World Sailing

sport / nature / technology

World Sailing Manufacturer Control System

Title: Scanner Report for Hydrofoil Registration with Class

Olympic Class: IKA Formula Kite

Equipment Item: Chubanga Mast V5

Project				
World Sailing Manufacturer Control System				
Title				
Scanner Report: IKA Formula Kite – Chubanga Mast V5				
Revision	**By**	**Date**	**Description of change**	**Checked**
A	A.S.	19/03/2024	Draft Issue	

Overview

As part of the World Sailing Manufacturer Control System project, which focuses on improving the quality of Olympic Equipment, World Sailing Technical Department performed an audit to Chubanga, in World Sailing Office in London.

In order to register new equipment models for the 2028 Olympic Quad, the IKA Formula Kite Class registration process requires manufacturers to produce for inspection 10 items of each model that they seek to register.

The analysis presented in this report is limited to a number of control points on specific cross sections following the scanning of the items. However, the data compiled and hold on record by World Sailing permits to analyse more aspects and areas of the geometry of the equipment.

Coordinate System

Figure 1 shows the coordinate system defined to analyse the Mast.

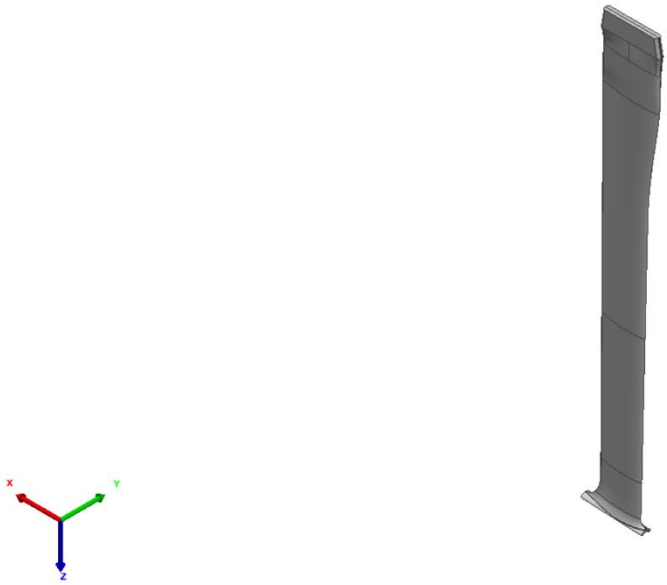


Figure 1 - Definition of the Coordinate System

Cross Sections

Figure 2 shows the Cross Sections (in yellow) defined to analyse the Mast.

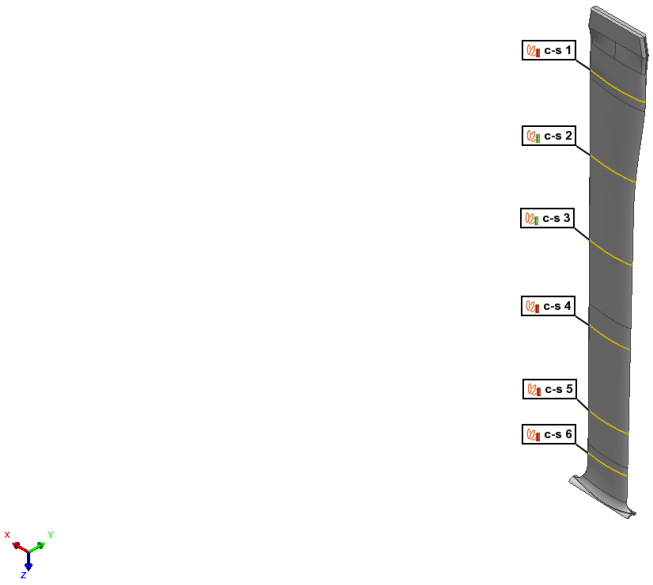


Figure 2 - Definition of Cross Sections

Name	Positioning
c-s 1	150 mm from the top
c-s 2	350 mm from the top
c-s 3	550 mm from the top
c-s 4	750 mm from the top
c-s 5	950 mm from the top
c-s 6	1050 mm from the top

Callipers

For each Cross Section, 3 Callipers are defined. Figure 3 shows the positioning of the Callipers a Cross Section. The Callipers measure the thickness in specific points of the Cross Sections.

Figure 3 - Callipers definition for one of the Cross Sections

Name	Positioning
#_LE	5 mm from the Leading Edge of the Cross Section
#_MAX	On the maximum thickness of the Cross Section
#_LE	5 mm from the Trailing Edge of the Cross Section

Surface Distance Points

For each Cross Section, 2 Surface Distance Points are defined. Figure 4 shows the positioning of the Surface Distance Points.

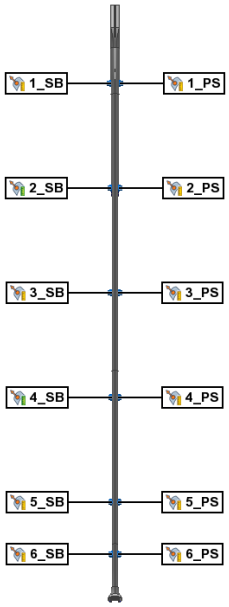


Figure 4 - Surface Distance Points definition

The Surface Distance Points measure the spatial distance between the Starboard (Y negative) and Port (Y positive) surfaces of the CAD file and the scanned equipment. Figure 5 shows a Surface Distance Point in a specific Cross Section measuring the spatial distance between the CAD file (grey) and the scanned equipment (yellow).

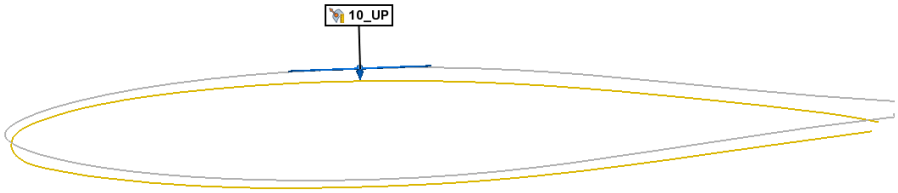


Figure 5 - Definition of Surface Distance Points on a Cross Section

Colour Map

Figure 6 shows the Colour Map of both Starboard and Port surfaces of a Mast.

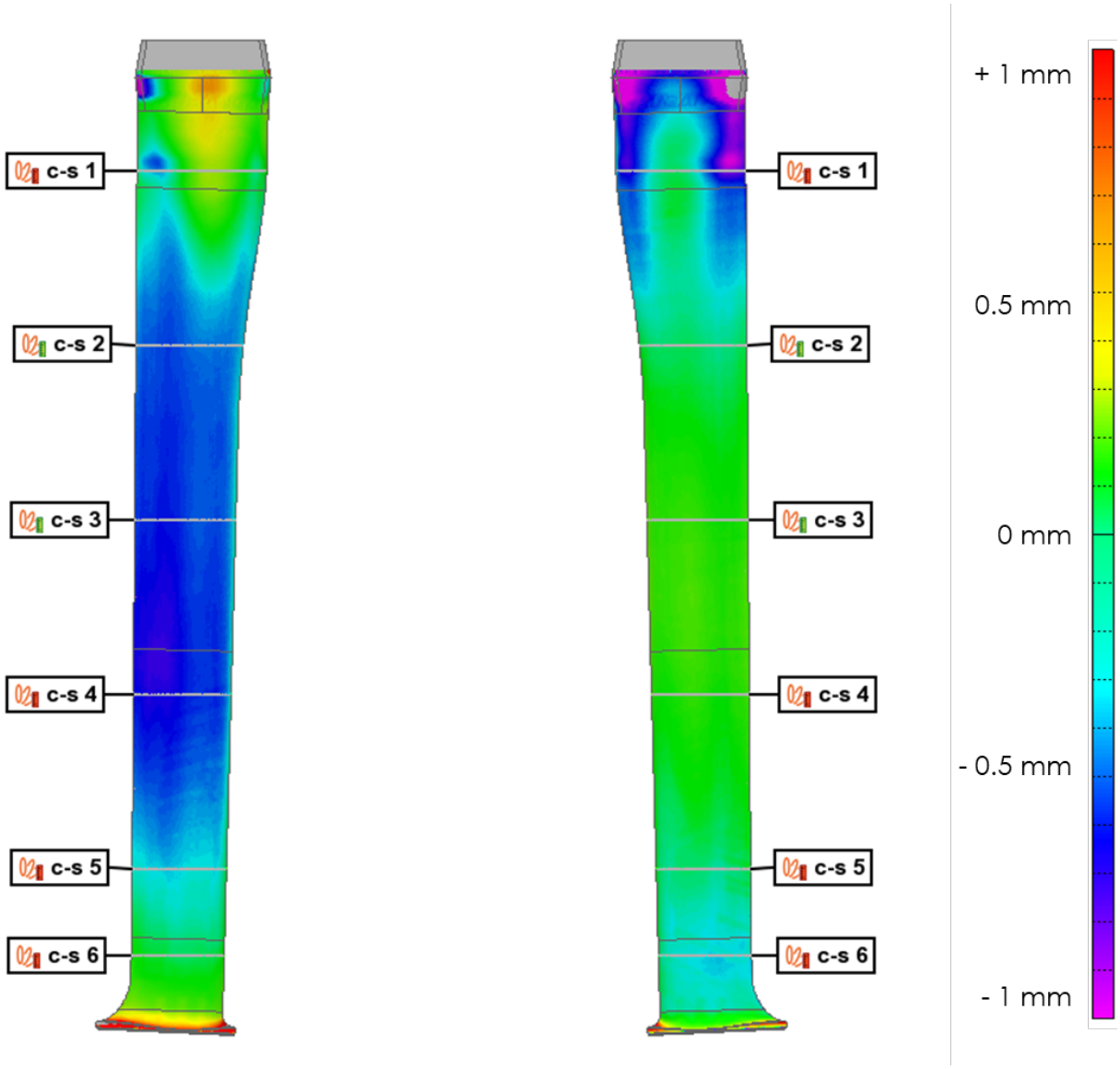


Figure 6 - Colour Map of the Upper (top) and Lower (bottom) surfaces of the Mast

The Colour Map measure the spatial distance between the Starboard and Port surfaces of the CAD file and the scanned equipment, as the Surface Distance Points.

Analysis

For each Mast the following measurements are evaluated:

- Upper Surface Distance for each Cross Section (#_UP)
- Lower Surface Distance for each Cross Section (#_DW)
- Thickness at 5mm from the Leading Edge for each Cross Section (#_LE)
- Maximum Thickness for each Cross Section (#_MAX)
- Thickness at 5mm from the Trailing Edge for each Cross Section (#_TE)

Surface Distance	Surface Distance	Calliper	Calliper	Calliper
1_SB	1_PS	1_LE	1_MAX	1_TE
2_SB	2_PS	2_LE	2_MAX	2_TE
3_SB	3_PS	3_LE	3_MAX	3_TE
4_SB	4_PS	4_LE	4_MAX	4_TE
5_SB	5_PS	5_LE	5_MAX	5_TE
6_SB	6_PS	6_LE	6_MAX	6_TE

For each measurement the average (Mean) is calculated:

$$Mean = \frac{\sum_1^{10} Value}{10}$$

In order to have a uniform scale to compare the results of measurements, all the Values are normalized against the Mean:

$$Norm.Value = Value - Mean$$

Results

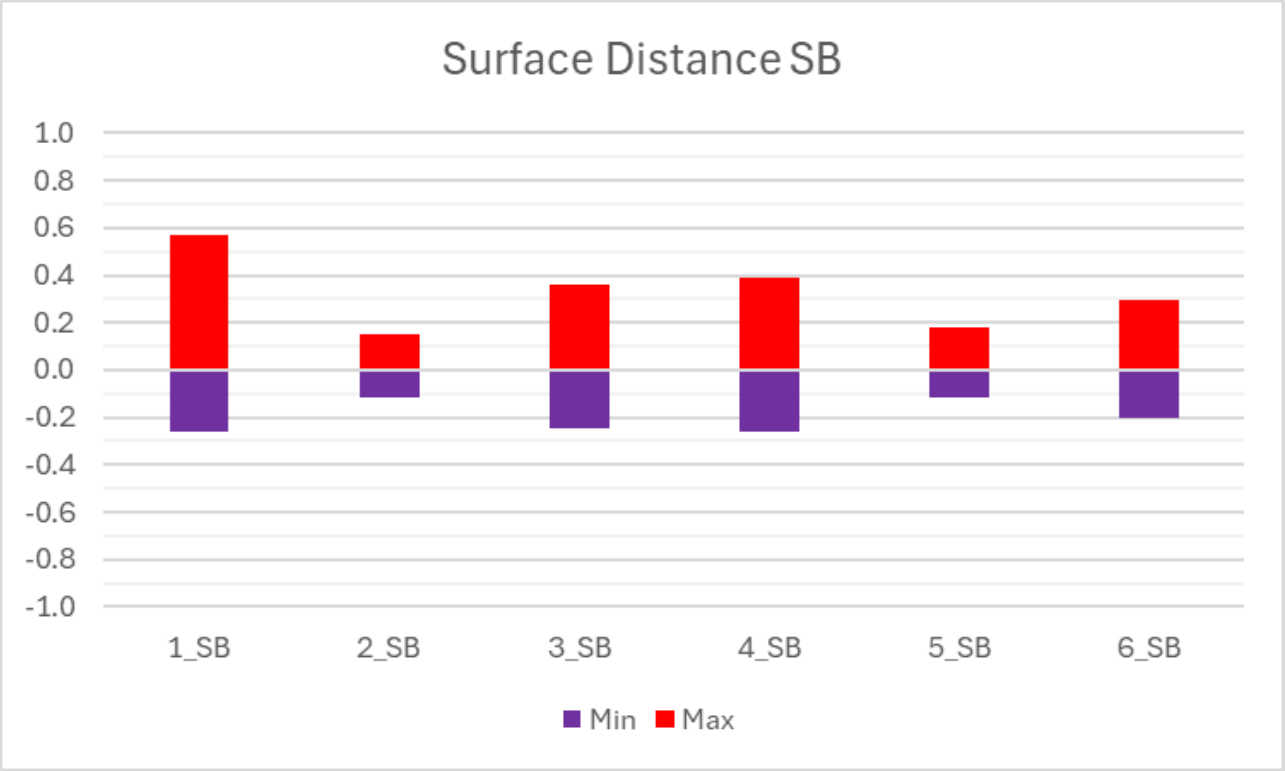
The table in the next page shows the normalised values (in mm) for each foil, minimum and maximum deviations and the standard deviation for each control. ±0.4 mm has been selected for visualisation purposes. The maximum, minimum and standard deviation values are also plotted.

World Sailing Manufacturer Control System

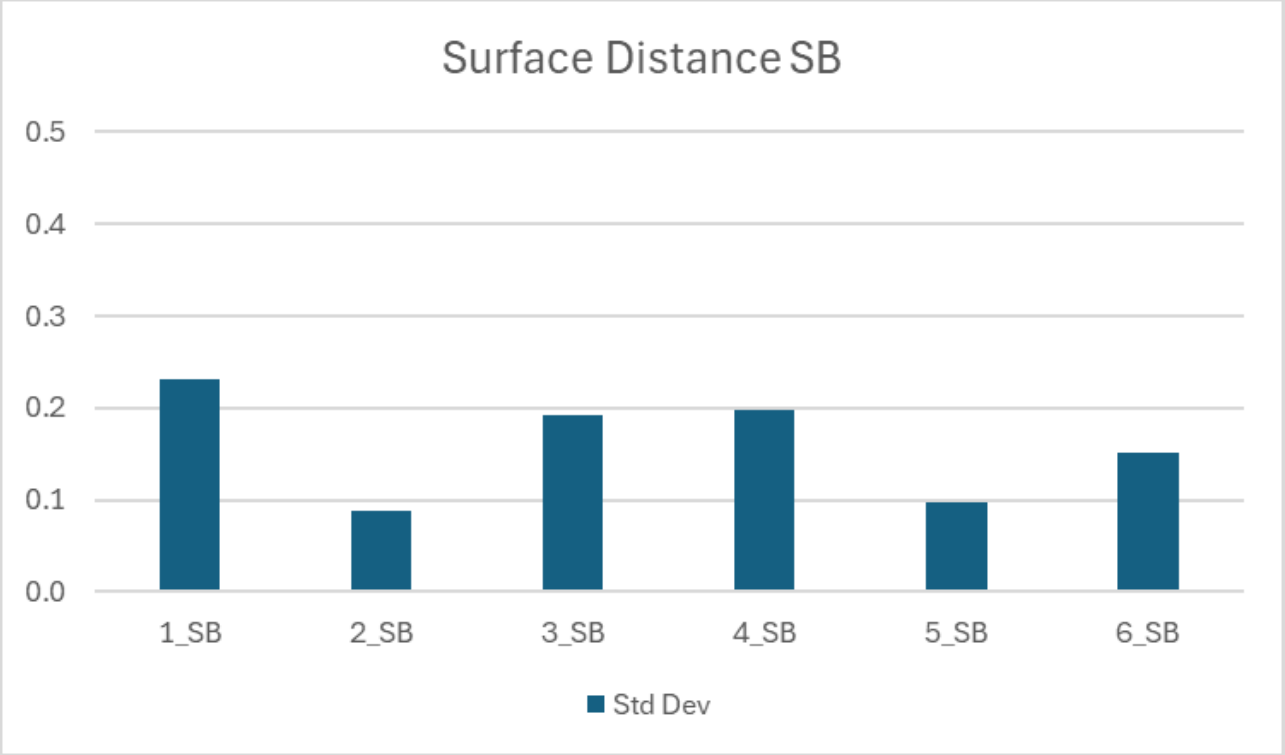
Scanner Report: IKA Formula Kite – Chubanga Mast V5

Control	Foil 1	Foil 2	Foil 3	Foil 4	Foil 5	Foil 6	Foil 7	Foil 8	Foil 9	Foil 10	Min	Max	StdDev
1_UP	0.567	0.193	0.01	-0.109	-0.087	-0.155	-0.093	-0.061	-0.264	-0.001	-0.264	0.567	0.232
2_UP	-0.119	0.072	0.114	0.004	-0.074	-0.043	0.012	-0.057	0.152	-0.065	-0.119	0.152	0.088
3_UP	-0.219	0.149	0.138	0.037	-0.192	0.069	0.02	-0.116	0.358	-0.247	-0.247	0.358	0.193
4_UP	-0.231	0.112	0.123	-0.001	-0.186	0.085	0.062	-0.093	0.389	-0.259	-0.259	0.389	0.198
5_UP	0.074	-0.113	0.083	-0.088	-0.112	0.031	0.04	-0.022	0.182	-0.075	-0.113	0.182	0.098
6_UP	0.299	-0.185	0.088	-0.203	-0.122	0	-0.003	0.038	-0.032	0.122	-0.203	0.299	0.151
1_DW	0.001	0.42	0.075	-0.042	-0.257	-0.011	-0.054	-0.054	0.226	-0.306	-0.306	0.420	0.211
2_DW	0.299	-0.004	0.066	-0.034	-0.134	0.03	0.016	0.014	-0.2	-0.056	-0.200	0.299	0.132
3_DW	0.531	-0.101	0.012	-0.106	-0.065	0.009	-0.019	0.011	-0.428	0.153	-0.428	0.531	0.239
4_DW	0.596	-0.068	0.032	-0.056	-0.088	-0.039	-0.016	0.019	-0.549	0.165	-0.549	0.596	0.279
5_DW	0.324	0.076	0.085	0.023	-0.147	0.025	0.044	-0.075	-0.343	-0.013	-0.343	0.324	0.172
6_DW	0.122	0.073	0.064	0.018	-0.208	0.124	0.15	-0.098	-0.136	-0.104	-0.208	0.150	0.127
1_LE	0.048	0.002	0.047	-0.078	-0.046	0.004	0.065	0.04	-0.093	0.011	-0.093	0.065	0.055
2_LE	0.113	0.041	0.108	-0.084	-0.123	0.045	0.057	-0.03	-0.099	-0.032	-0.123	0.113	0.085
3_LE	0.206	0.045	0.096	-0.1	-0.145	0.082	0.025	-0.041	-0.153	-0.011	-0.153	0.206	0.114
4_LE	0.211	0.004	0.077	-0.094	-0.167	0.067	0.088	-0.009	-0.178	0.003	-0.178	0.211	0.121
5_LE	0.226	-0.046	0.112	-0.087	-0.194	0.064	0.129	0.017	-0.21	-0.007	-0.210	0.226	0.140
6_LE	0.317	-0.098	0.161	-0.119	-0.251	0.04	0.141	-0.052	-0.186	0.05	-0.251	0.317	0.175
1_MAX	0.568	0.613	0.085	-0.151	-0.345	-0.165	-0.147	-0.116	-0.036	-0.307	-0.345	0.613	0.334
2_MAX	0.18	0.067	0.18	-0.03	-0.207	-0.013	0.028	-0.043	-0.047	-0.12	-0.207	0.180	0.121
3_MAX	0.313	0.048	0.151	-0.068	-0.256	0.079	0.001	-0.104	-0.069	-0.093	-0.256	0.313	0.158
4_MAX	0.366	0.044	0.156	-0.057	-0.274	0.045	0.047	-0.073	-0.159	-0.094	-0.274	0.366	0.177
5_MAX	0.398	-0.038	0.168	-0.065	-0.259	0.055	0.083	-0.097	-0.16	-0.089	-0.259	0.398	0.186
6_MAX	0.42	-0.114	0.151	-0.186	-0.332	0.123	0.146	-0.062	-0.167	0.016	-0.332	0.420	0.217
1_TE	0.035	0.09	0.03	-0.023	-0.104	0.035	-0.011	0.003	-0.063	0.006	-0.104	0.090	0.055
2_TE	0.134	0.085	0.038	-0.09	-0.114	0.035	0.007	-0.012	-0.083	0.003	-0.114	0.134	0.079
3_TE	0.238	0.084	0.058	-0.123	-0.2	0.133	-0.003	-0.073	-0.077	-0.036	-0.200	0.238	0.130
4_TE	0.29	0.017	0.087	-0.109	-0.257	0.11	0.059	-0.058	-0.105	-0.031	-0.257	0.290	0.149
5_TE	0.4	-0.017	0.12	-0.138	-0.264	0.127	0.092	-0.067	-0.219	-0.039	-0.264	0.400	0.195
6_TE	0.473	-0.132	0.147	-0.179	-0.301	0.106	0.153	-0.096	-0.145	-0.03	-0.301	0.473	0.224

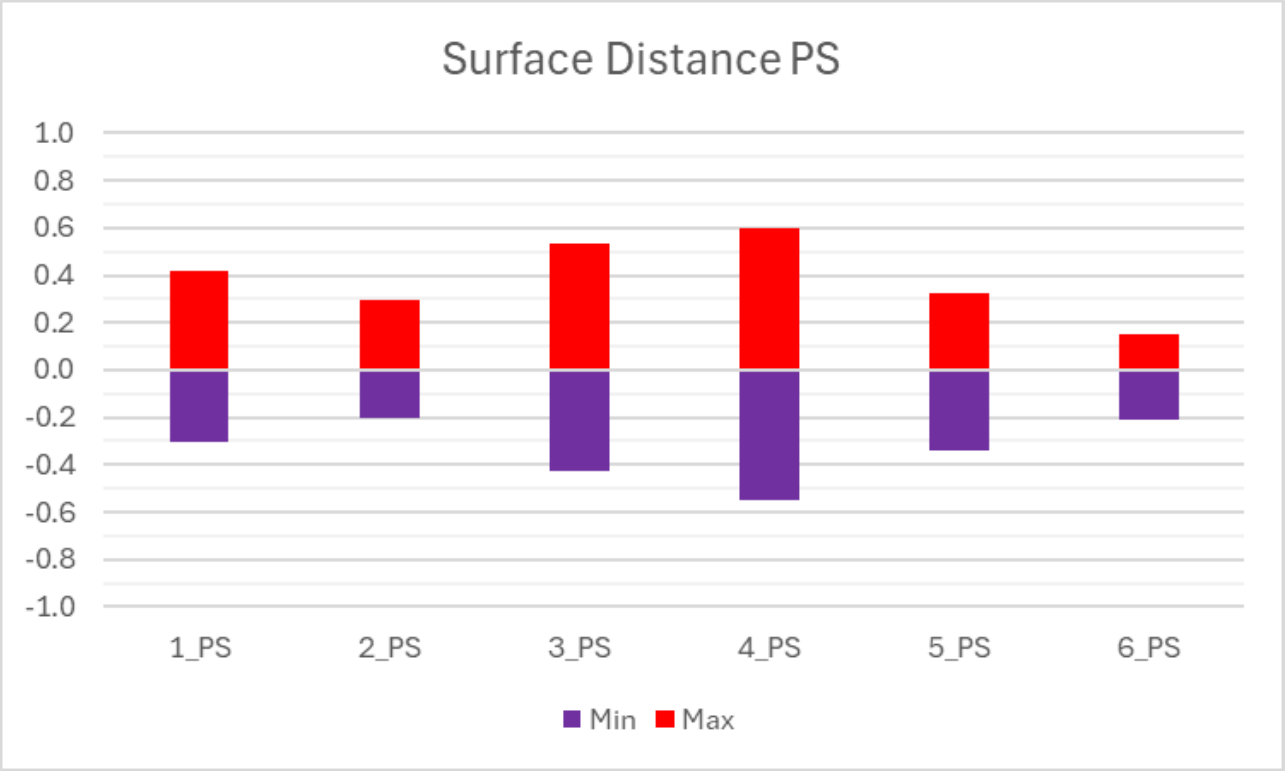
Maximum and minimum 'Surface Distances' on the Starboard side at each cross section (mm):



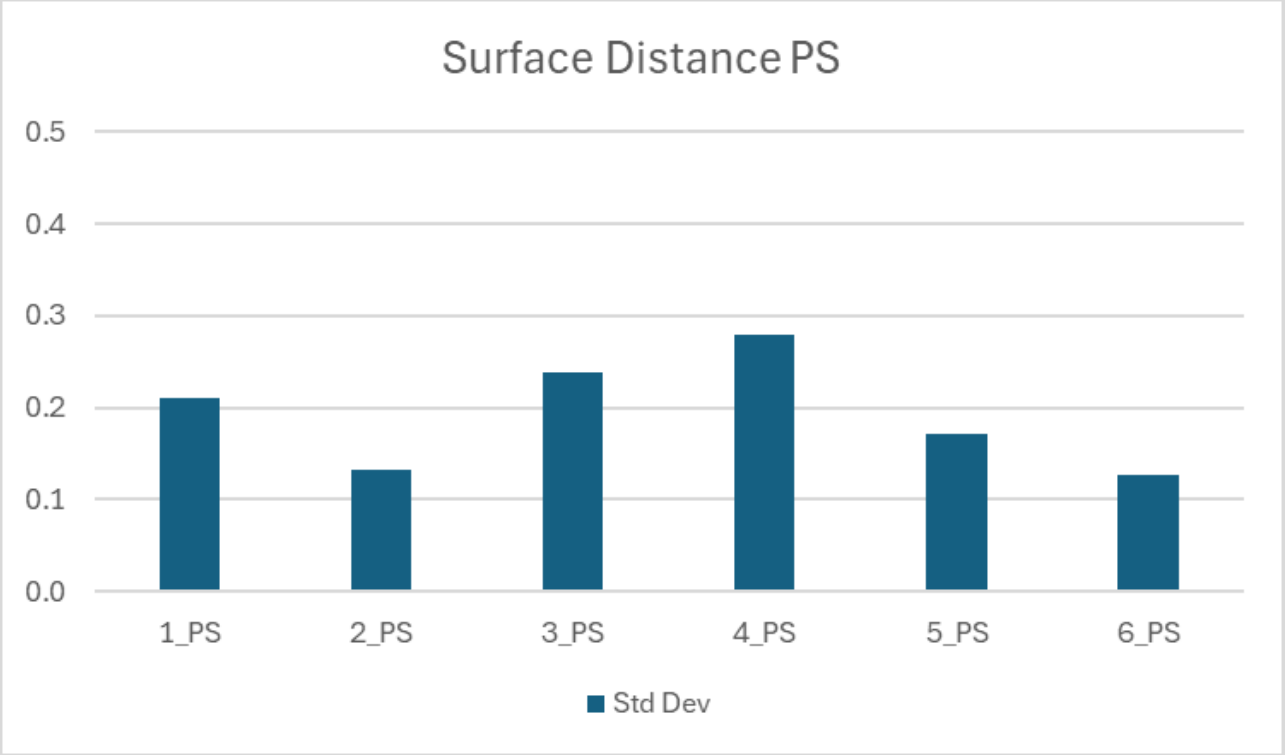
Standard deviation of 'Surface Distances' on the Starboard side at each cross section (mm):



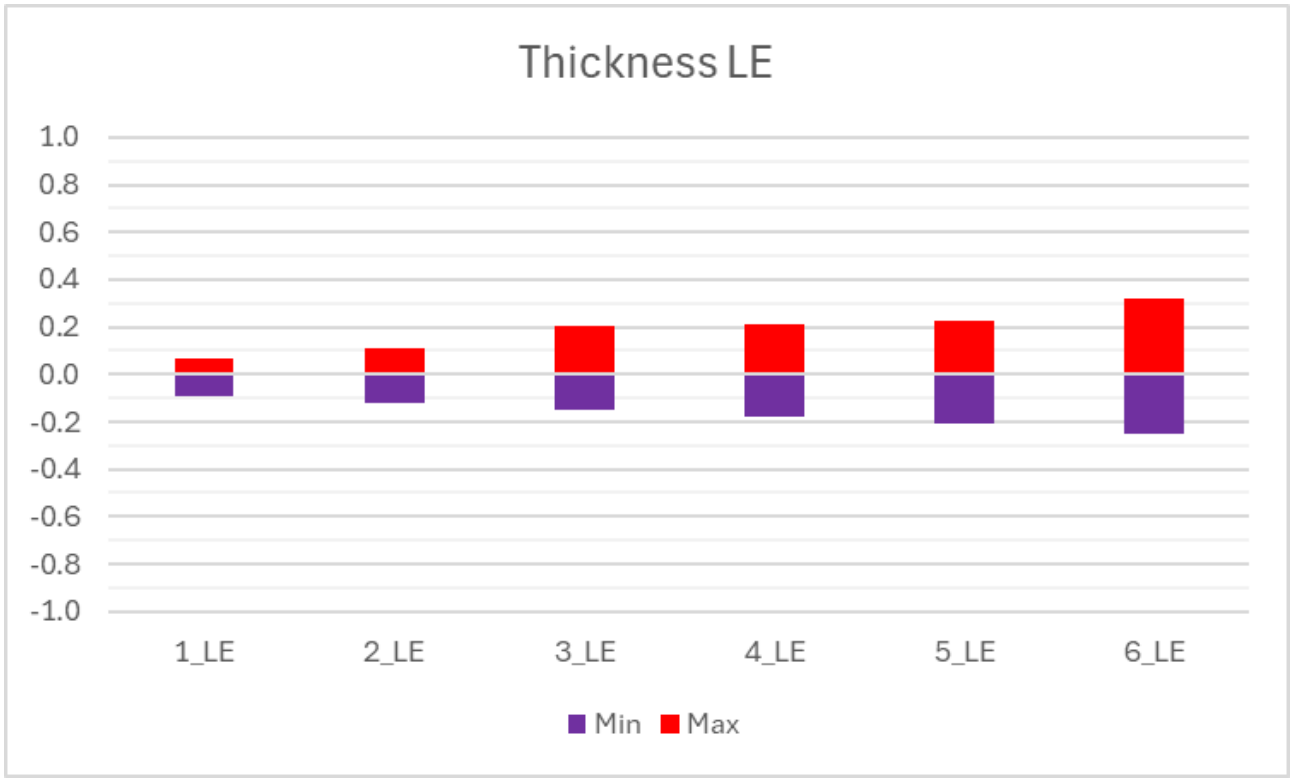
Maximum and minimum 'Surface Distances' on the Port side at each cross section (mm):



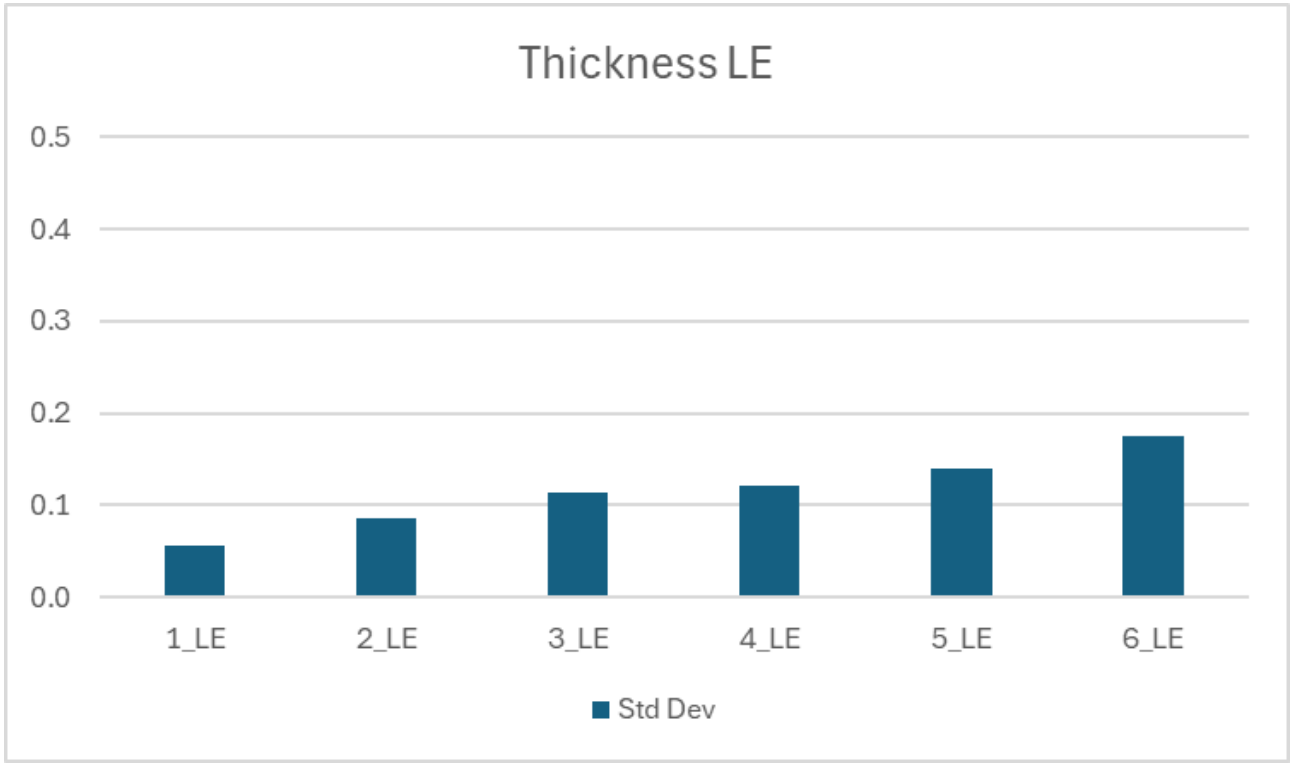
Standard deviation of 'Surface Distances' on the Port side at each cross section (mm):



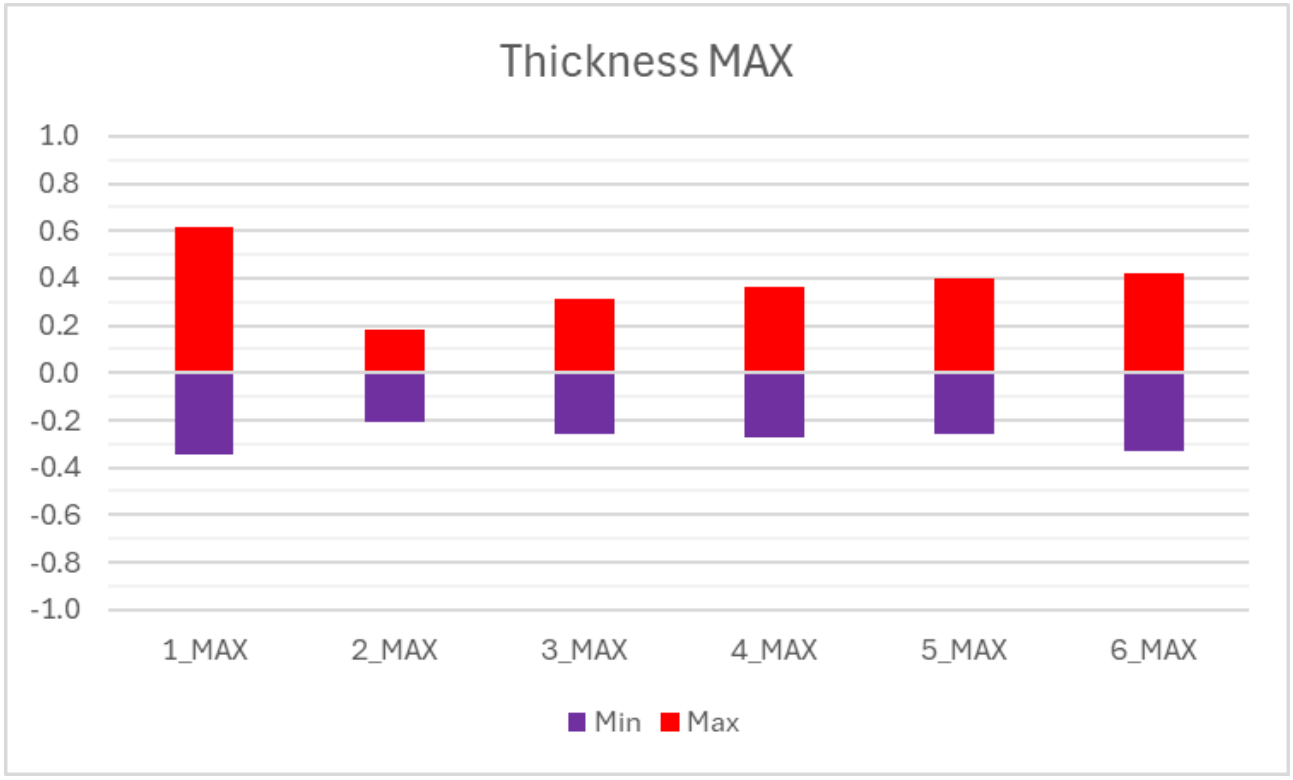
Maximum and minimum Thickness at the 'Leading Edge point' at each cross section (mm):



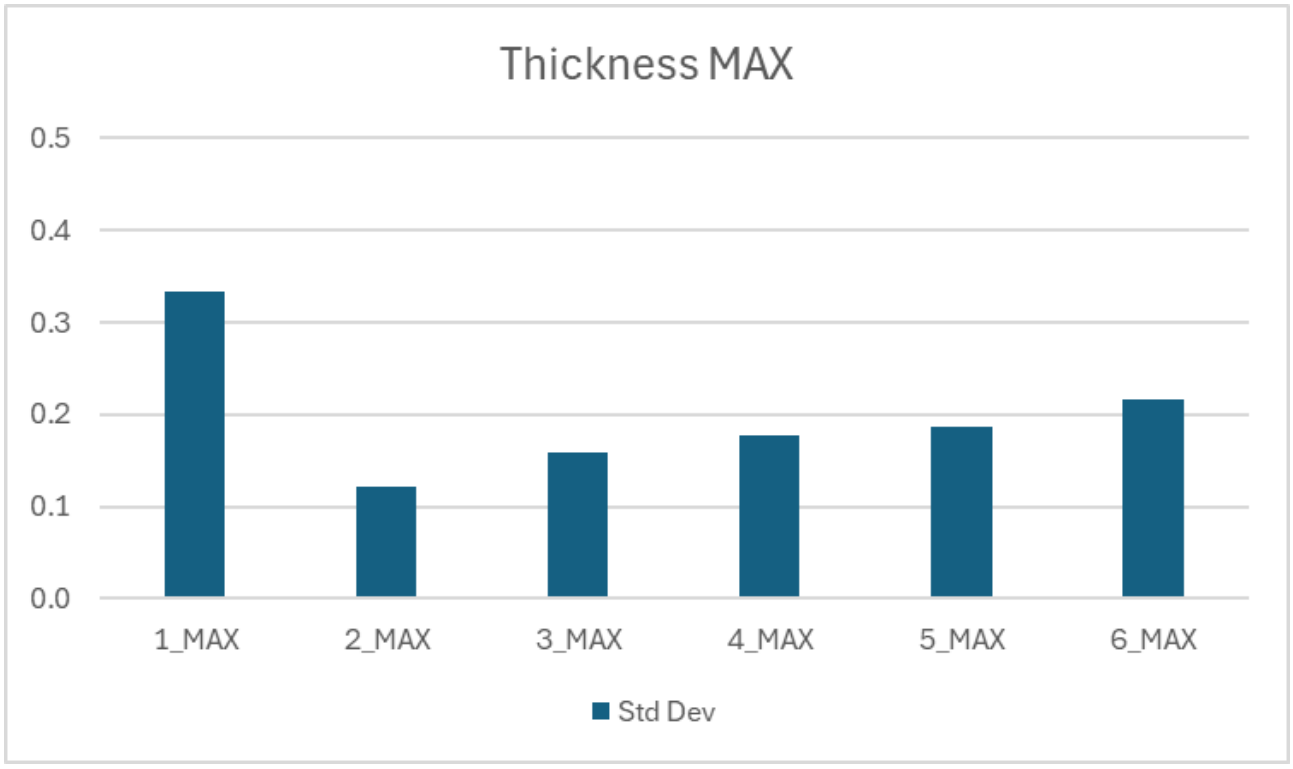
Standard deviation of Thickness at the 'Leading Edge point' at each cross section (mm):



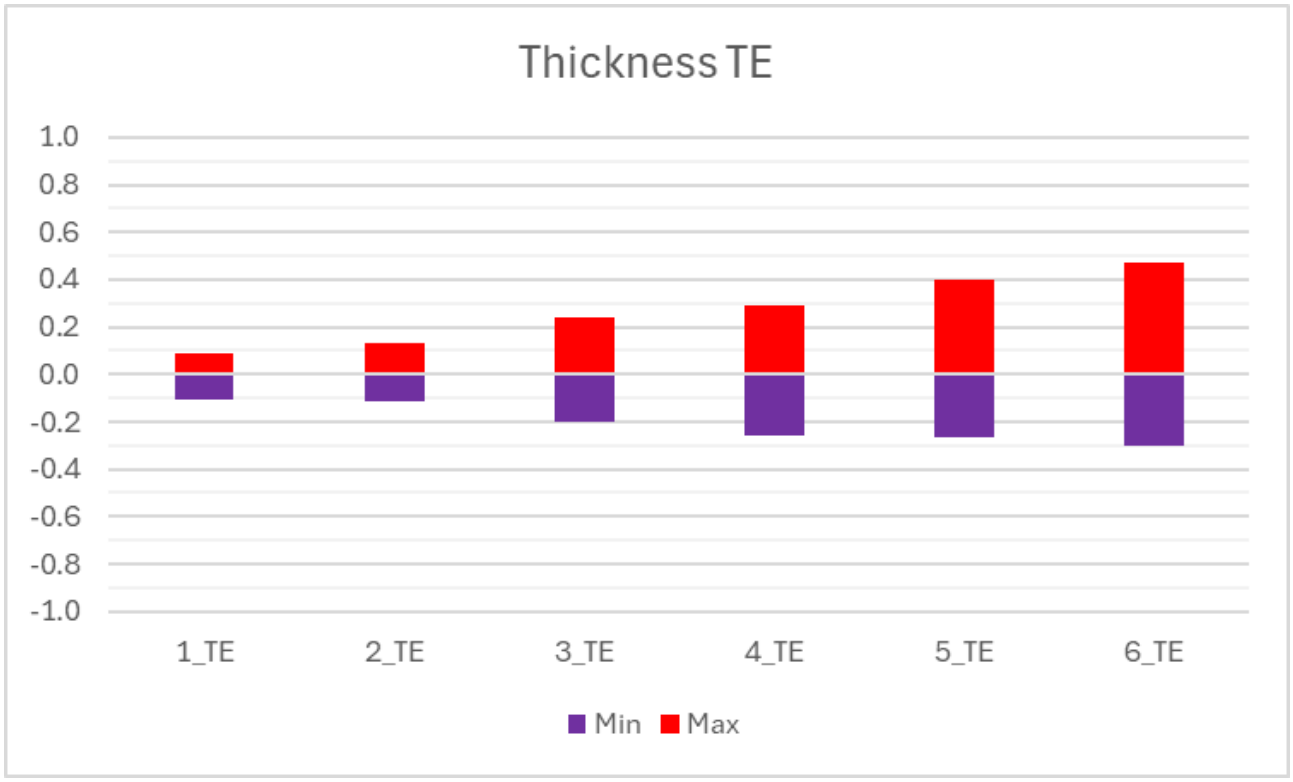
Maximum and minimum Thickness at the 'Maximum thickness point' at each cross section (mm):



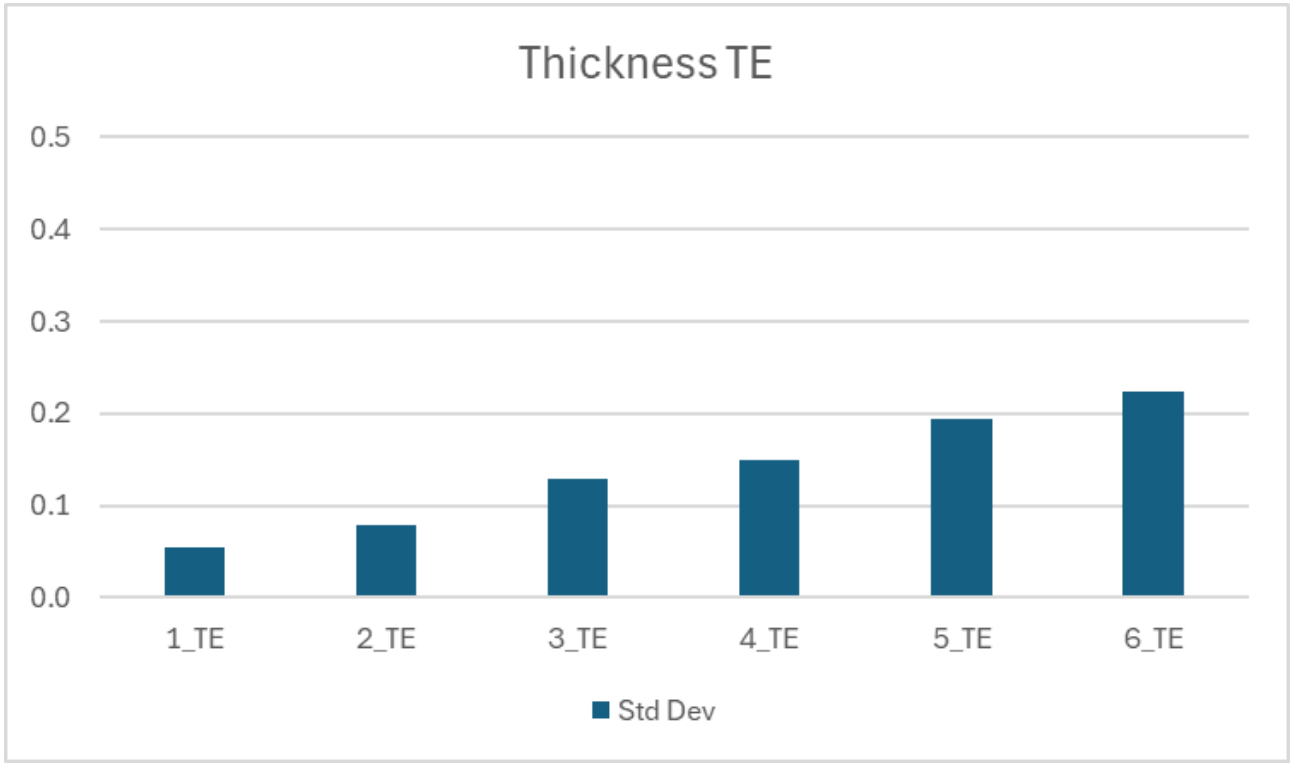
Standard deviation of Thickness at the 'Maximum thickness point' at each cross section (mm):



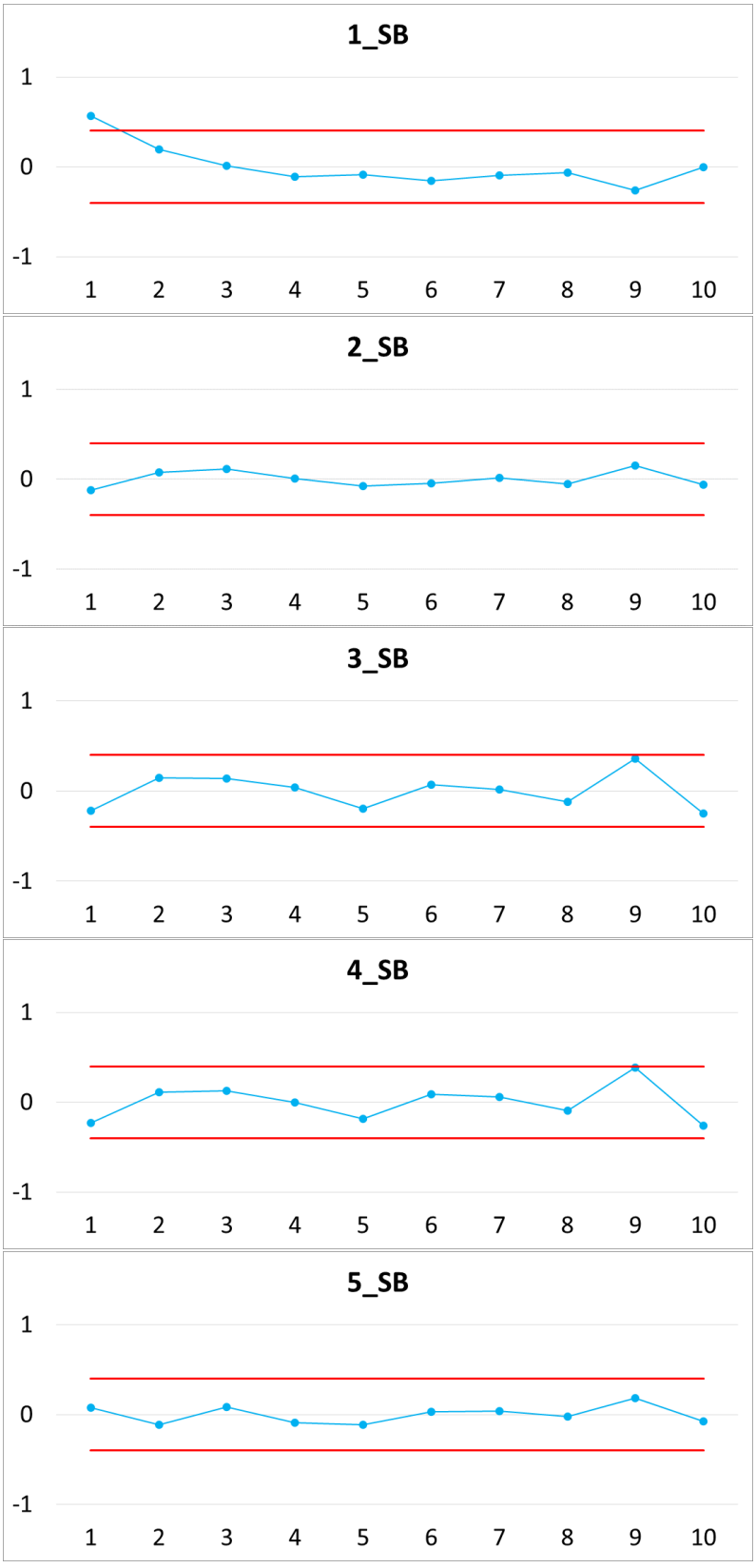
Maximum and minimum Thickness at the 'Trailing Edge point' at each cross section (mm):

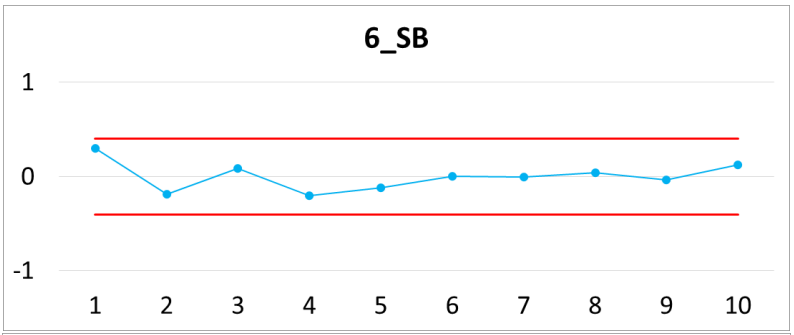


Standard deviation of Thickness at the 'Trailing Edge point' at each cross section (mm):



- Blue Lines: Normalised values (mm) for each control point
- Red Lines: ±0.4 mm for visualisation purposes
- X-Axis: 1 to 10 foils

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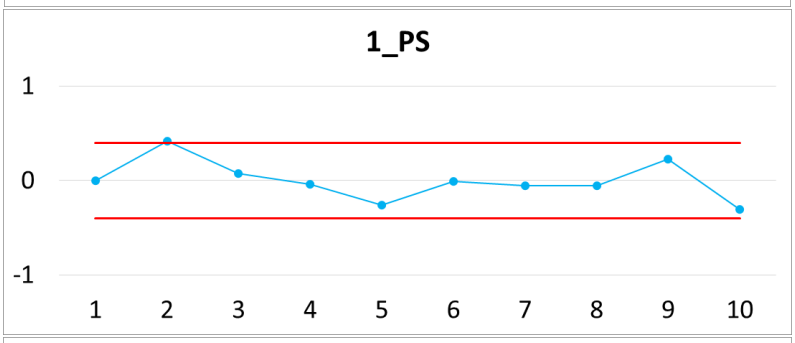
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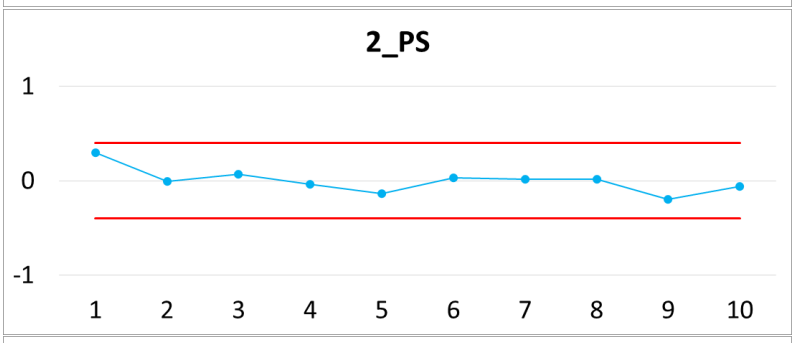
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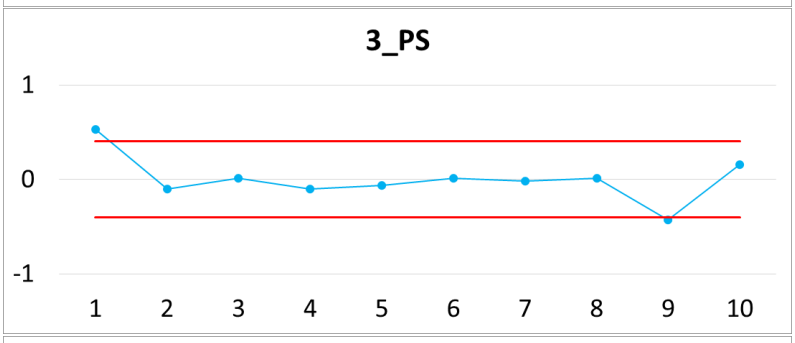
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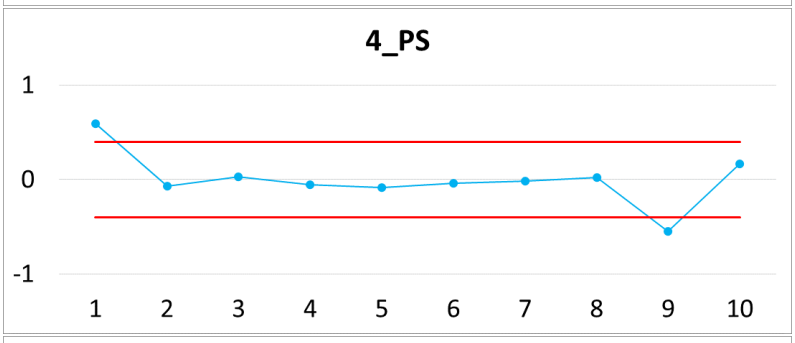
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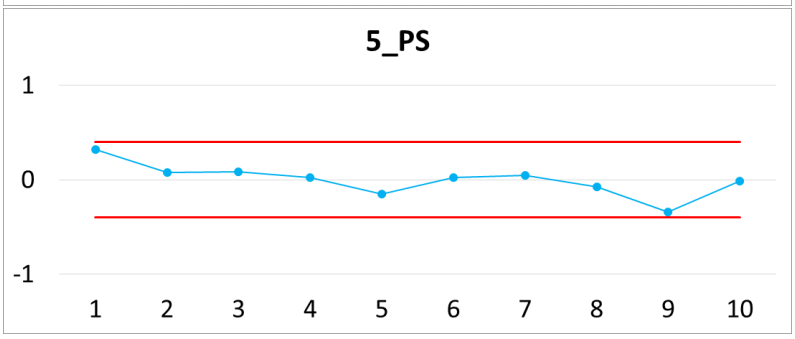
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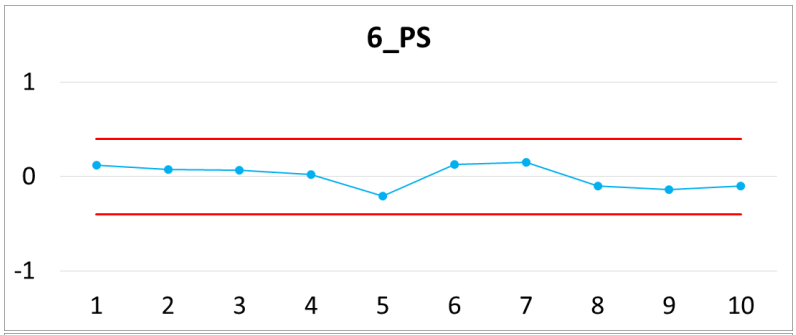
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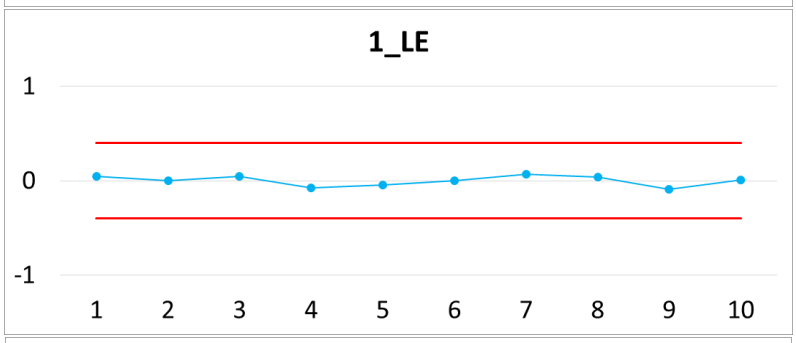
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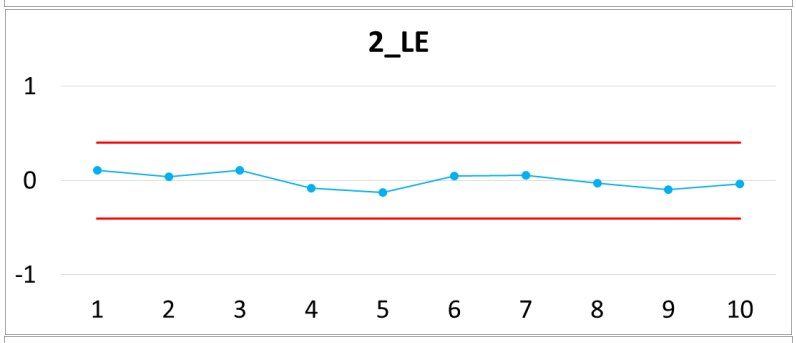
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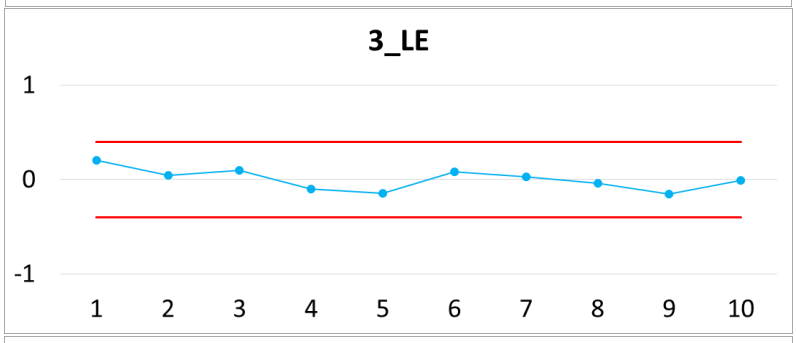
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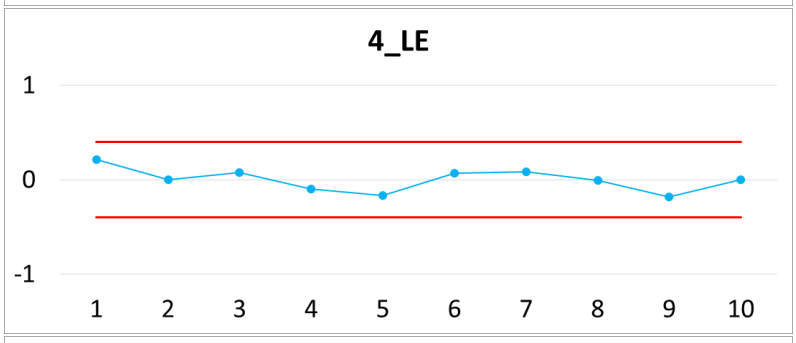
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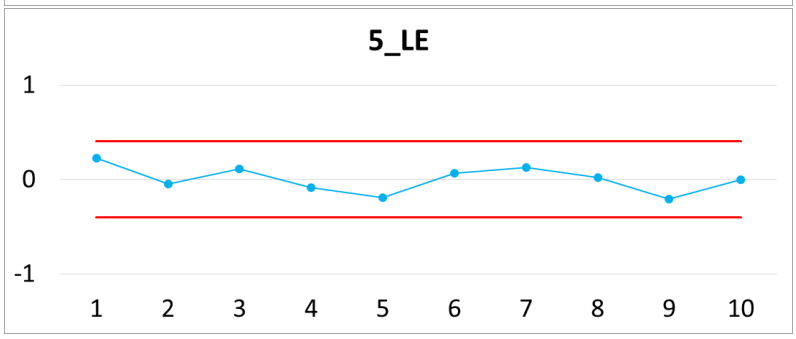
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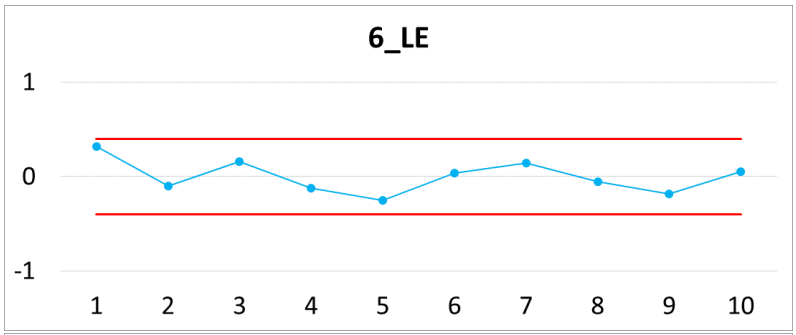
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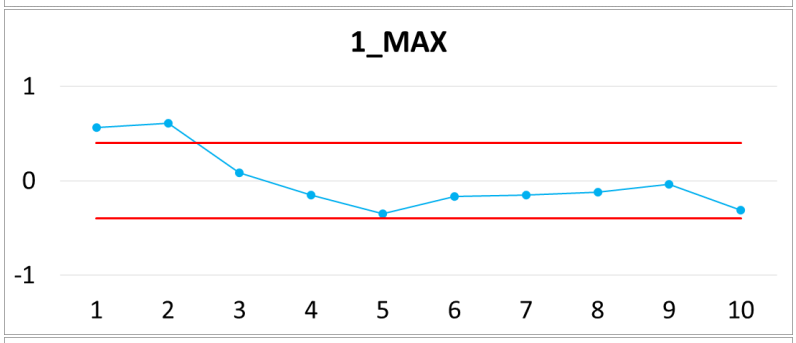
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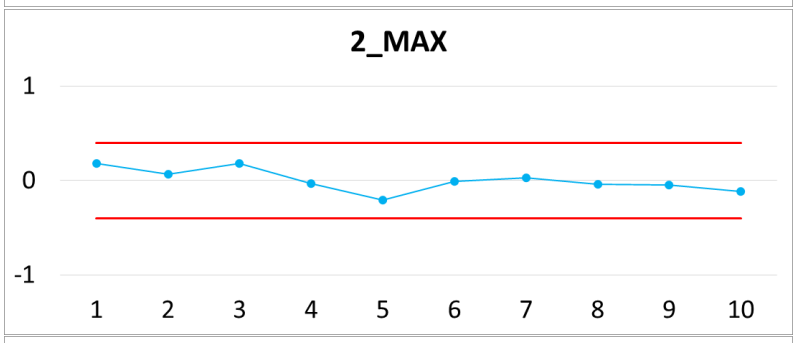
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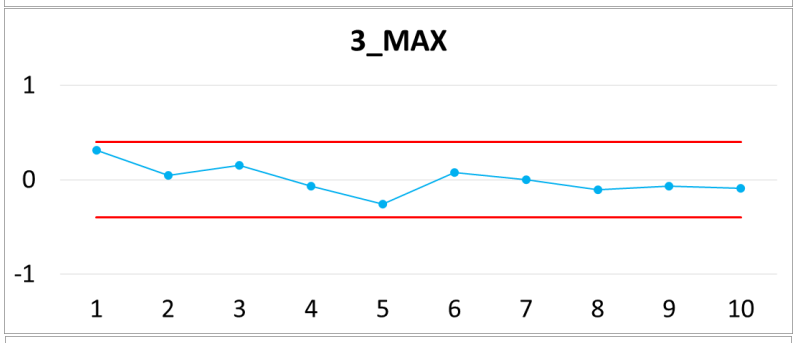
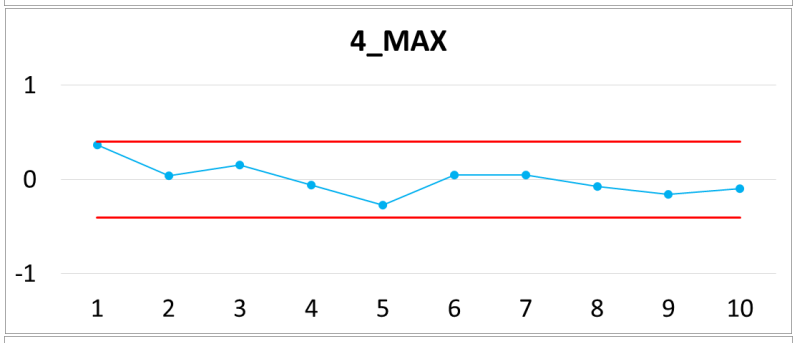

3_MAX
1
0
-1
1 2 3 4 5 6 7 8 9 10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0
-1
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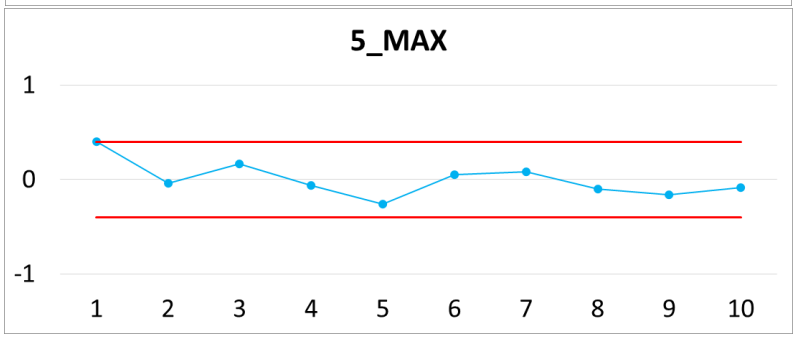
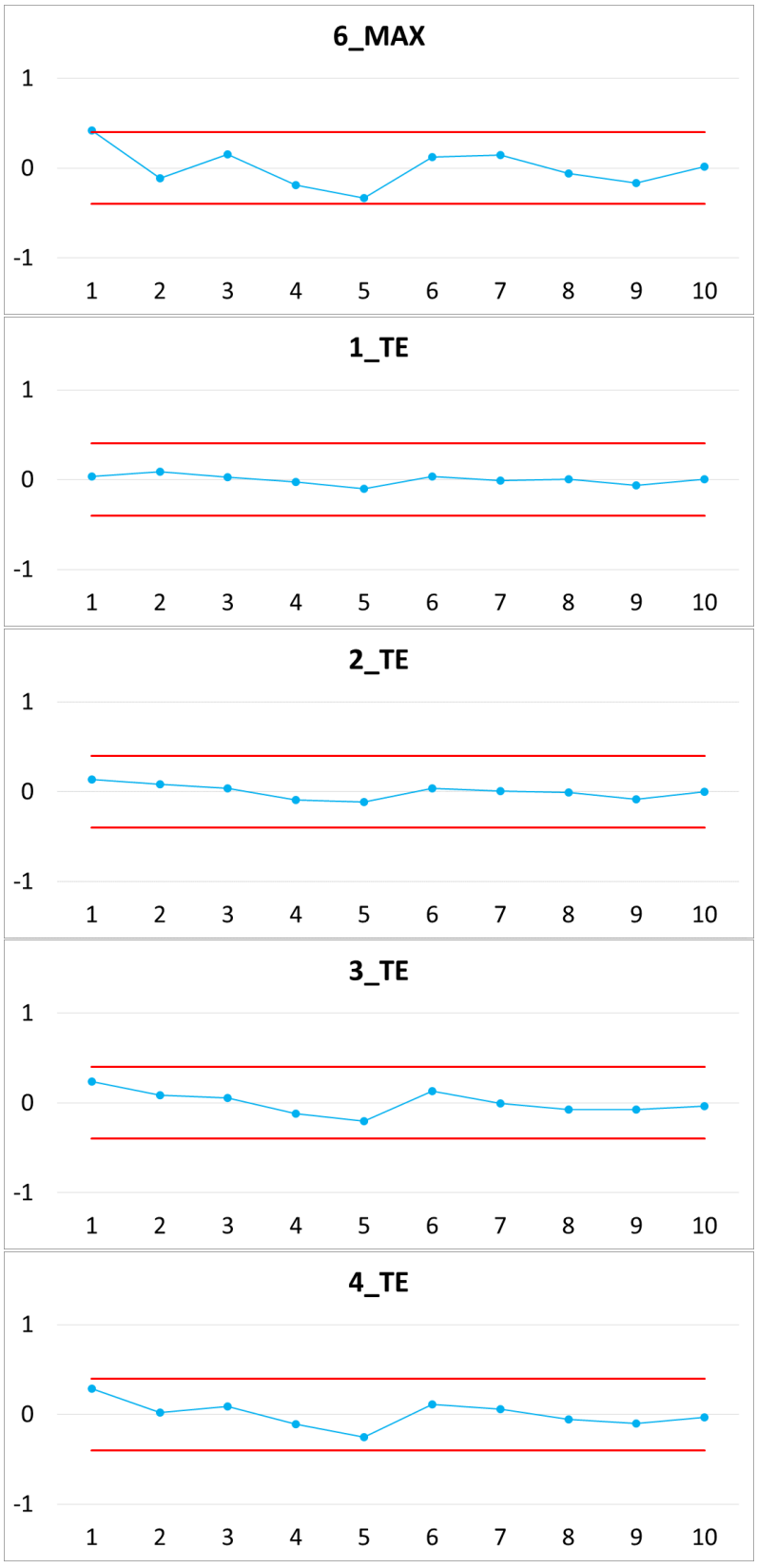
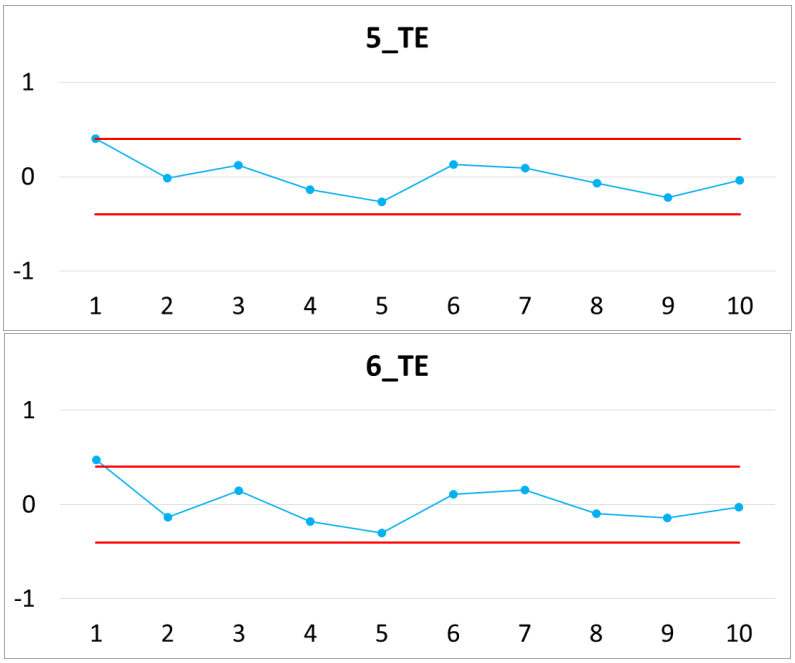
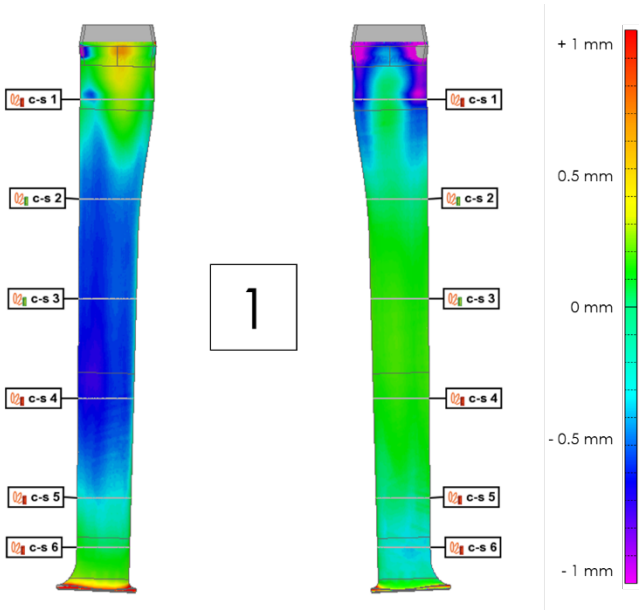
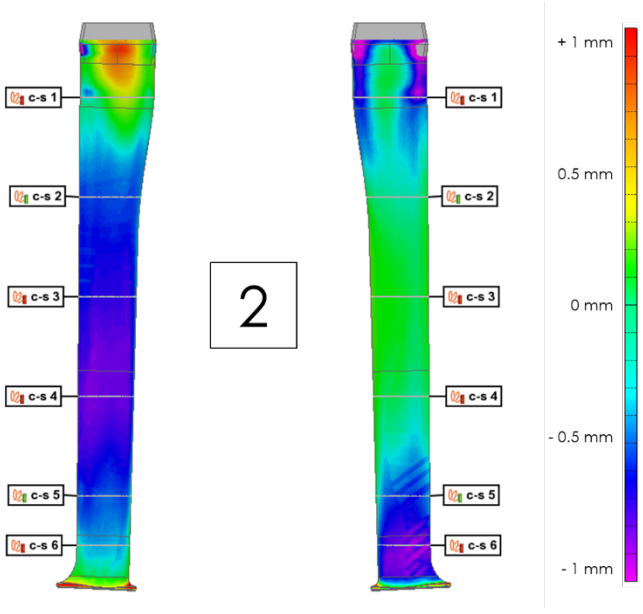
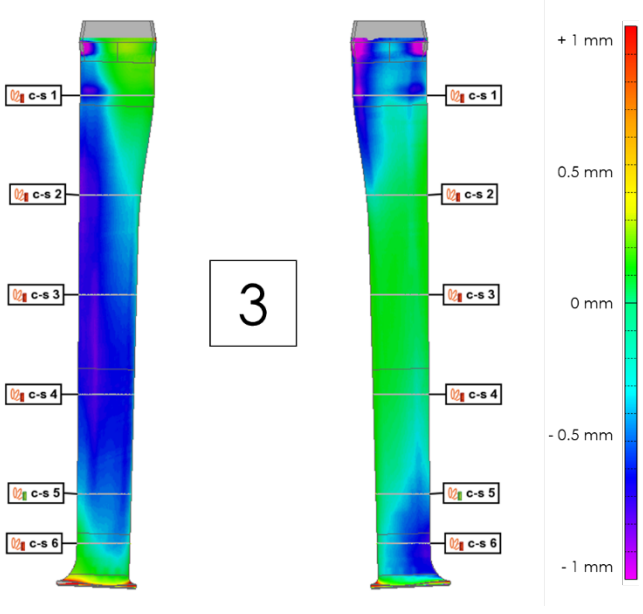

5_MAX
1
0
-1
1 2 3 4 5 6 7 8 9 10

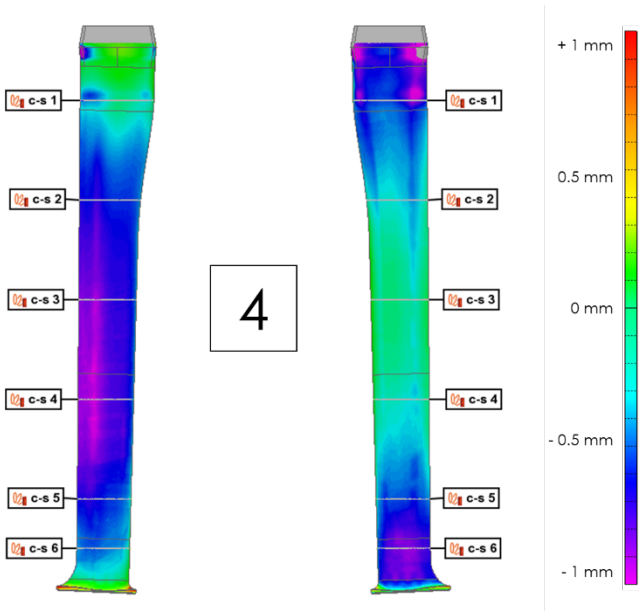

6_MAX
1_TE
2_TE
3_TE
4_TE
1
0
-1
1 2 3 4 5 6 7 8 9 10


5_TE
1
0
-1
1 2 3 4 5 6 7 8 9 10
6_TE
1
0
-1
1 2 3 4 5 6 7 8 9 10


c-s 1
c-s 2
c-s 3
c-s 4
c-s 5
c-s 6
1
+ 1 mm
0.5 mm
0 mm
- 0.5 mm
- 1 mm


c-s 1
c-s 2
c-s 3
c-s 4
c-s 5
c-s 6
2
+ 1 mm
0.5 mm
0 mm
- 0.5 mm
- 1 mm


c-s 1
c-s 2
c-s 3
c-s 4
c-s 5
c-s 6
3
+ 1 mm
0.5 mm
0 mm
- 0.5 mm
- 1 mm


c-s 1
c-s 2
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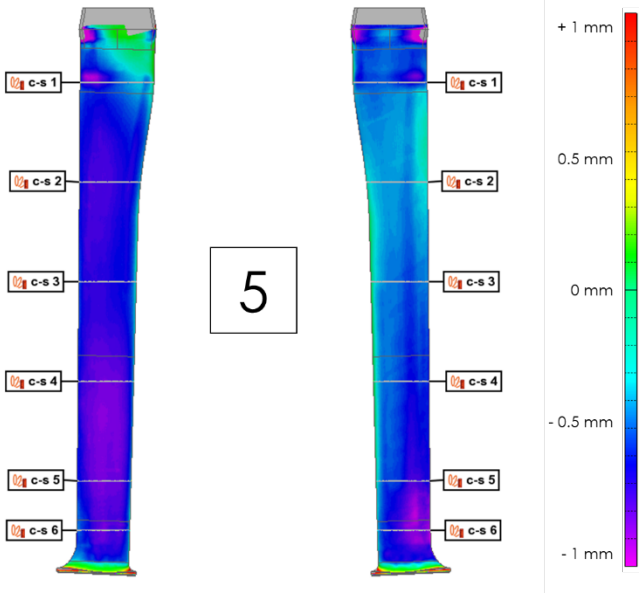
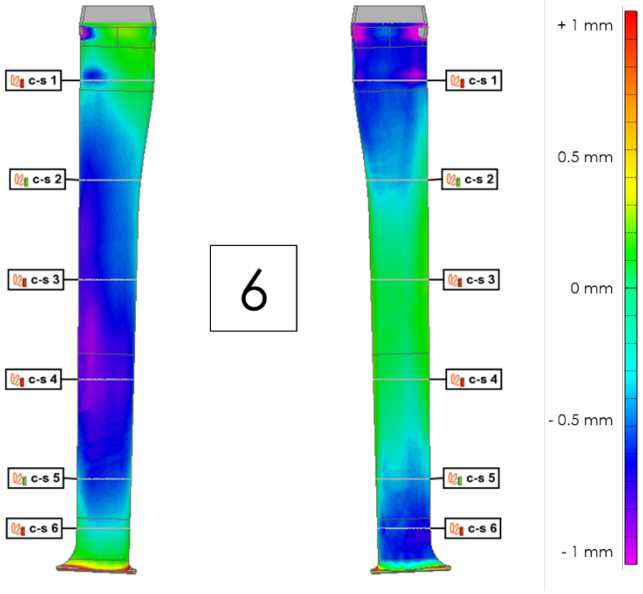
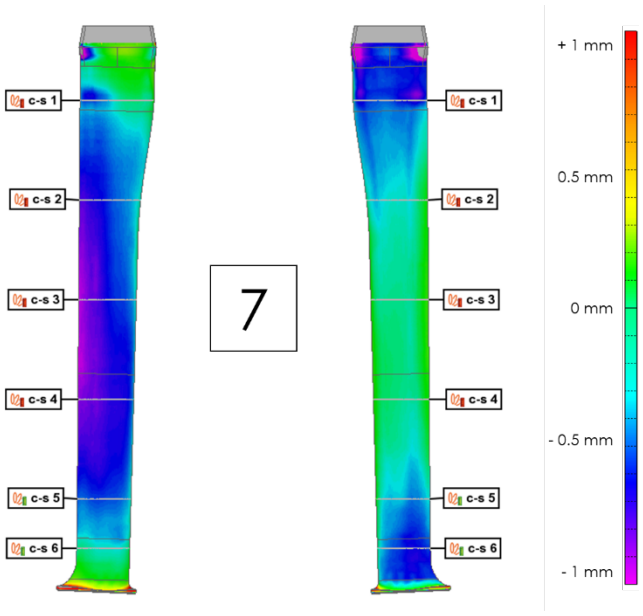
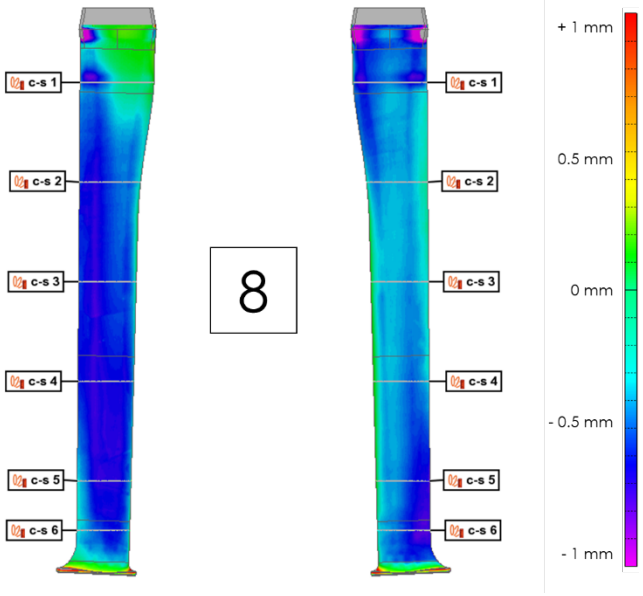
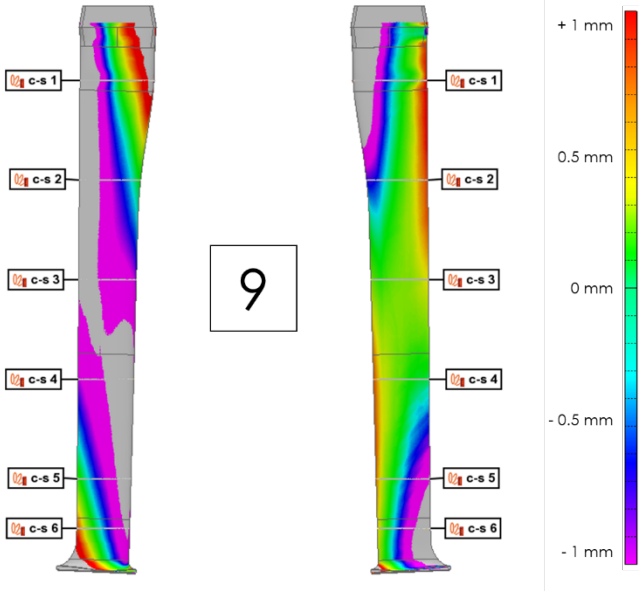
c-s 4
c-s 5
c-s 6
4
+ 1 mm
0.5 mm
0 mm
- 0.5 mm
- 1 mm


c-s 1
c-s 2
c-s 3
c-s 4
c-s 5
c-s 6
5
+ 1 mm
0.5 mm
0 mm
- 0.5 mm
- 1 mm


c-s 1
c-s 2
c-s 3
c-s 4
c-s 5
c-s 6
6
+ 1 mm
0.5 mm
0 mm
- 0.5 mm
- 1 mm


c-s 1
c-s 2
c-s 3
c-s 4
c-s 5
c-s 6
7
+ 1 mm
0.5 mm
0 mm
- 0.5 mm
- 1 mm


c-s 1
c-s 2
c-s 3
c-s 4
c-s 5
c-s 6
8
+ 1 mm
0.5 mm
0 mm
- 0.5 mm
- 1 mm


c-s 1
c-s 2
c-s 3
c-s 4
c-s 5
c-s 6
9
+ 1 mm
0.5 mm
0 mm
- 0.5 mm
- 1 mm

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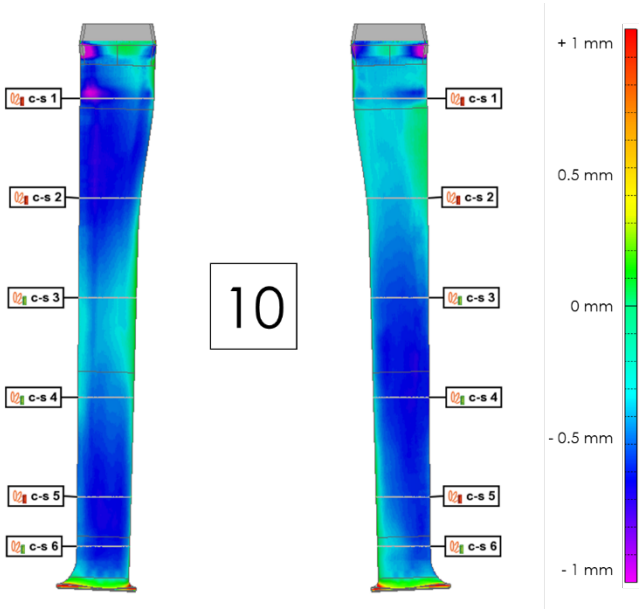
Scanner Report: IKA Formula Kite – Chubanga Mast V5