



*the boat the world sails*

# HULL APPENDAGES INSPECTION GUIDE

(Ver.1 09/2007)

(For Use By the Int.470 Class International Measurers)

## 1) INTRODUCTION

This guide is meant to help standardizing the inspection process at the 470 Class 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.

## 2) 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. Aluminum templates are also possible if there is adequate class funding, which will save the measurers about 1-1½ hours of preparation time.

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 25X25mm sections you may also do a crude thickness check. A square angle like that used for the mast stoppers is also needed for mark transfers.

## Rudder

Dimensions of template panel: about 900 X 350 mm



Fig.1 Tools



Fig.2 Axis system

- 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. 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 (pivot legal position is inside the white part then).

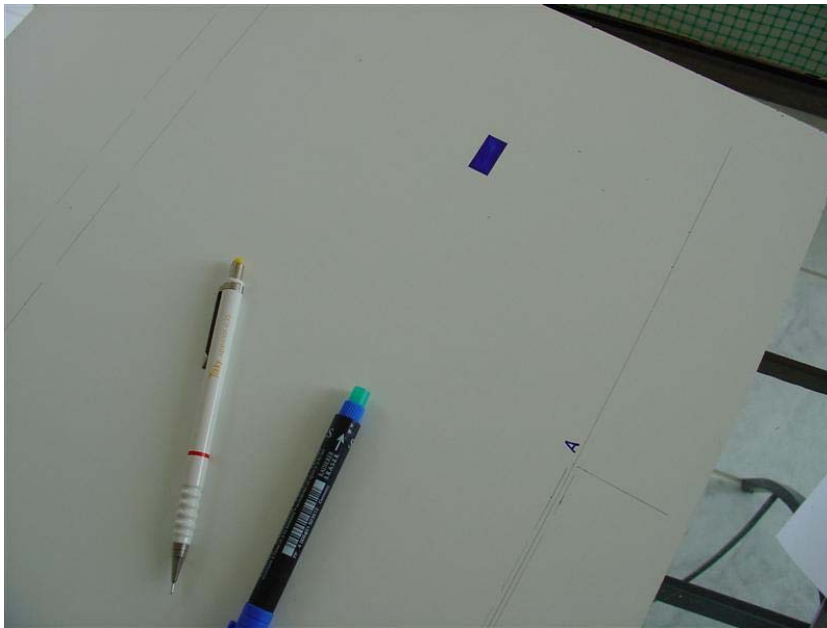


Fig.4 Pivot area mark (dark inside)

- Draw the min and max lines for the width (trailing edge) with point (G) at 516mm from y-axis and also mark the limitation lines at the bottom leading and trailing corners. 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!

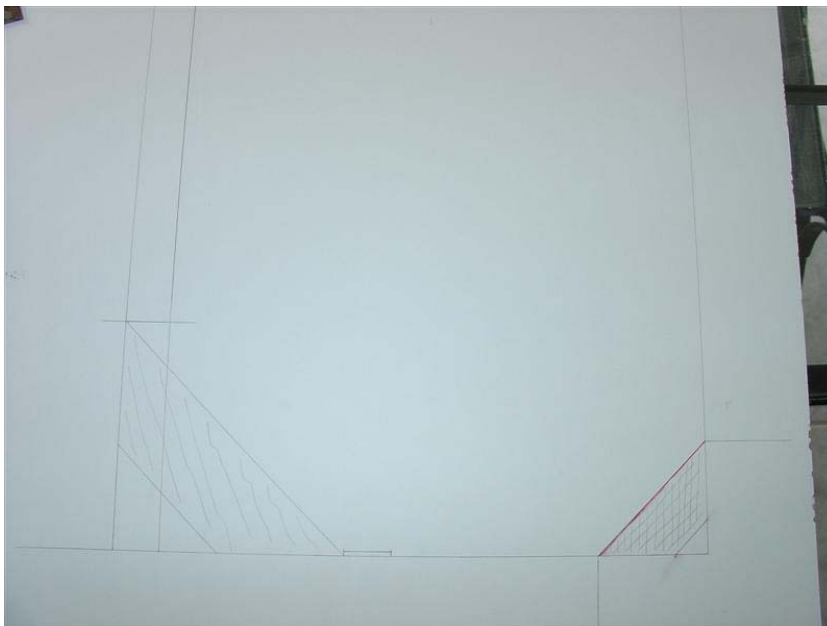


Fig. 5 Width limit & bottom corner lines

- Draw two dashed lines 2mm +/- off the (leading edge) x-axis (Fig. 6). They are needed to check foils that are not straight-edged! For the bottom edge, you just need to do it in point D (always at 100mm 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

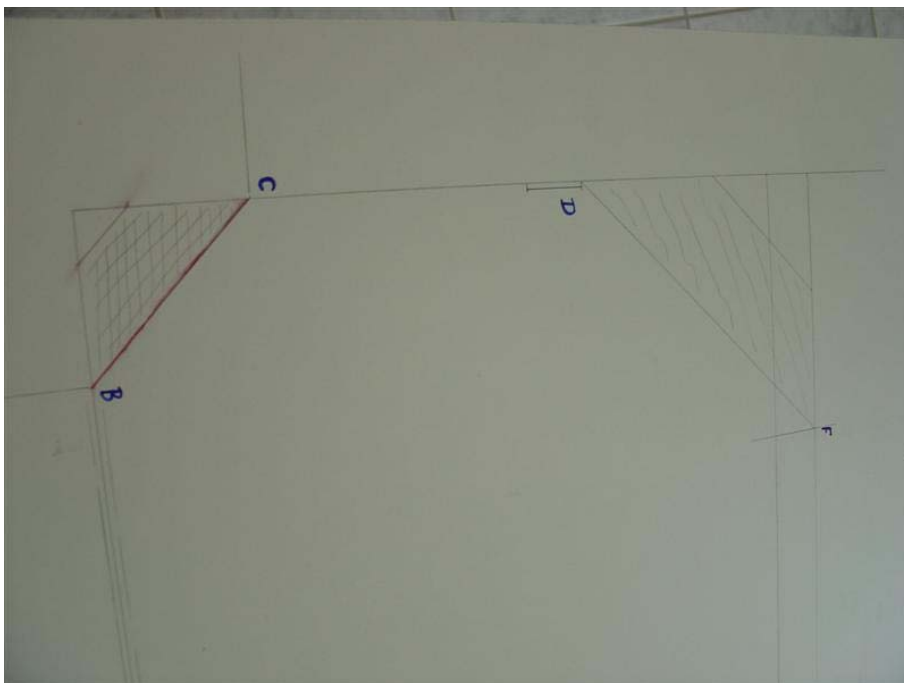


Fig. 7 Bottom edge offset at D

- Cover all lines with clear tape! That will hopefully preserve them till the end of measurement time.

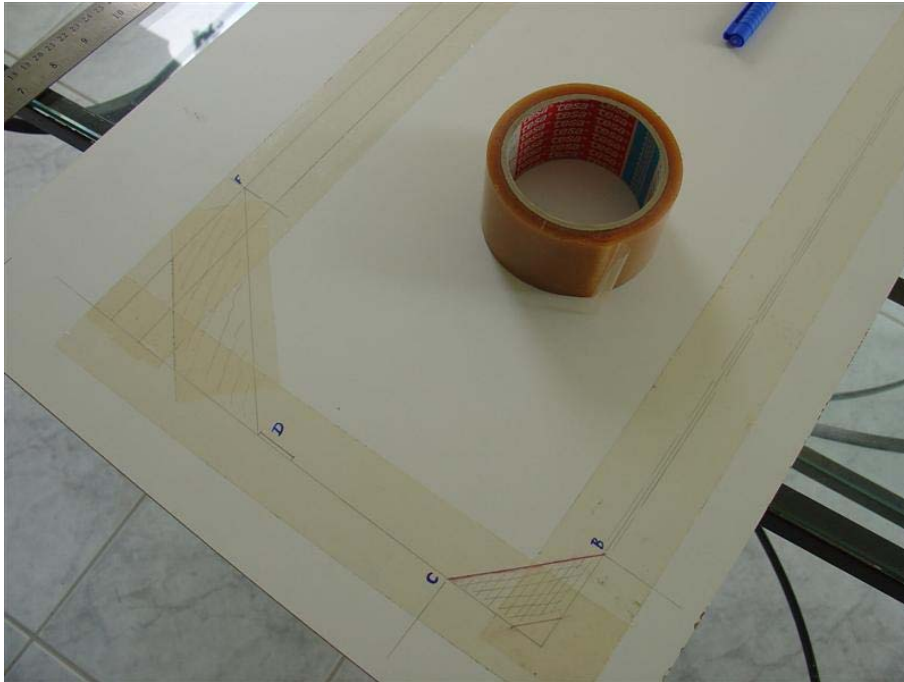


Fig. 8 Protect the lines!

- 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 rudder rules fit in one sheet of paper. Protect it from water with clear tape!

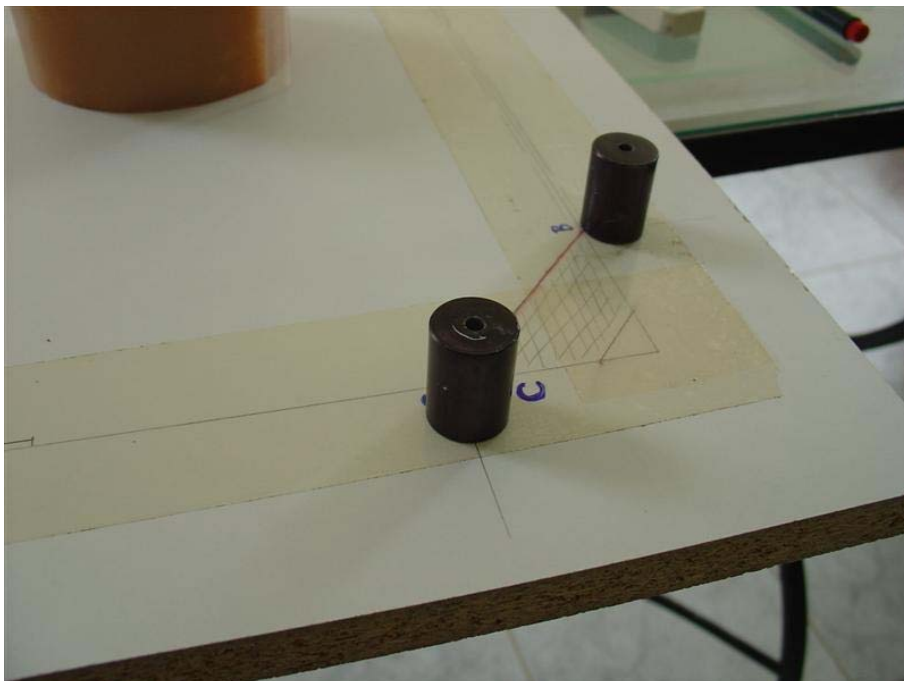


Fig. 9 B and C point cylinders

## Centerboard

Dimensions of template panel: about 1100 X 600mm. Make sure that the neck of the centerboard is lying outside the template itself, since in some foils the uphaul-downhaul blocks are practically fixed (see Fig. 14). Procedure is generally the same as for the rudder, but the centerboard doesn't have a set angle for the trailing edge, which depends on the bottom edge and upper point (G) widths. The following describes the additional steps needed:

- Mark the minimum and maximum widths at the Y-axis (Point E at the bottom edge, Fig. 10), two lines at 30 and 100 mm from Y-axis for points F' and F (also in Fig. 10) and a rectangle for point G (Fig. 11, like the one for the pivot).



Fig. 10 Bottom edge of centerboard template

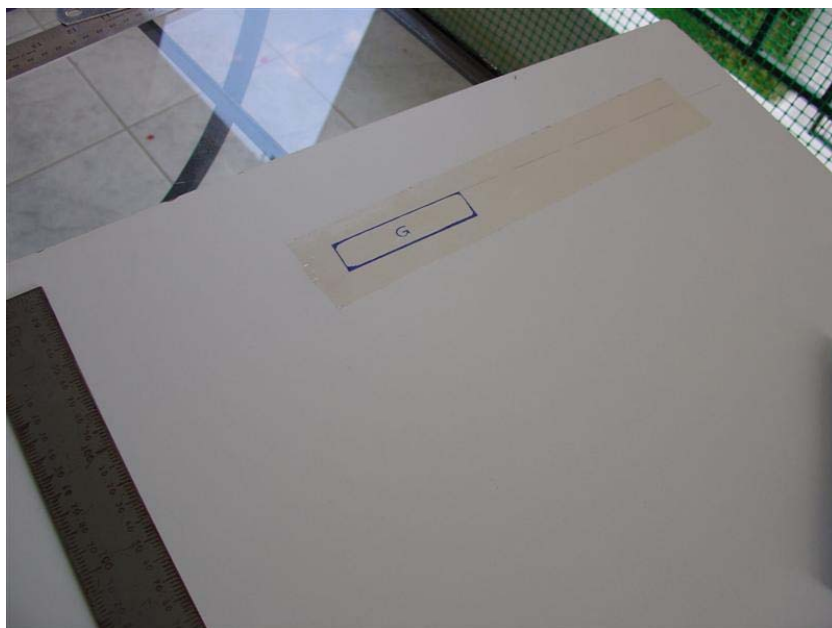


Fig. 11 Point G



### 3. APPLICATION OF THE CENTERBOARD/RUDDER TEMPLATES

Blades have to be clean & dry; centerboards without blocks when possible.

- Position rudder blade (or 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 (Rudder)



Fig. 14 Centerboard on template

- Mark on the blade points F & G: G on the centerboard is the widest point of the blade.



Fig. 15 Point F

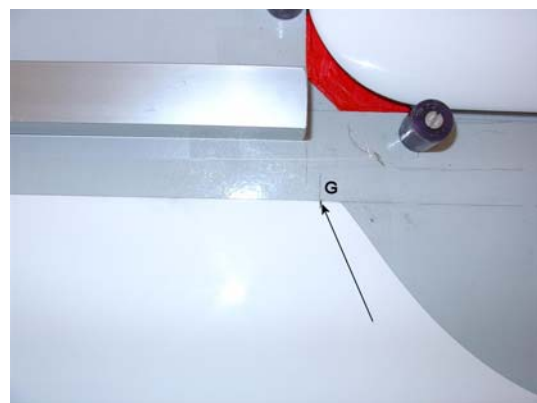


Fig. 16 Point G (Rudder)



Fig. 17 Point G (Centerboard)

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



Fig. 18 Corner area

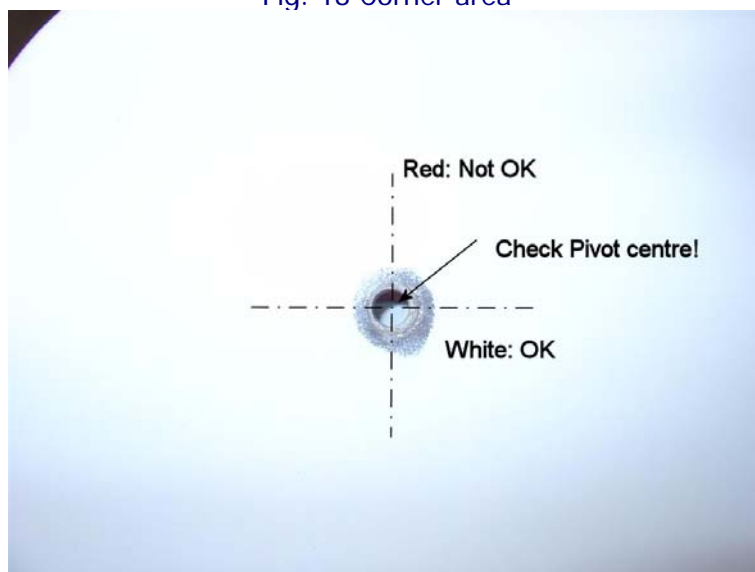
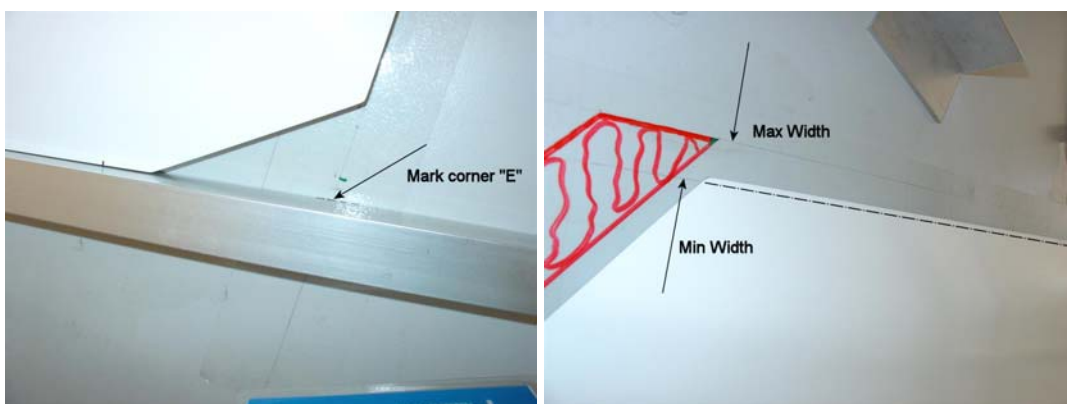


Fig. 19 Pivot hole

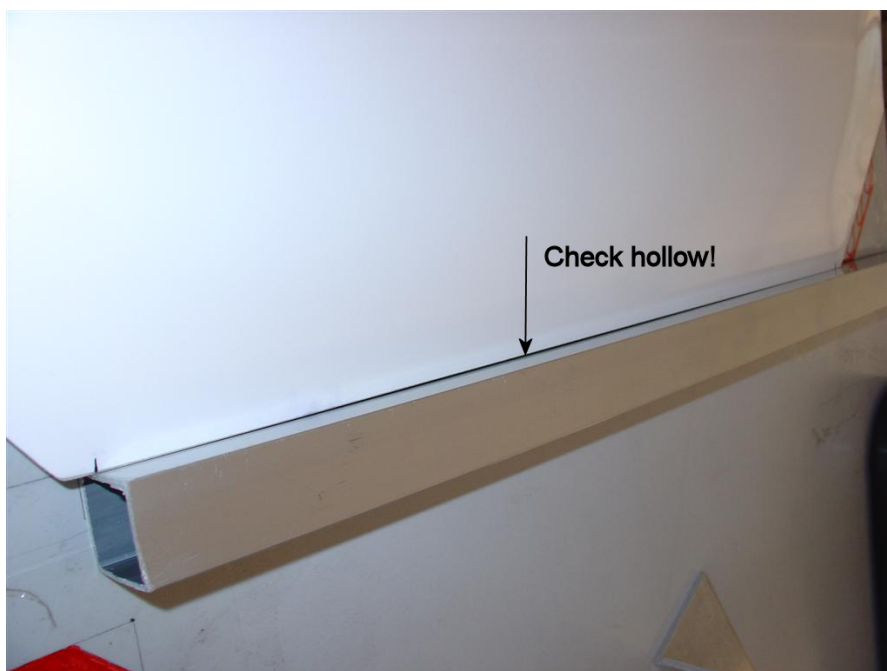
The pivot legal area is white and the boundaries are painted red.



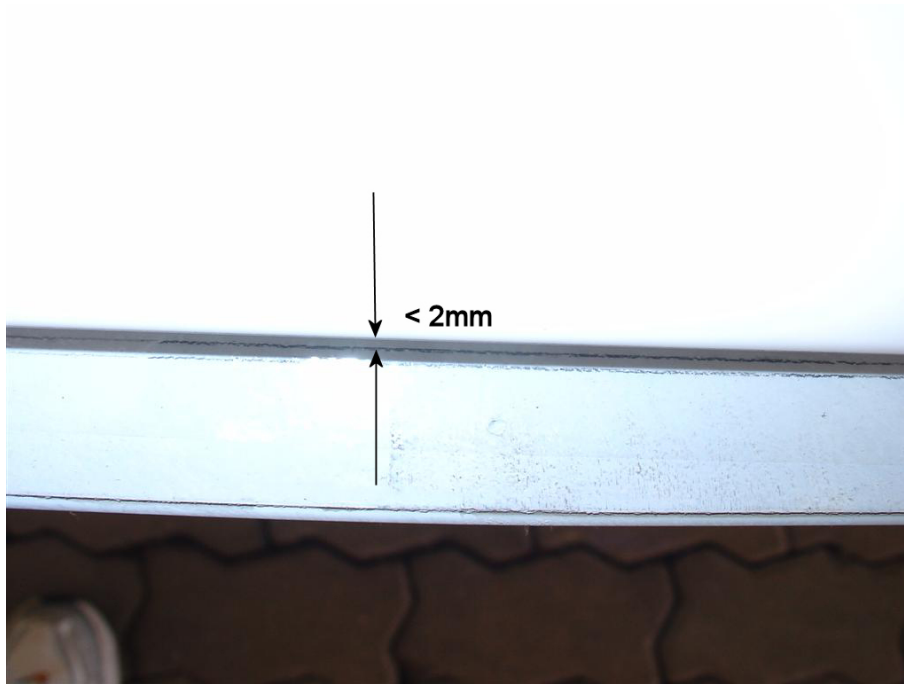
- Using the straight edge, extend the trailing edge to the y-axis and find point E. Check rudder width using the min/max lines. Check the width at point G and compare it with that at the bottom edge OE. Difference shall be no more than 2mm!



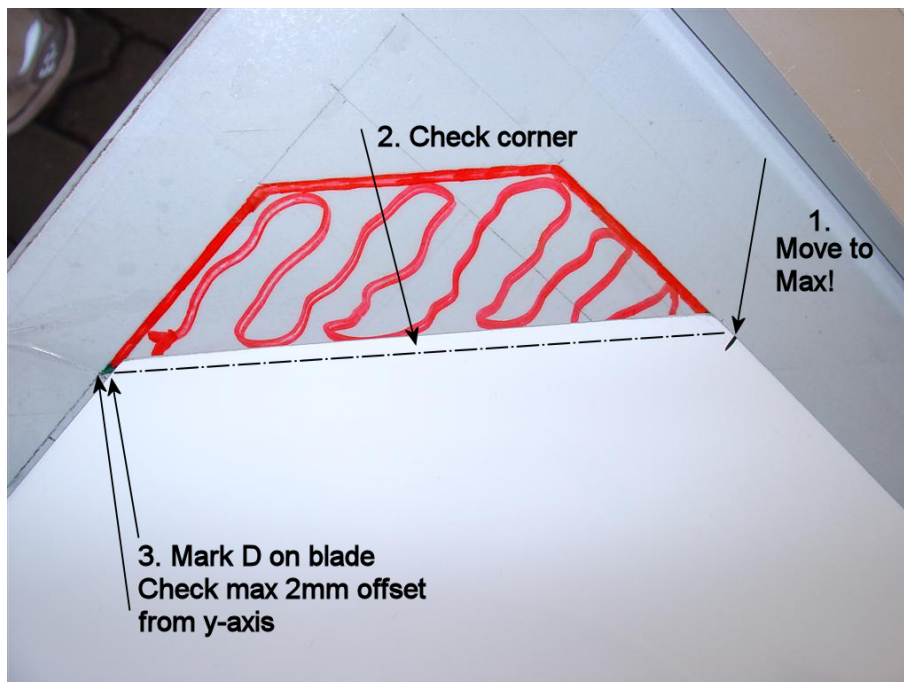
- Check the straightness of the leading edge by comparing it with the x-axis and the two  $\pm 2$  mm lines, and then the trailing edge using the straight edge between points F and G. Check the maximum hollow (less than 2mm)



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 than 1mm!

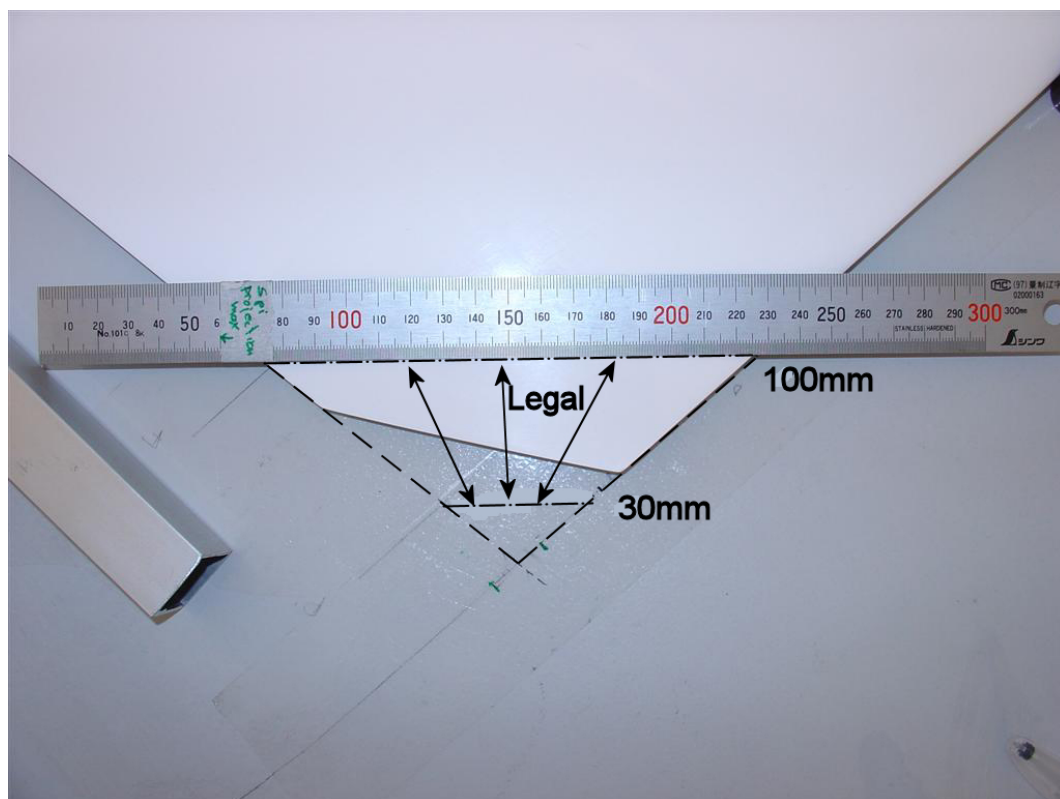
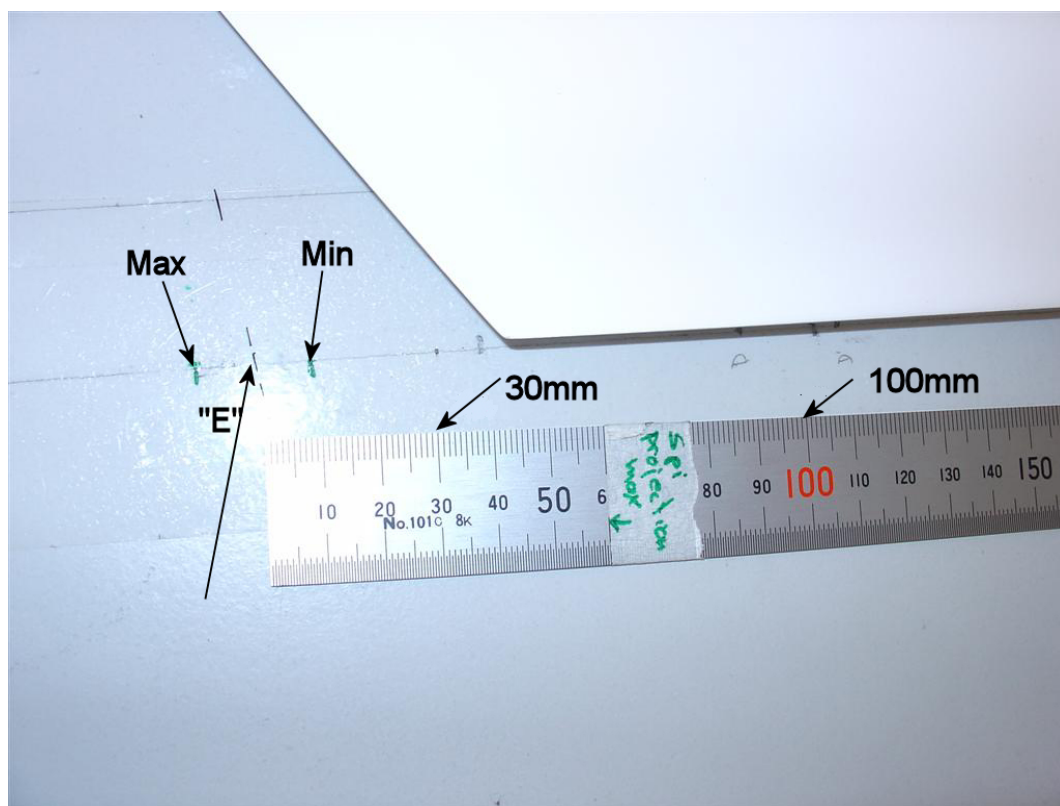


- To check the **rudder's** trailing edge bottom corner, always place the blade at the maximum width position first! After doing the corner, check point D and the difference from y-axis (maximum 2mm). Remember that boards with the bottom edge going below y-axis are not permitted.

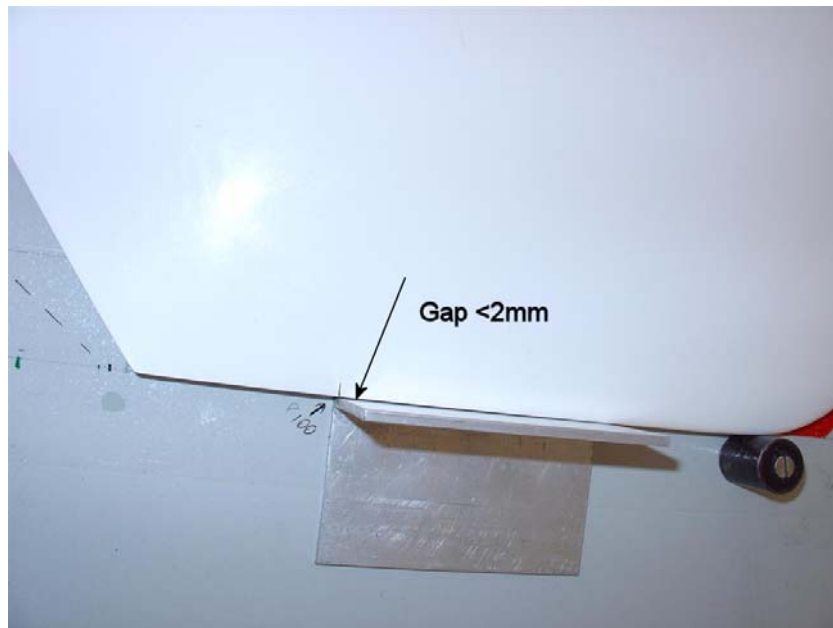


Remember to check point D and the difference from y-axis (maximum 2mm)

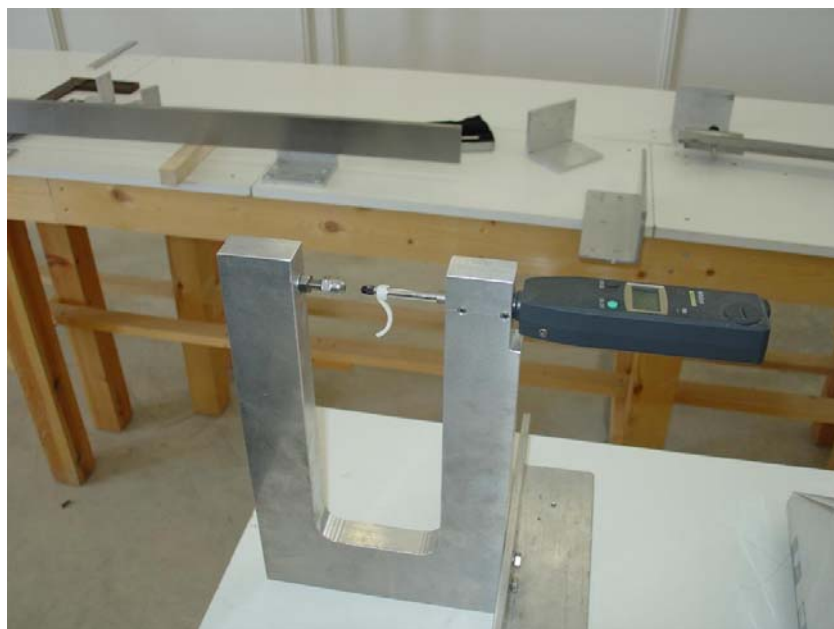
- For the centerboard, first find point E and mark it on the template (use something that you can erase afterwards!). Then, use a small ruler and mark the points on y-axis at 30 and 100mm from point E.



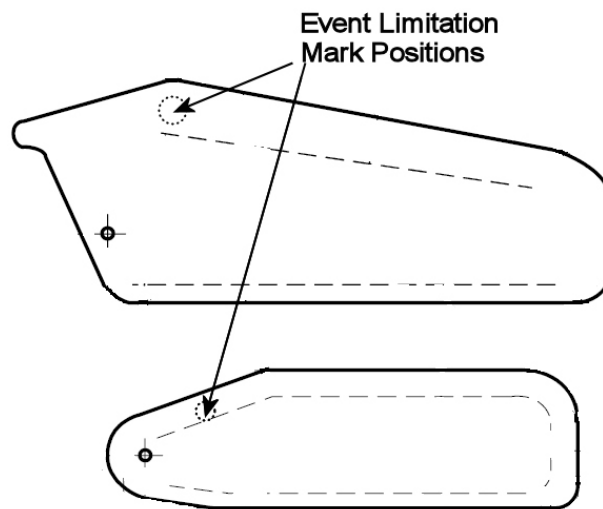
- Always use the small square to transfer the template marks to the measurement point when you are in doubt or when the board is close to the limit!



- 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 edges (at least 25mm 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 3<sup>rd</sup> bar and the blade, subtract it from 25 and find crudely the thickness (template must be absolutely flat!)



Finally, always check that the assistants put the limitation stickers at the correct position!

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