These must be such that the foils touch them at one point only. Cubes may be also used but you may damage the foils because their edges are sharp. For checking the foils themselves, a straight edge at least 1m long is needed; an aluminum square section hollow bar is OK. A 20X20mm section is enough but with three beams like that you may also do a crude thickness check. A square angle like that used for the mast stoppers is also needed for mark transfers.

Centreboard

Dimensions of template panel: about 1000 X 500 mm

- First step: use the carpenter's square to draw very carefully the axis system
- Once the axes are set, mark points A, B and C (B and C shown below). The actual center of the hole depends on the cylinder's diameter! In this example there is no hole marked yet.

Fig.1 Tools

Fig.2 Axis system

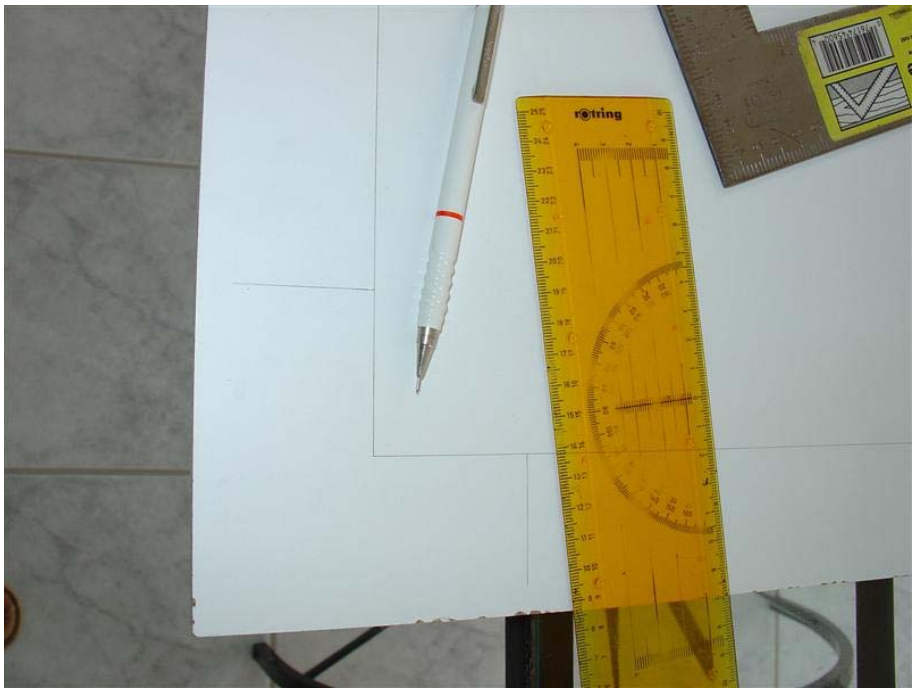


Fig. 3 Axis origin and marks for points B & C

- Mark the rectangular area for the pivot. It should be painted afterwards either all dark-colored inside, so the pivot center must be within the dark part, or outside (legal pivot position is inside the white part then).

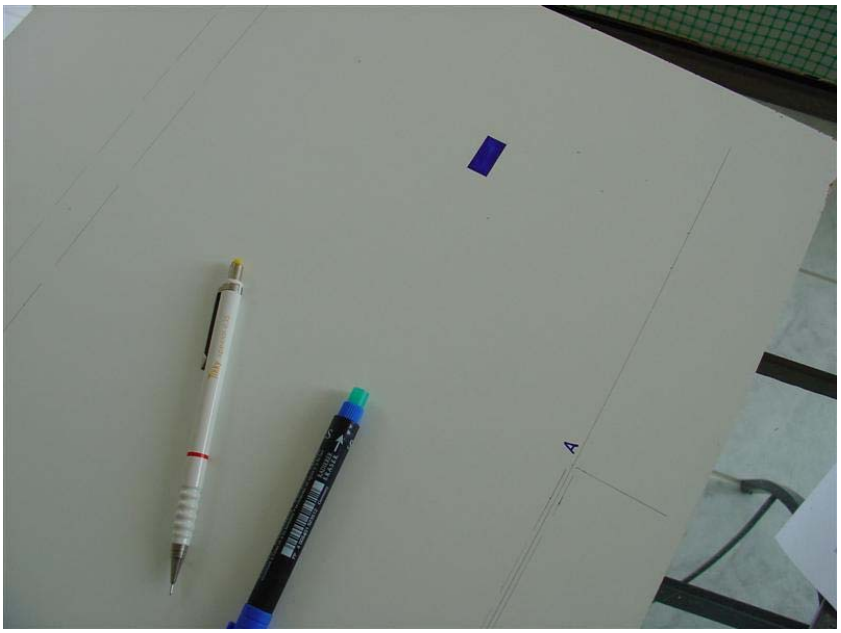


Fig.4 Pivot area mark (dark inside)

- Draw the min and max lines for the width (trailing edge) at 415mm and 425mm from x-axis, with point (G) at 995mm from y-axis and also mark the limitation lines at the bottom leading and trailing corners (minimum at 85 and maximum at 45mm from corner points). Mark the inside (or outside) of the legal areas at the corners. For the trailing bottom corner, in reality there is an infinite number of line sets, because there is the width tolerance of the blade itself. However, only the maximum width set is really needed, if the inspectors re-position each rudder to the max width position before checking that corner's shape!

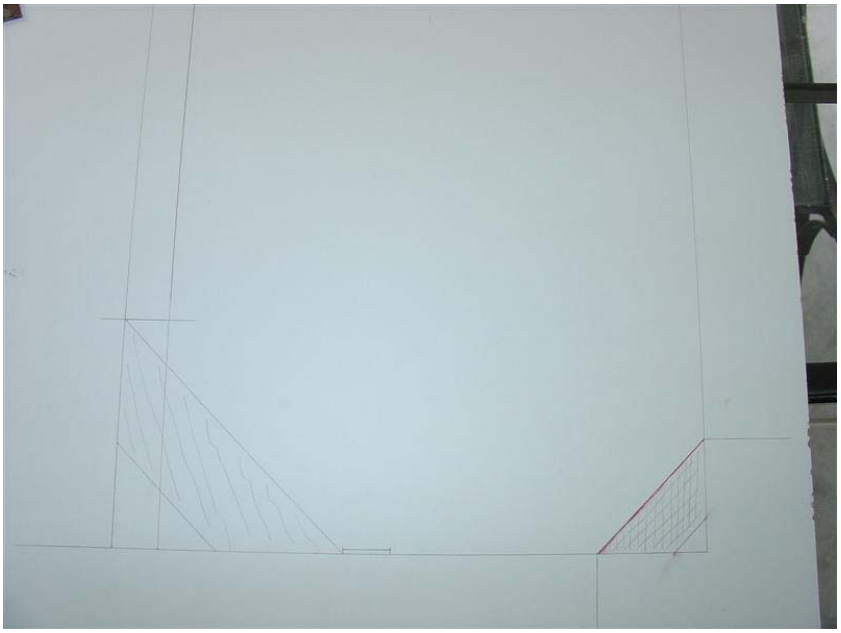


Fig. 5 Width limit & bottom corner lines (example from 470 class rudder template)

- Draw two dashed lines 2mm +/- off the (leading edge) x-axis (Fig. 6). They are needed to check foils that are not perfectly straight-edged! For the bottom edge, you just need to do it in point D (always at 85mm from the corner E) and only above the Y-axis line (Fig. 7). To check the trailing edge's straightness, you may use the straight bar or turn the rudder blade so the trailing edge is on the template's x-axis.

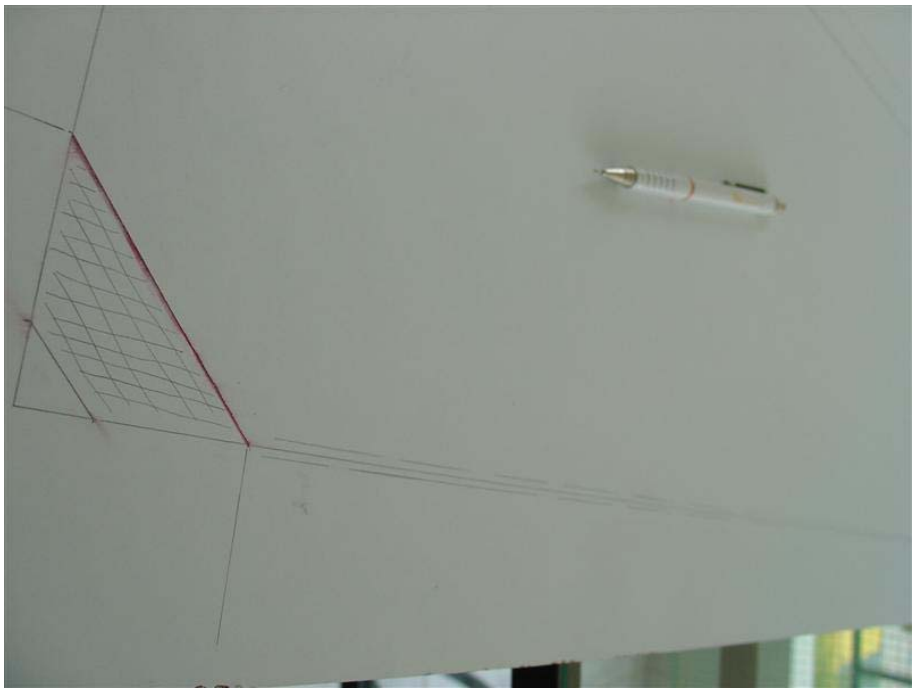


Fig. 6 Leading edge offset lines

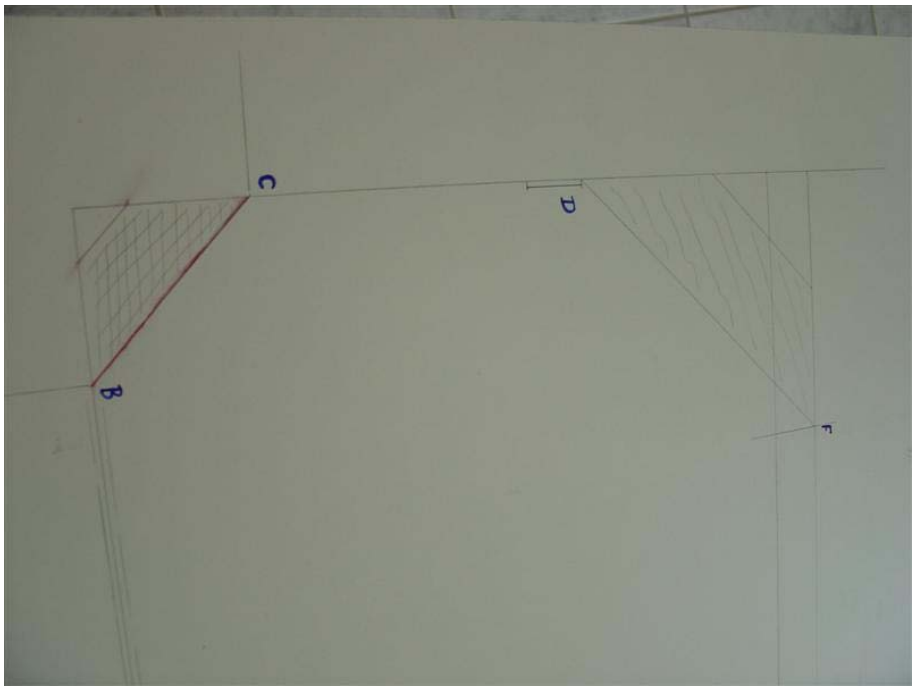


Fig. 7 Bottom edge offset at D

- Cover all lines with clear tape! That will hopefully preserve them till the last day of the event's measurement time.

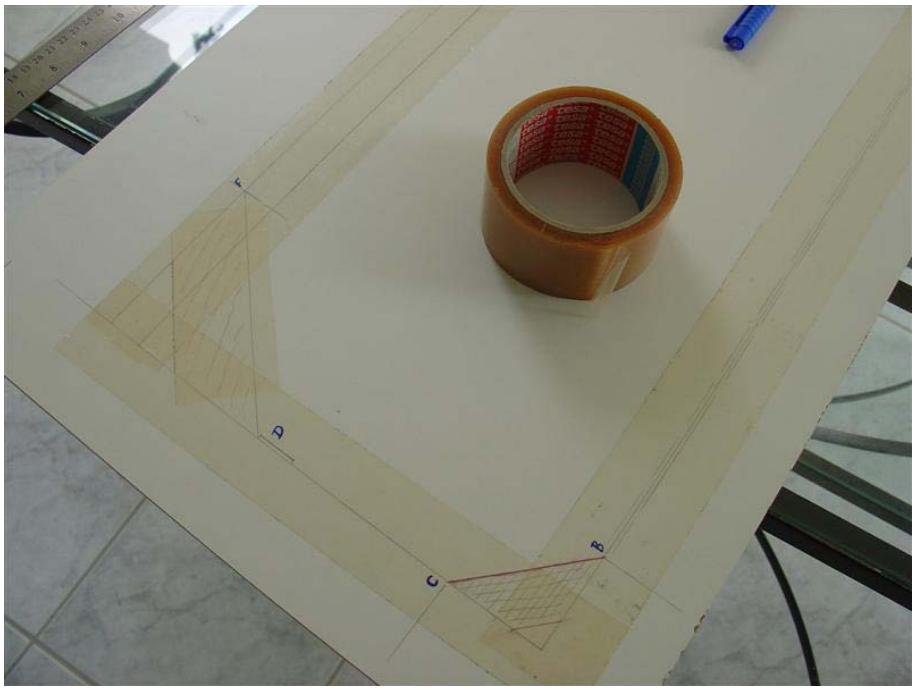


Fig. 8 Protect the lines!

- Final step: drill carefully the holes and fix the cylinders (B & C points shown in Fig. 9). You may also put a copy of the rules in one corner. If you print it in landscape form with two pages per sheet, all centerboard rules (E.2) fit in one sheet of paper. Protect it from water with clear tape!

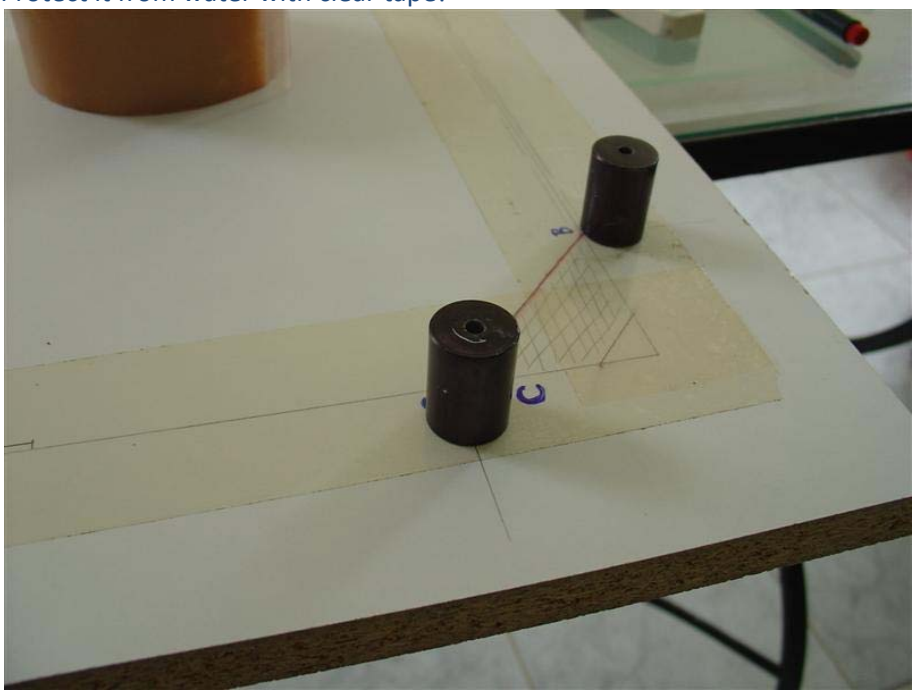
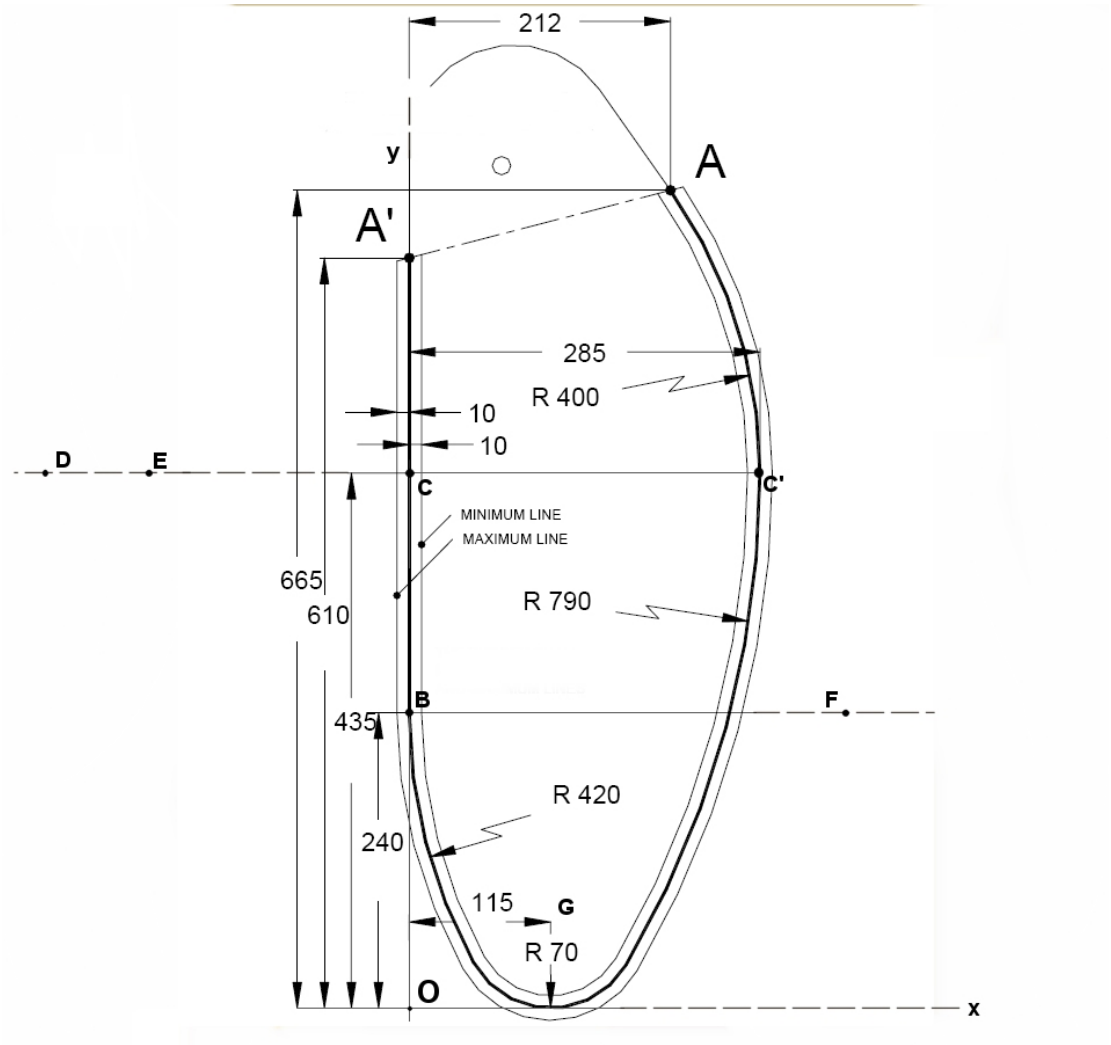


Fig. 9 B and C point cylinders

Rudder

Dimensions of template panel: about 750 X 350 mm



First draw the original profile shape, and then add the minimum and maximum curves:

- Use a carpenter's or a laser square to draw the axis system, with origin O and axes Ox and Oy as above.
- Mark points B, C and A' on axis Oy with (x,y) coordinates in mm as below:
  B (0, 240)
  C (0, 435)
  A' (0, 610)
- Create lines parallel to axis Ox from points B and C as shown above.
- Mark points D and E on the line passing from C. These are the centers for the R400 and R790mm arcs that will form the leading edge.
  D (-505, 435)
  E (-115, 435)
  You just deduct the 285mm width of the blade from the 400 and 790mm radii to find the x-coordinates!
- Mark point F on the line passing from B, which is the center for the R420 arc that will form the lower part of the trailing edge.
  F (420, 240)
- Now draw with a pencil the line BA', and the three arcs. The two that form the

leading edge meet at point C' (just draw the R400 over and the R790 below this point). You must find point A (212, 665) which is the uppermost point of the leading edge to be controlled.

- Mark point G at (115, 70) which is needed for the bottom R70 arc. Draw this arc until it merges with the R420 on the trailing edge and the R790 on the leading edge.
- To make the minimum and maximum lines which are the ones you actually need to use the template, you draw with a thin marker pen the following:
  Two lines parallel to line BA' but offset by +/-10mm to the left and right,
  An arc at R800mm and another at R780mm from point D
  An arc at R390 and another at R410 from point E
  An arc at R410 and another at R430 from point F and finally
  An arc at R60 and another at R80 from point G
  Draw the line AA' and its extensions to meet the minimum and maximum limit curves.
- Either paint the inside area or the outside one between the two sets of curves to mark the legal or illegal areas respectively.

APPLICATION OF THE CENTERBOARD/RUDDER TEMPLATES

Blades have to be clean & dry.

- The rudder control is very easy and straightforward, just try to fit the blade so that all parts below the line AA' are within the limits. Move the blade up, down, left and right or even rotate it inside the template until it fits. Try all possible combinations before ruling out a blade!

The centerboard is more complicated but again straightforward: Position the centerboard on the template so that it touches **all** three cylinders at points A, B and C:

Fig. 12 Points B & C

Fig. 13 Point A (Example from a 470 rudder which has a similar shape)

Fig. 14 Centerboard on template

- Mark on the blade points F & G: G is the point of the trailing edge at 995mm from y-axis.

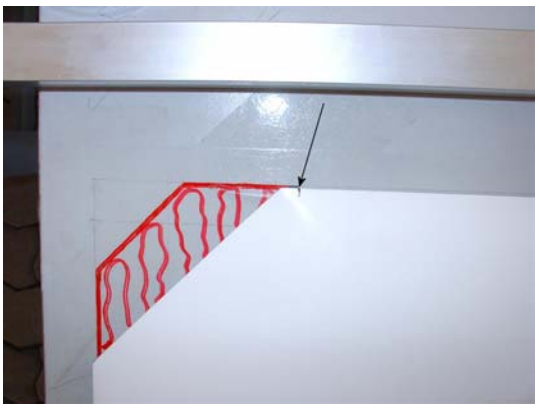


Fig. 15 Point F

- Check leading edge bottom corner and pivot point. In the following example the legal leading edge corner area is painted red.

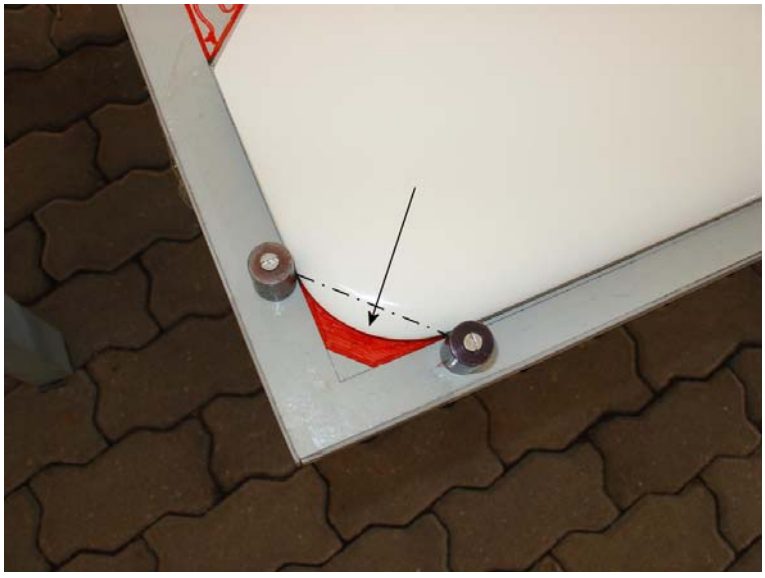


Fig. 18 Corner area

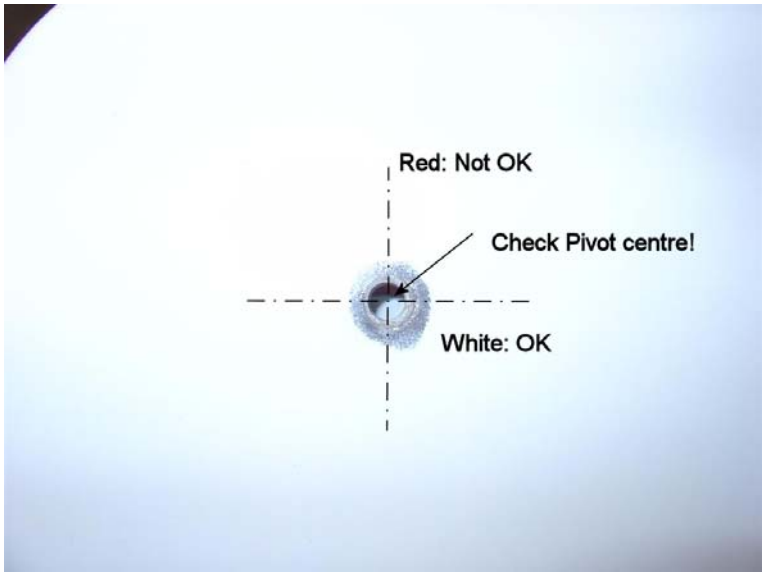
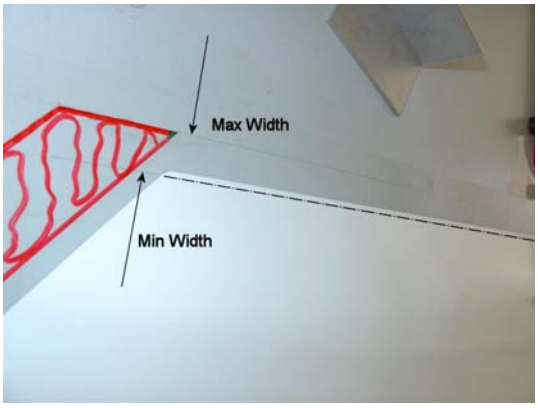
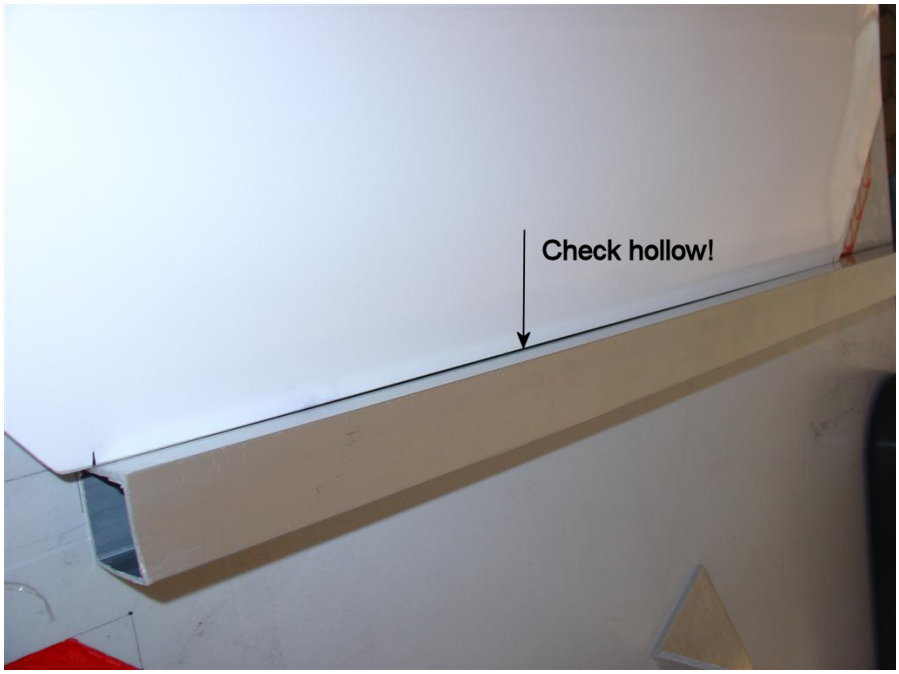


Fig.19 Pivot hole; in this example the legal area for the pivot is white and the boundaries are painted red.

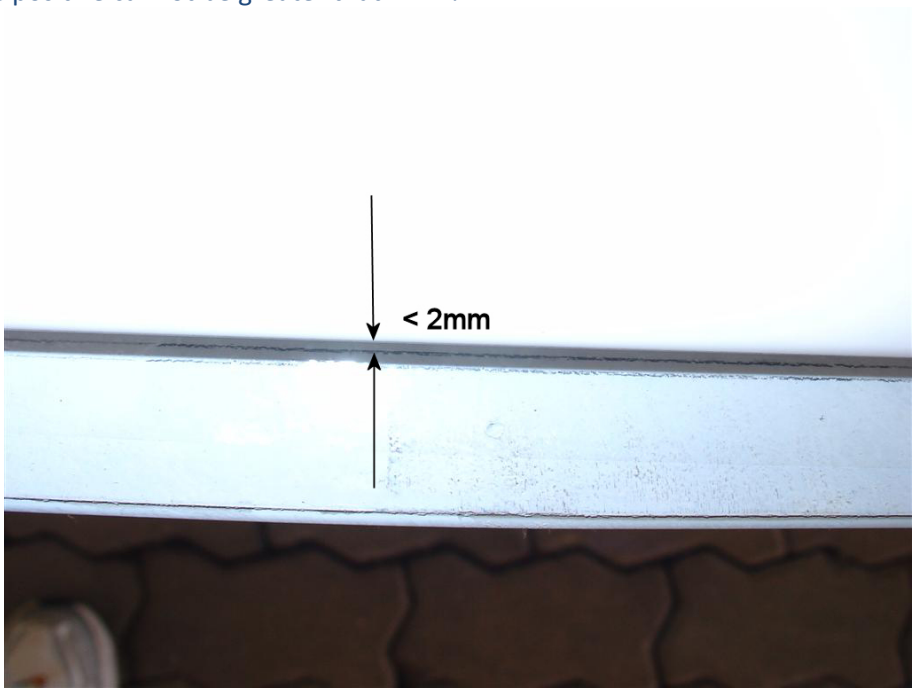
- Using the straight edge, extend the trailing edge to the y-axis and find point E. Check rudder width using the min/max lines. Check the width at point G and compare it with that at the bottom edge OE. Difference shall be no more than 2mm!



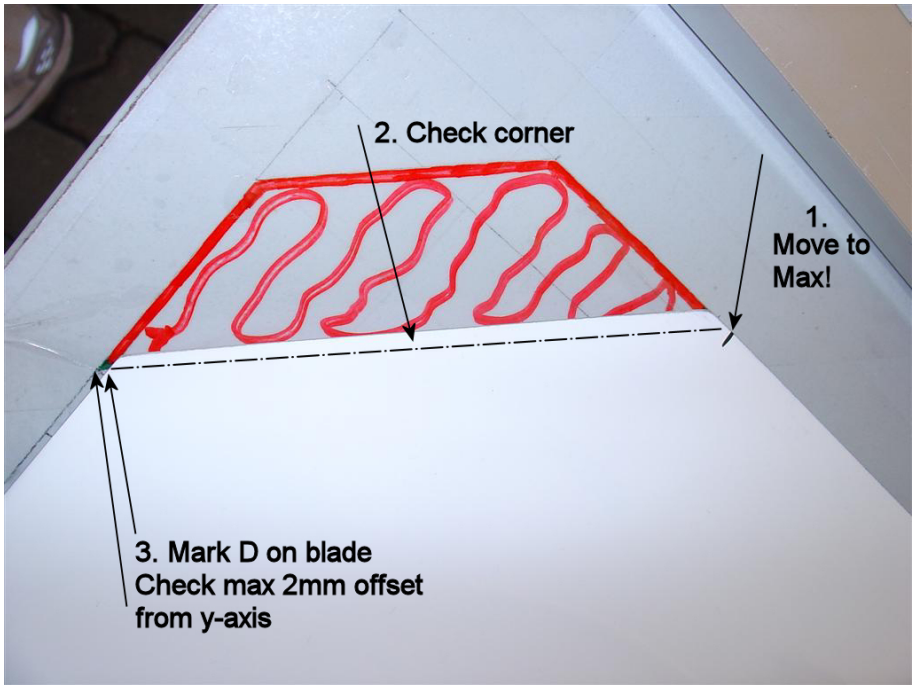
- Check the straightness of the leading edge by comparing it with the x-axis and the two +/- 2mm lines, and then the trailing edge using the straight edge between points F and G. Check the maximum hollow (less than 2mm)



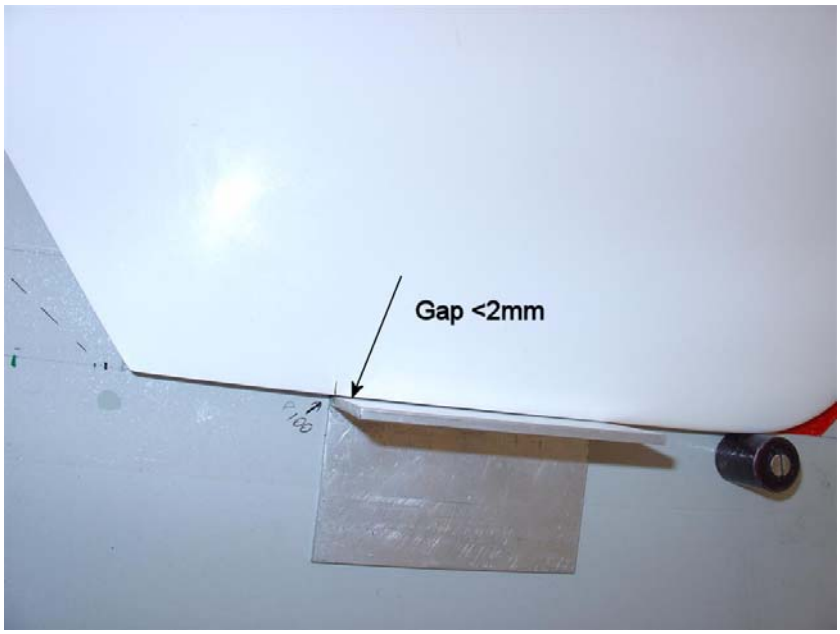
In some cases, the middle of the trailing edge lies outside the line connecting points F & G. The tolerance is still 2mm but to measure it, first balance the difference so the gap at point F is the same as the gap at point G. Remember to subtract this gap length from width OE! For cases where there is both positive and negative difference from the straight edge, then remember that 2mm is the **total** difference permitted! If you have 1mm negative (hollow) then the positive cannot be greater that 1mm!



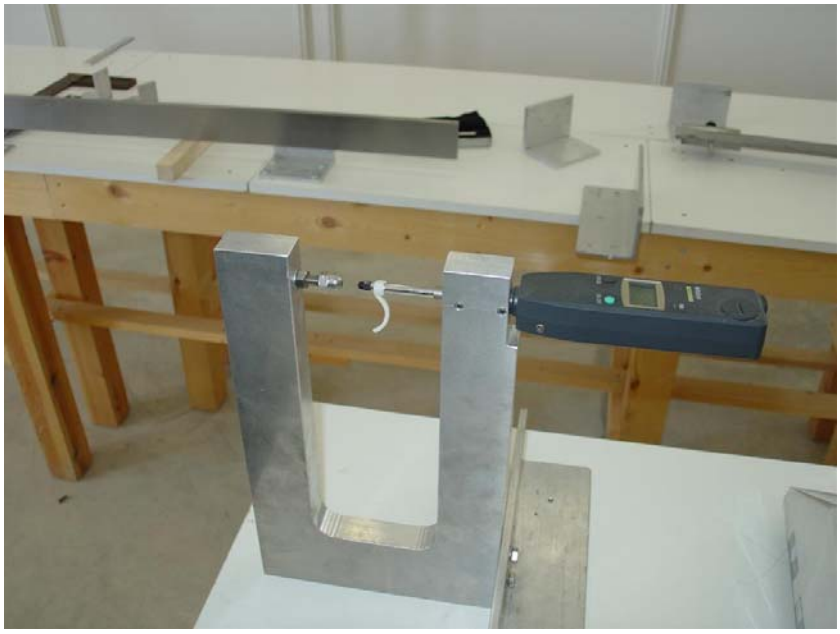
- To check the trailing edge bottom corner, always place the blade at the maximum width position first! After doing the corner, check point D and the difference from y-axis (maximum 2mm). Remember that boards with the bottom edge going below y-axis are not permitted.



- Always use the small square to transfer the template marks to the measurement point when you are in doubt or when the board is close to the limit!



- Thickness measurement should be done with a slot tool or with more sophisticated equipment like the specially adapted micrometer shown below:



If these tools are not available, two additional straight beams (at least 20mm high) may be used instead so that you have the first at the trailing and the second at the leading edge, with a third (smaller) one bridging the first two. Then you can measure the gap between the 3rd beam and the blade, subtract it from 20 and find crudely the thickness (template surface must be absolutely flat!)

Dimitris Dimou
Int. Measurer, Chairman of the TC