

World Sailing Manufacturer Control System

Title: iQFOiL Olympic Supplied Equipment (Hydrofoil System)

Olympic Class: iQFOiL

Equipment Item: Hydrofoil System

Project				
World Sailing Manufacturer Control System				
Title				
Scanner Report: iQFOiL – Olympic Supplied Equipment (Hydrofoil System)				
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Overview

As part of the World Sailing Manufacturer Control System project, which focuses on improving the quality of Olympic Equipment, World Sailing Technical Department and iQFOiL Class Association overviewed the process of supplied equipment for the Paris 2024 Olympic Games. This document focuses only on the hydrofoils system.

A total of 200 sets of hydrofoils were produced and inspected during the Last Chance Regatta in Hyeres in April 2024. The quota for the Windsurfing Events at Paris 2024 Olympic Games is 48 sailors equally divided in Men (24) and Women (24). Each sailor received 4 sets of hydrofoils (each set consists of 1 Frontwing 900, 1 Rearwing RW255, 1 Foil Mast OMA95, 1 Fuselage 115+).

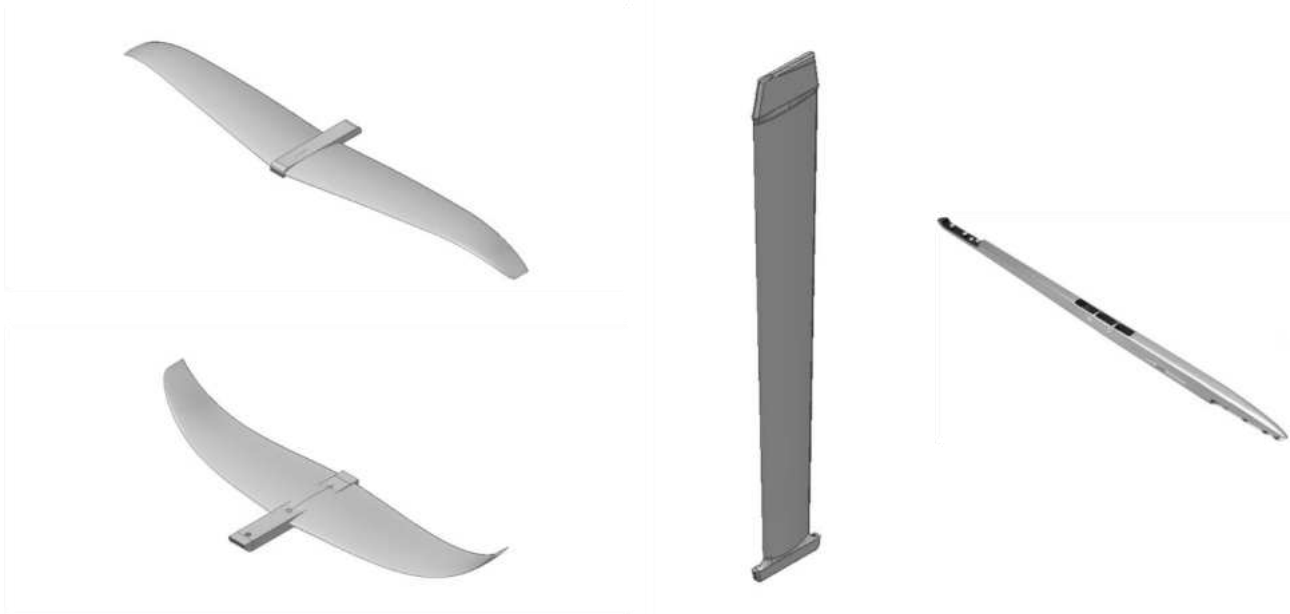


Figure 1 - Frontwing 900 (top left), Rearwing 255 (bottom left), Foil Mast 95 (middle), Fuselage 115+ (right)

In collaboration with Sonic (manufacturer) and Starboard (brand), World Sailing received a detailed report of the production targets and tolerances for each equipment item. Every equipment item was scanned at production, lateral stiffness and torsional stiffness of the equipment items were recorded. In consultation with the Class, the foil mast stiffness was considered the most relevant characteristic of the hydrofoil system. World Sailing analysed the data provided by the manufacturer and defined the packs to assure that 2 stiff and 2 soft foil mast were included in every pack. As a result, the sailors have the same level of choice within the supplied equipment. The composition of the hydrofoil packs for each sailor can be summarised as follows:

- Set 1: Frontwing, Rearwing, Fuselage, Foil Mast (Stiff)
- Set 2: Frontwing, Rearwing, Fuselage, Foil Mast (Stiff)
- Set 3: Frontwing, Rearwing, Fuselage, Foil Mast (Soft)
- Set 4: Frontwing, Rearwing, Fuselage, Foil Mast (Soft)

At the end of the Last Chance Regatta, the packs were randomly allocated to the qualified NOC with a draw performed by World Sailing and Paris 2024 representatives. NOC representative signed a declaration form to acknowledge their responsibilities and that Class Rules changes

were in place since the moment the equipment was handed over: no repair and maintenance is allowed from that moment.

Sailors were able to train to select their best hydrofoils system (FOR USE) and their second best one (SPARE) before the 19th of July 2024. From the 20th till the 24th of July the FOR USE and SPARE hydrofoils systems were scanned in Marseille by World Sailing and the scans were compared to the ones made before handing the hydrofoils systems to sailors. Below the steps that resume the process described above is presented:

Production Phase	The production of the 200 Olympic Hydrofoil System starts in December 2023 and ends in January 2024. All the equipment items are produced with the same material batch.
Quality Controls	All the equipment items are scanned to check the compliance with the Olympic tolerances. Stiffness tests and weights are recorded for each equipment item.
Data Analysis	World Sailing receives all the scans of the equipment items (STL files) and the records of all the measurements during quality controls phases.
Packs Definition	According to "Supplied Equipment Allocation and Distribution Guidelines", World Sailing defines the packs. After consultation with iQFOiL Class, it was decided to use the foil mast stiffness as a reference value to assure the fairest conditions for all sailors. Every pack contains 2 stiff and 2 soft foil masts.
Packs Distribution	World Sailing with Paris 2024 performs the random allocation of the packs after the Last Chance Regatta in Hyeres, April 2024.
Training and Selection	Sailors train and select the equipment items and declare them with an online form, before the start of the Pre-Event Inspection, as: FOR USE (racing) and SPARE (reserve).
Pre-Event Inspection	Between the 20 th and the 24 th of July, World Sailing scans all the equipment items registered as FOR USE and SPARE. The difference between the scans performed before the distribution and during the Pre-Event Inspection are evaluated. All the equipment items are compared using statistical tools to find outliers across the fleet.

Objective

The document focuses on the following equipment items: Frontwing 900, Rearwing 255, Foil Mast 95 and in particular on understanding:

1. Correlation between Foil Mast stiffness and the selection of FOR USE and SPARE hydrofoils systems
2. Findings of scans of the hydrofoils systems before and after usage in sailing conditions

Hydrofoils Systems Selection

The key factor for a successful supplied equipment event is to ensure the same level of performance across the entire fleet. To obtain the same level of fairness, among all the foils characteristics, the foil mast stiffness was used as a key parameter to create the most homogeneous conditions for all the sailors.

Since the foil mast stiffness was used as key parameter for the definition of packs and since all sailors have 2 stiffer and 2 softer masts, it was interesting to observe if there was a clear preference of the sailors for stiffer or softer foil mast both for the Men and Women fleets.

The tables below show, the selection of foil mast for the two fleets. The first tables present the later stiffness of the foil masts and the following tables show the torsional stiffness of foil masts.

Foil Mast Lateral Stiffness

Foil Mast Lateral Stiffness				
Men Event				
Rank	More Stiffness		Less Stiffness	
1	-	FOR USE	-	SPARE
2	-	SPARE	-	FOR USE
3	FOR USE	-	-	SPARE
4	SPARE	-	-	FOR USE
5	-	SPARE	-	FOR USE
6	-	FOR USE	SPARE	-
7	-	SPARE	-	FOR USE
8	-	FOR USE	SPARE	-
9	-	SPARE	-	FOR USE
10	SPARE	-	-	FOR USE
11	FOR USE	SPARE	-	-
12	FOR USE	SPARE	-	-
13	SPARE	-	-	FOR USE
14	-	-	SPARE	FOR USE
15	SPARE	-	-	FOR USE
16	FOR USE	-	SPARE	-
17	-	SPARE	-	FOR USE
18	FOR USE	SPARE	-	-
19	FOR USE	-	SPARE	-
20	FOR USE	-	-	SPARE
21	-	FOR USE	-	SPARE
22	-	FOR USE	SPARE	-
23	SPARE	-	FOR USE	-
24	SPARE	-	FOR USE	-

Foil Mast Lateral Stiffness				
Women Event				
Rank	More Stiffness		Less Stiffness	
1	FOR USE	SPARE	-	-
2	SPARE	FOR USE	-	-
3	-	-	SPARE	FOR USE
4	SPARE	-	FOR USE	-
5	FOR USE	-	SPARE	-
6	FOR USE	SPARE	-	-
7	SPARE	-	-	FOR USE
8	FOR USE	-	-	SPARE
9	FOR USE	-	SPARE	-
10	FOR USE	SPARE	-	-
11	SPARE	-	-	FOR USE
12	-	SPARE	FOR USE	-
13	-	-	FOR USE	SPARE
14	SPARE	-	FOR USE	-
15	FOR USE	SPARE	-	-
16	-	-	FOR USE	SPARE
17	-	FOR USE	-	SPARE
18	SPARE	-	-	FOR USE
19	-	FOR USE	SPARE	-
20	-	FOR USE	-	SPARE
21	-	FOR USE	SPARE	-
22	-	FOR USE	-	SPARE
23	SPARE	-	FOR USE	-
24	-	-	FOR USE	SPARE

Foil Mast Lateral Stiffness FOR USE				
	More Stiffness		Less Stiffness	
Men	29%	21%	8%	42%
Men Top 10	10%	30%	0%	60%
Women	29%	25%	29%	17%
Women Top 10	60%	10%	10%	20%

Foil Mast Lateral Stiffness SPARE				
	More Stiffness		Less Stiffness	
Men	25%	33%	25%	17%
Men Top 10	20%	40%	20%	20%
Women	29%	21%	21%	29%
Women Top 10	30%	30%	30%	10%

Foil Mast Torsional Stiffness

Foil Mast Torsional Stiffness				
Men Event				
Rank	More Stiffness		Less Stiffness	
1	SPARE	-	FOR USE	-
2	FOR USE	SPARE	-	-
3	-	SPARE	FOR USE	-
4	-	-	SPARE	FOR USE
5	SPARE	-	FOR USE	-
6	SPARE	-	FOR USE	-
7	FOR USE	-	-	SPARE
8	SPARE	-	FOR USE	-
9	-	SPARE	FOR USE	-
10	FOR USE	-	SPARE	-
11	SPARE	-	FOR USE	-
12	-	FOR USE	-	SPARE
13	FOR USE	-	SPARE	-
14	FOR USE	SPARE	-	-
15	FOR USE	-	-	SPARE
16	-	-	SPARE	FOR USE
17	-	SPARE	-	FOR USE
18	-	SPARE	FOR USE	-
19	FOR USE	-	SPARE	-
20	SPARE	-	-	FOR USE
21	-	FOR USE	SPARE	-
22	SPARE	-	FOR USE	-
23	-	FOR USE	-	SPARE
24	FOR USE	-	-	SPARE

Foil Mast Torsional Stiffness				
Women Event				
Rank	More Stiffness		Less Stiffness	
1	-	-	FOR USE	SPARE
2	FOR USE	SPARE	-	-
3	SPARE	FOR USE	-	-
4	-	FOR USE	-	SPARE
5	SPARE	-	-	FOR USE
6	-	SPARE	-	FOR USE
7	SPARE	-	FOR USE	-
8	-	SPARE	FOR USE	-
9	-	SPARE	-	FOR USE
10	SPARE	-	-	FOR USE
11	FOR USE	-	SPARE	-
12	-	FOR USE	-	SPARE
13	SPARE	-	-	FOR USE
14	-	-	FOR USE	SPARE
15	-	SPARE	-	FOR USE
16	-	SPARE	FOR USE	-
17	SPARE	-	-	FOR USE
18	FOR USE	-	-	SPARE
19	-	FOR USE	SPARE	-
20	SPARE	FOR USE	-	-
21	SPARE	-	FOR USE	-
22	-	FOR USE	SPARE	-
23	FOR USE	-	-	SPARE
24	SPARE	-	-	FOR USE

Foil Mast Torsional Stiffness FOR USE				
	More Stiffness		Less Stiffness	
Men	33%	13%	38%	17%
Men Top 10	30%	0%	60%	10%
Women	17%	25%	25%	33%
Women Top 10	10%	20%	30%	40%

Foil Mast Torsional Stiffness SPARE				
	More Stiffness		Less Stiffness	
Men	29%	25%	25%	21%
Men Top 10	40%	30%	20%	10%
Women	38%	25%	13%	25%
Women Top 10	40%	40%	0%	20%

3D Scanner

For the first time World Sailing introduced the technology of the 3D Scanner to inspect equipment items during an event. The Olympic Games was a great opportunity to do so since the Windsurfing Event was, as well as the Single Dinghy, a supplied equipment event. Thanks to this format World Sailing was able to inspect all the equipment items twice: before the distribution and during the pre-event inspections.

All the Frontwings, Rearwings and Foil Masts were scanned before the distribution and the files were saved as STL files, these ones are the reference for later comparison during inspections. Every file was saved using the Serial Number and the QR Code, both present in every foil, to link the physical object with the STL file.

The distribution of the equipment items was performed after the Last Chance Regatta (April 2024), once all the National Olympic Committees (NOC) were qualified, every sailor received 4 sets of hydrofoils to train and select the two best hydrofoils sets.

The scans of the pre-event inspections and the scans performed before the distribution were compared to highlight the gaps, if any, between before and after handing the equipment items to sailors.

For each control point, the difference between the inspection's scan and the scan before the distribution was evaluated as showed in the following image.

Equipment Item XXX XXXXXX SCXXXXXX			
Pre-Event Inspection (Marseille)		Before Distribution (Hyeres)	Gap (Inspection - Production)
Control Point 1	-	Control Point 1	= Control Point 1
Control Point 2	-	Control Point 2	= Control Point 2
...	-	...	= ...
Control Point n	-	Control Point n	= Control Point n

For the Frontwing, Rearwing and Foil Mast, the surface distance points and the callipers were selected to perform the analysis of the equipment items, below the surface distance points and callipers are defined:

Surface Distance Points

For each Cross Section, 2 Surface Distance Points were defined. The Surface Distance Points measure the spatial distance between the surfaces of the CAD file and the scanned equipment item. The figure below shows a Surface Distance Point in a specific Cross Section measuring the spatial distance between the CAD file (grey) and the scanned equipment (yellow).

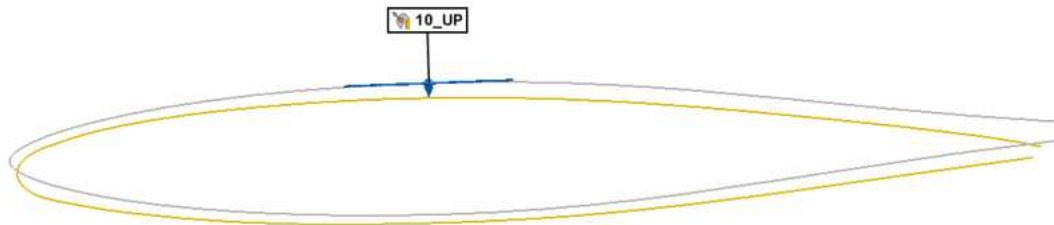


Figure 2 - Surface distance point for a specific section of a foil

Callipers

For each Cross Section, 5 Callipers are defined. The Callipers measure the thickness in specific points of the Cross Sections. The figure below shows the positioning of the Callipers for a cross-section.

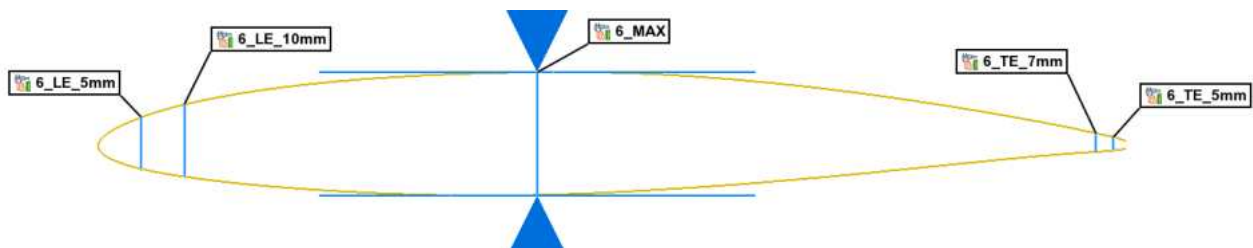


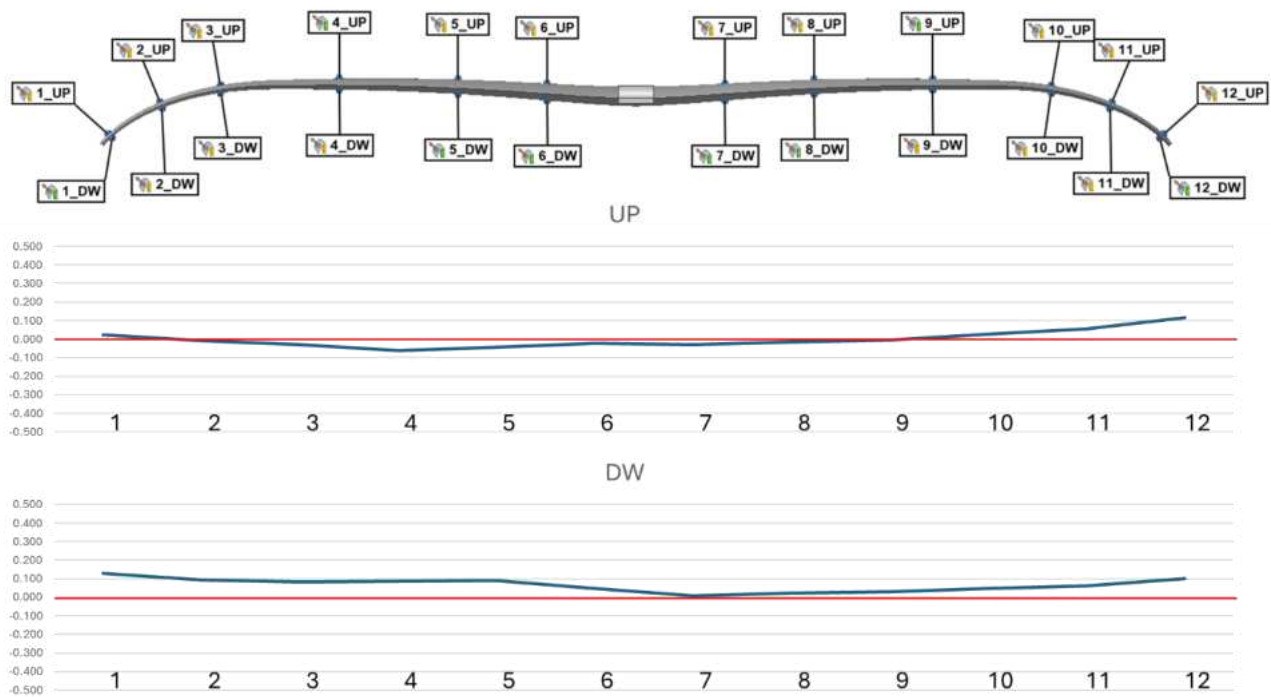
Figure 3 - Callipers for a specific section of a foil

Charts

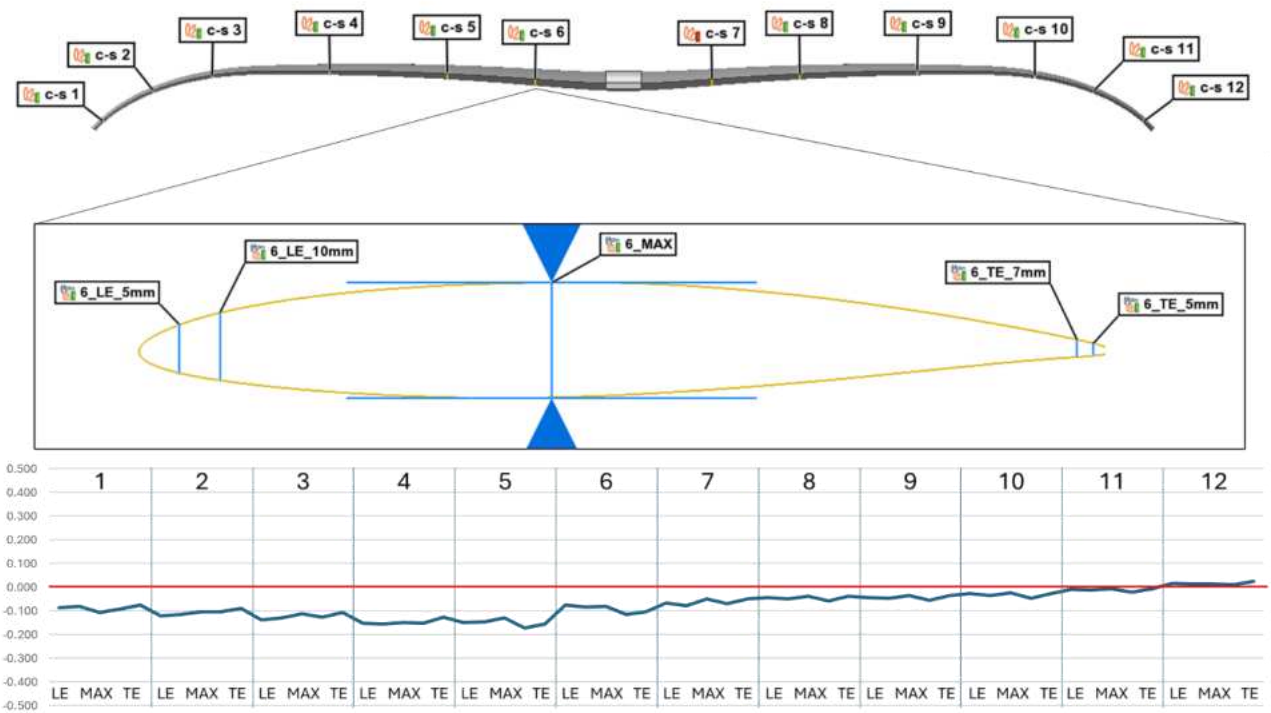
In the following pages the results are presented. The red line in the charts is the ideal scenario where the “before distribution” is identical to the “pre-event inspection” equipment item. The blue line represents the average of the gaps for each control of the equipment items considering the entire Olympic fleet.

FRONTWING 900

Surface Distance Points (Olympic Fleet Average)

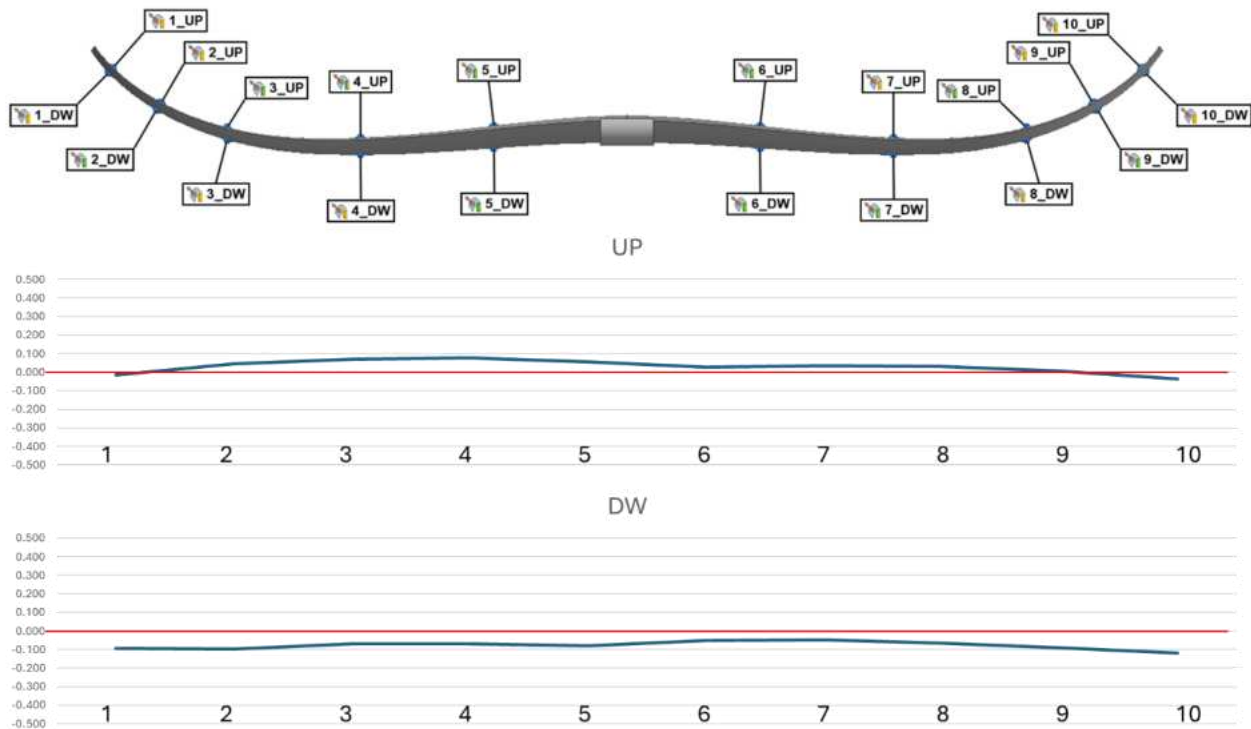


Callipers for thickness (Olympic Fleet Average)

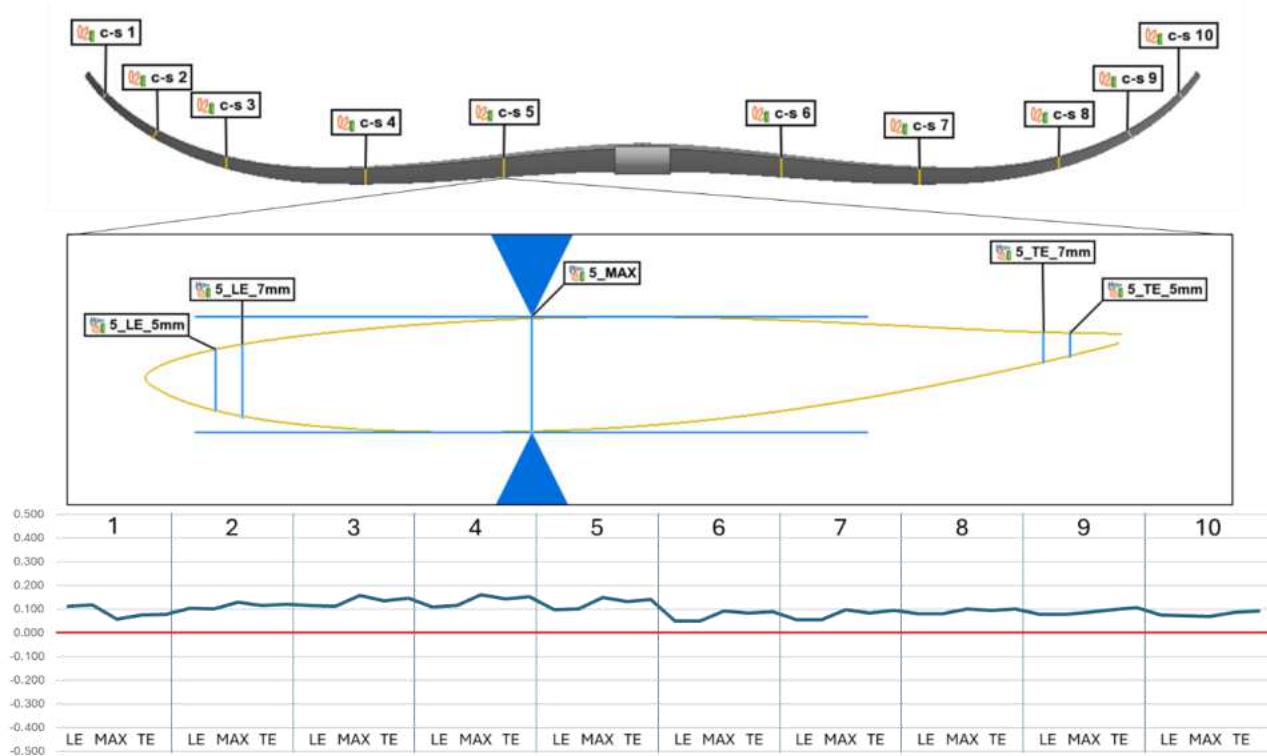


REARWING 255

Surface Distance Points (Olympic Fleet Average)

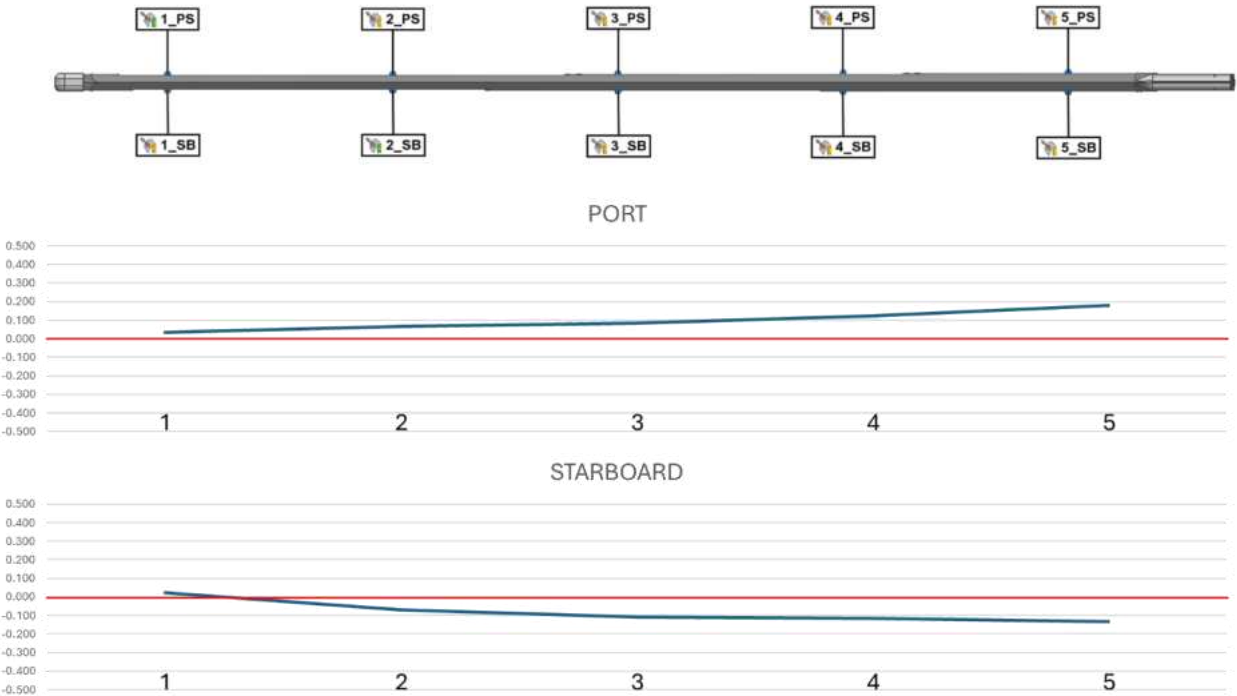


Callipers for thickness (Olympic Fleet Average)

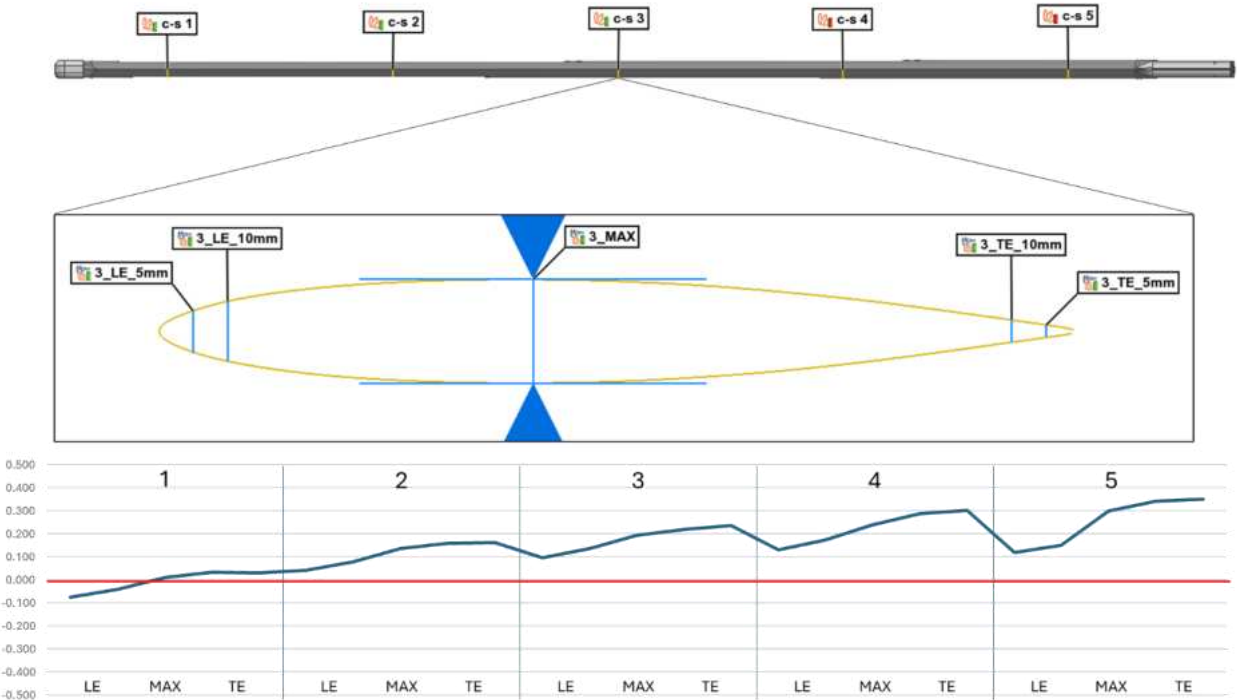


FOIL MAST 95

Surface Distance Points (Olympic Fleet Average)



Callipers for thickness (Olympic Fleet Average)



Conclusions

Hydrofoils System Selection

The foil mast stiffness was used as key parameter for the definition of packs. Every sailor had 2 stiffer and 2 softer masts available for selection of the best 2 hydrofoils systems. Although it seems possible to detect some preference looking at the selection of the FOR USE hydrofoils system, the same trend is not always confirmed by the selection of the SPARE hydrofoil system.

Men Event:

Lateral and Torsional Stiffness:

On average the Men's Event selected less stiff foil masts as FOR USE foils. 42% of the fleet selected the least stiff foil mast and 60% of the top 10 sailors did the same choice. Looking at the SPARE hydrofoils system the trend is different, it is possible to observe a less predominant preference between the stiff and soft foil masts.

Women Event

Lateral Stiffness:

On average the Women's Event selected more stiff foil masts as FOR USE foils. 29% of the fleet selected the stiffest mast and 60% of the top 10 sailors did the same choice. As per Men's Event, the selection of the SPARE foils does not follow the same trend of the FOR USE without showing a clear preference for stiff and soft foil masts.

Torsional Stiffness:

It is interesting to notice the fact that Women's Event selected on average soft foil mast in terms of torsional stiffness, although there is not a dominant trend. As Men's Event the SPARE foils selected are the stiffer ones.

It is possible to summarise the findings as follows:

- Men's Event selected softer foil masts both in terms of lateral and torsional stiffness for the FOR USE foil set
- Women's Event selected stiffer lateral and softer torsional foil masts for the FOR USE foil set
- For both Events it was not possible to detect the same trend for FOR USE and SPARE foil sets

3D Scanner

The charts presented in the document highlight the common trends across the Olympic fleet. Some interesting findings were detected and can be resume as follow:

Frontwing 900 & Rearwing 255

The wings, Frontwing and Rearwing, present a minor asymmetric between the Starboard and Port side that could be due to the sailing usage. Interestingly, the Frontwing shows a reduction in thickness and the Rearwing an increase in thickness.

Foil Mast 95

The Foil Mast shows a more evident trend, compared to the wings, that shows an increase of thickness in the top part of the Foil Mast, close to the link between the foil and the Board.

A systematic study in a controlled environment would be ideal to confirm the findings and to have a better understanding of how much sailing usage of the equipment affect the shape of equipment items. The most interesting aspect would be evaluating how much the equipment items can be modified by the solely use of the foils and after how many hours of sailing this effect stops.