

World Sailing Manufacturer Control System

Title: Scanner Report for Hydrofoil Registration with Class

Olympic Class: IKA Formula Kite

Equipment Item: Chubanga Frontwing V4

Project				
World Sailing Manufacturer Control System				
Title				
Scanner Report: IKA Formula Kite – Chubanga Frontwing V4				
Revision	By	Date	Description of change	Checked
A	A.S.	19/03/2024	Draft Issue	J.N

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, at the World Sailing offices 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 Frontwing.

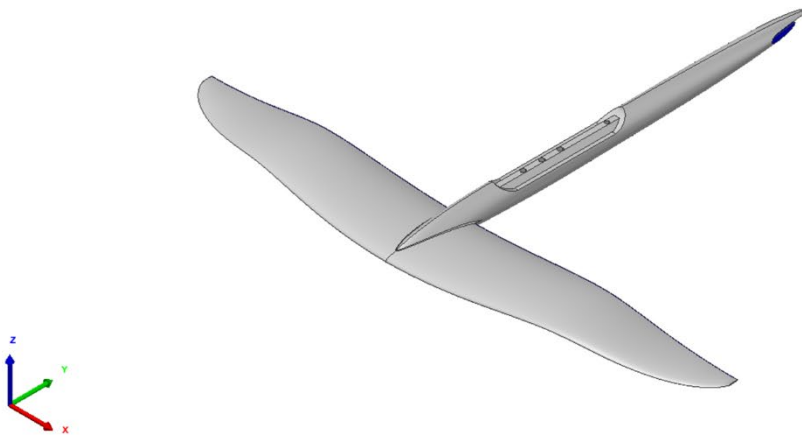


Figure 1 - Definition of the Coordinate System

Cross Sections

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

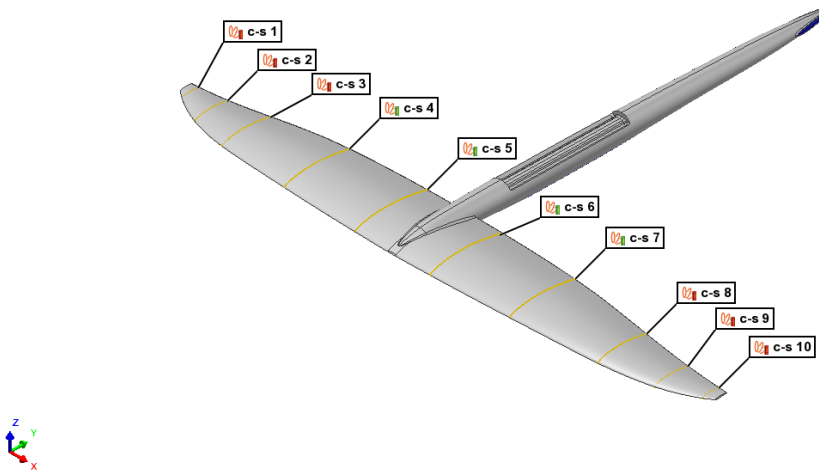


Figure 2 - Definition of Cross Sections

Name	Positioning
c-s 1	10 mm from the tip
c-s 2	50 mm from the tip
c-s 3	250 mm from the symmetry plane (X=0)
c-s 4	150 mm from the symmetry plane (X=0)
c-s 5	50 mm from the symmetry plane (X=0)
c-s 6	50 mm from the symmetry plane (X=0)
c-s 7	150 mm from the symmetry plane (X=0)
c-s 8	250 mm from the symmetry plane (X=0)
c-s 9	50 mm from the tip
c-s 10	10 mm from the tip

Callipers

For each Cross Section, 3 Callipers are defined. Figure 3 shows the positioning of the Callipers per 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	At the maximum thickness of the Cross Section
#_TE	5 mm from the Trailing Edge of the Cross Section

A Calliper is used to measure the span of the Frontwing, Figure 4 shows the positioning.

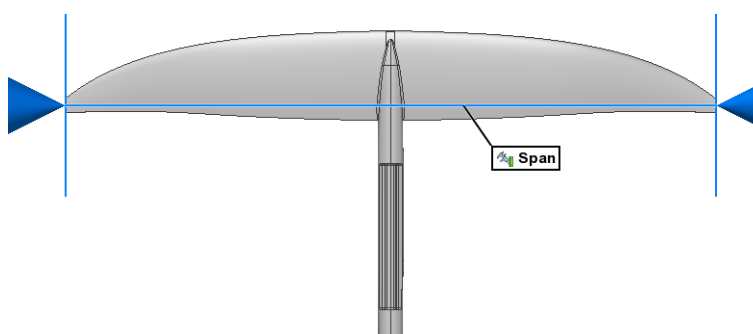


Figure 4 – Calliper to measure the Span

Surface Distance Points

For each Cross Section, 2 Surface Distance Points are defined. Figure 5 shows the positioning of the Surface Distance Points.

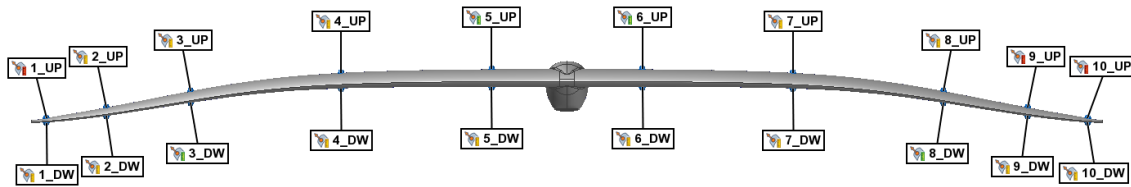


Figure 5 - Surface Distance Points definition

The Surface Distance Points measure the spatial distance between the Upper (Z positive) and Lower (Z negative) surfaces of the CAD file and the scanned equipment. Figure 6 shows a Surface Distance Point in a specific Cross Section measuring the spatial distance between the CAD file (grey) and the scanned equipment (yellow).

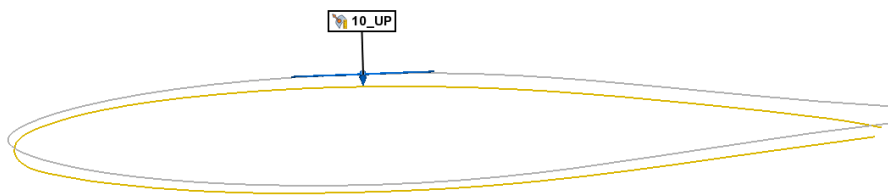


Figure 6 - Definition of Surface Distance Points on a Cross Section

Colour Map

Figure 7 shows the Colour Map of both Upper and Lower surfaces of a Frontwing.

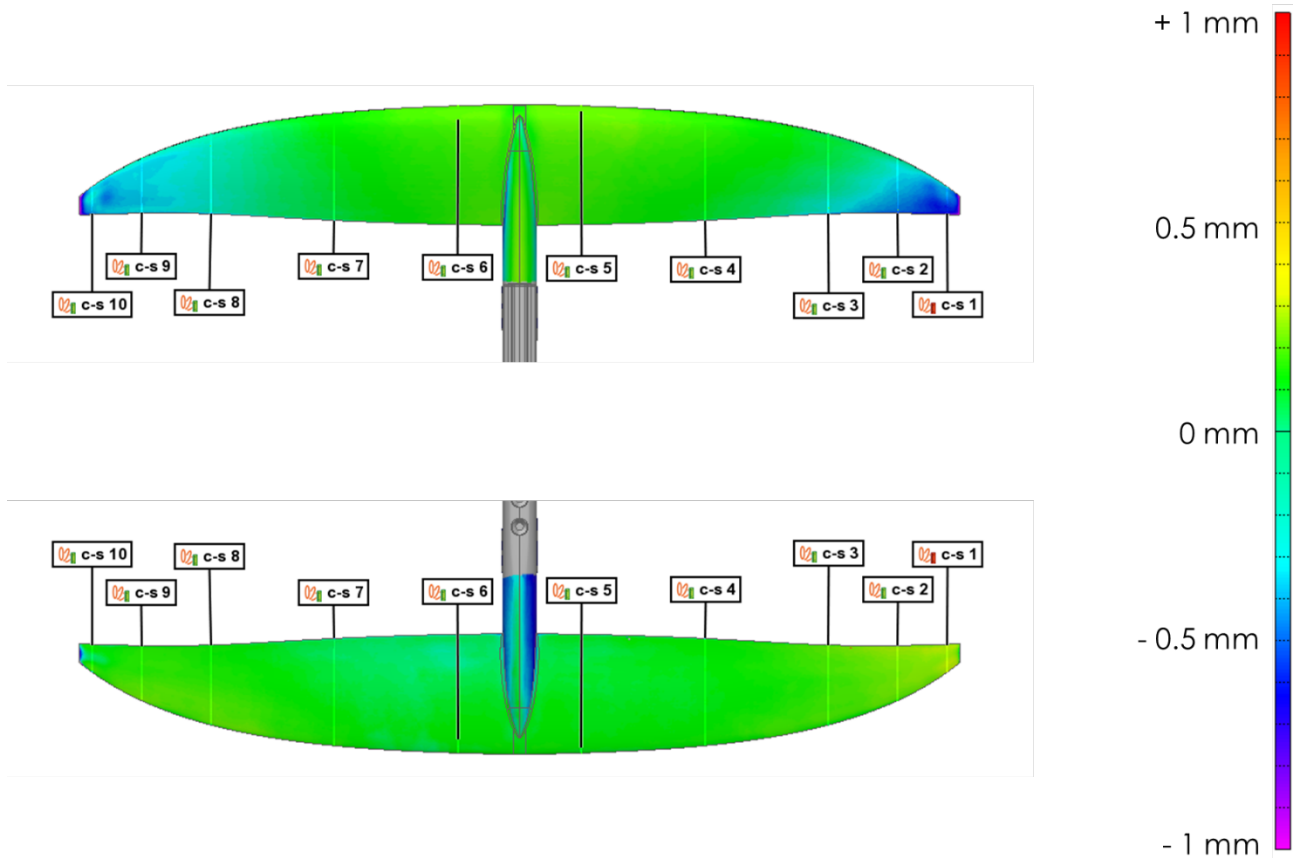


Figure 7 - Colour Map of the Upper (top) and Lower (bottom) surfaces of the Frontwing

The Colour Map shows the measure of the spatial distance between the Upper (Z positive) and Lower (Z negative) surfaces of the CAD file and the scanned equipment, as the Surface Distance Points.

Analysis

For each Frontwing 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)
- Span of the foil as distance from Tip to Tip

Surface Distance	Surface Distance	Calliper	Calliper	Calliper	Calliper
1_UP	1_DW	1_LE	1_MAX	1_TE	Span
2_UP	2_DW	2_LE	2_MAX	2_TE	
3_UP	3_DW	3_LE	3_MAX	3_TE	
4_UP	4_DW	4_LE	4_MAX	4_TE	
5_UP	5_DW	5_LE	5_MAX	5_TE	
6_UP	6_DW	6_LE	6_MAX	6_TE	
7_UP	7_DW	7_LE	7_MAX	7_TE	
8_UP	8_DW	8_LE	8_MAX	8_TE	
9_UP	9_DW	9_LE	9_MAX	9_TE	
10_UP	10_DW	10_LE	10_MAX	10_TE	

For each measurement the average (Mean) is calculated:

$$Mean = \frac{\sum_{i=1}^{10} Value}{10}$$

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

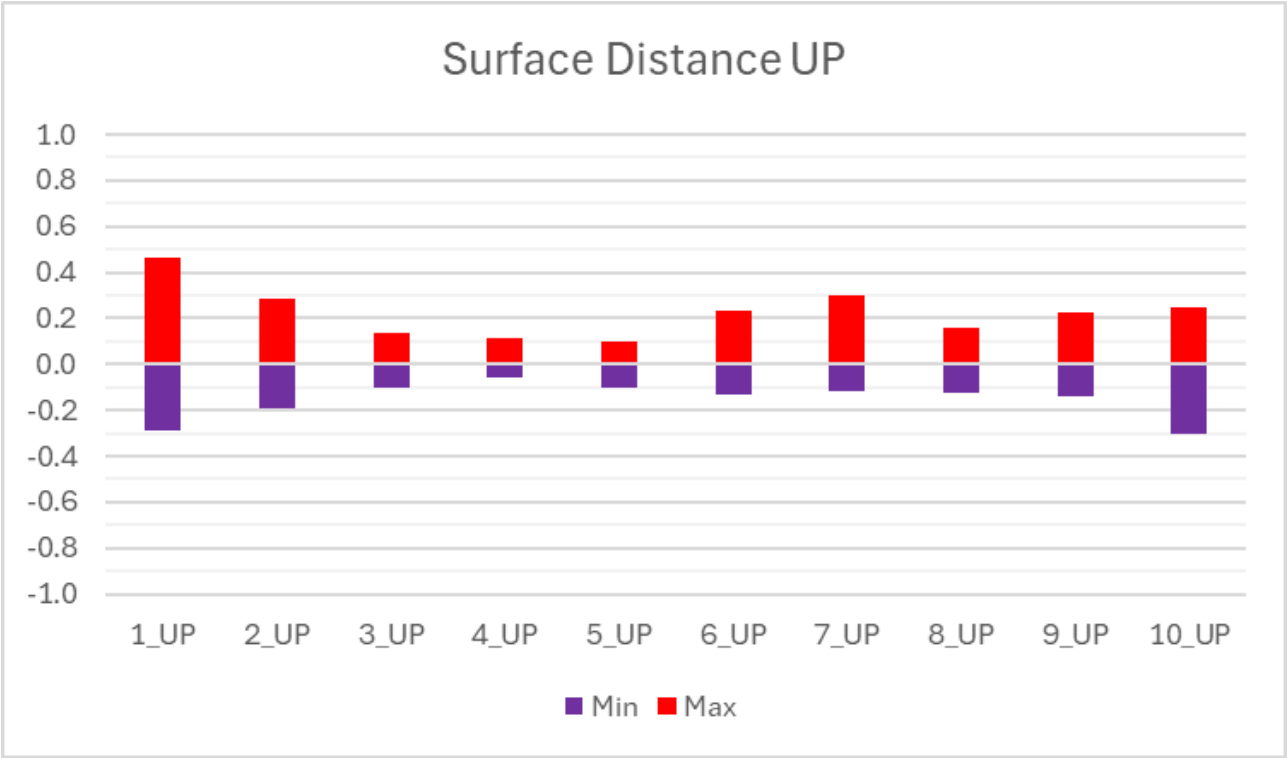
$$Norm.Value = Value - Mean$$

Results

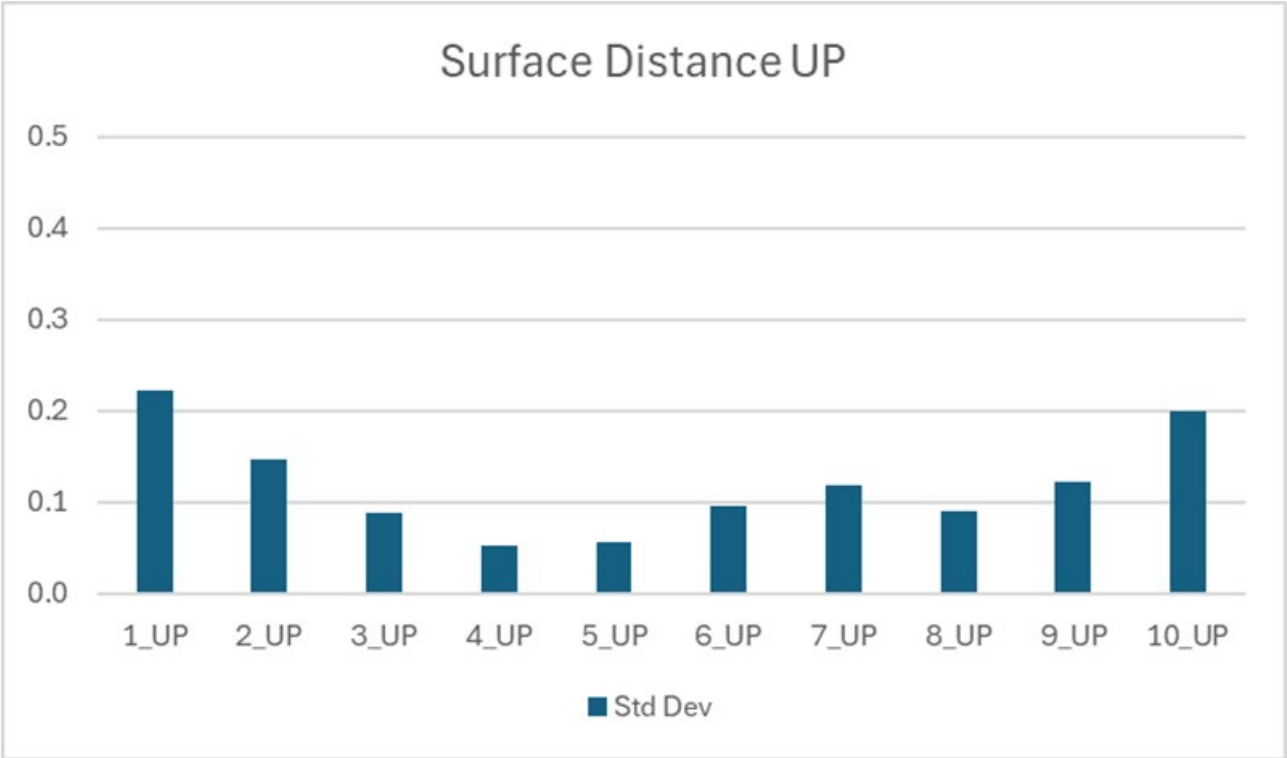
The table in the next page shows the normalised values (in mm) for each foil, minimum and maximum deviations and the standard deviation for each control. ± 0.4 mm has been selected for visualisation purposes. The maximum, minimum and standard deviation values are also plotted.

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	-0.212	0.126	-0.236	0.026	-0.058	0.098	0.108	-0.285	0.467	-0.038	-0.285	0.467	0.222
2_UP	-0.192	0.118	-0.153	-0.063	-0.041	0.105	0.102	-0.095	0.285	-0.064	-0.192	0.285	0.147
3_UP	-0.104	0.134	-0.094	-0.057	-0.037	0.06	0.07	-0.015	0.12	-0.08	-0.104	0.134	0.089
4_UP	0.004	0.117	-0.05	-0.041	-0.033	-0.012	0.026	0.02	0.028	-0.056	-0.056	0.117	0.052
5_UP	0.098	0.08	-0.011	-0.026	-0.017	-0.101	-0.008	0.022	-0.039	0	-0.101	0.098	0.057
6_UP	0.231	0.056	0.016	-0.068	-0.037	-0.132	-0.019	0.002	-0.042	-0.005	-0.132	0.231	0.096
7_UP	0.303	0.049	-0.033	-0.114	-0.039	-0.093	-0.037	-0.029	0.052	-0.062	-0.114	0.303	0.119
8_UP	0.108	0.065	-0.069	-0.123	-0.026	0.004	0.023	-0.03	0.155	-0.103	-0.123	0.155	0.090
9_UP	-0.1	0.126	-0.14	-0.063	0.034	0.046	0.076	-0.081	0.228	-0.127	-0.140	0.228	0.122
10_UP	-0.303	0.181	-0.211	0.17	0.093	0.096	0.085	-0.249	0.25	-0.114	-0.303	0.250	0.200
1_DW	0.137	-0.013	0.116	-0.08	-0.041	-0.042	-0.001	0.409	-0.547	0.065	-0.547	0.409	0.239
2_DW	0.135	0.034	0.044	-0.012	-0.068	-0.029	0.011	0.208	-0.389	0.065	-0.389	0.208	0.158
3_DW	0.095	0.087	-0.015	-0.018	-0.091	-0.048	0.012	0.102	-0.204	0.076	-0.204	0.102	0.098
4_DW	0.007	0.07	-0.064	-0.096	-0.033	-0.1	0.082	-0.014	0.173	-0.025	-0.100	0.173	0.086
5_DW	-0.022	0.119	-0.086	-0.104	0.029	-0.065	0.118	-0.131	0.233	-0.087	-0.131	0.233	0.121
6_DW	-0.024	0.124	-0.077	-0.065	0.036	-0.029	0.098	-0.147	0.175	-0.095	-0.147	0.175	0.105
7_DW	0.05	0.067	-0.013	-0.007	0.014	-0.088	0.054	-0.111	0.078	-0.041	-0.111	0.078	0.065
8_DW	0.279	0.062	0.093	0.002	0.028	-0.16	-0.083	-0.048	-0.201	0.029	-0.201	0.279	0.136
9_DW	0.448	-0.062	0.15	-0.056	-0.017	-0.166	-0.117	0.041	-0.269	0.051	-0.269	0.448	0.197
10_DW	0.622	-0.32	0.233	-0.26	-0.053	-0.191	-0.083	0.223	-0.243	0.069	-0.320	0.622	0.293
1_LE	-0.008	0.068	-0.122	-0.011	-0.101	0.026	0.091	0.094	-0.067	0.031	-0.122	0.094	0.077
2_LE	-0.048	0.08	-0.118	-0.013	-0.134	0.072	0.135	0.08	-0.086	0.029	-0.134	0.135	0.094
3_LE	0.01	0.173	-0.089	-0.041	-0.16	0.069	0.076	0.026	-0.097	0.031	-0.160	0.173	0.098
4_LE	0.074	0.197	-0.114	-0.091	-0.094	-0.004	0.016	-0.03	-0.001	0.051	-0.114	0.197	0.093
5_LE	0.168	0.207	-0.093	-0.134	-0.024	-0.028	-0.064	-0.087	0.076	-0.021	-0.134	0.207	0.114
6_LE	0.343	0.164	-0.097	-0.089	0.01	-0.056	-0.147	-0.156	0.054	-0.021	-0.156	0.343	0.154
7_LE	0.463	0.127	-0.09	-0.135	-0.015	-0.084	-0.096	-0.096	-0.02	-0.057	-0.135	0.463	0.178
8_LE	0.346	0.089	-0.002	-0.146	0.033	-0.122	-0.077	-0.049	-0.041	-0.031	-0.146	0.346	0.140
9_LE	0.289	0.023	0.013	-0.107	0.022	-0.118	-0.019	-0.03	-0.014	-0.057	-0.118	0.289	0.113
10_LE	0.224	-0.058	0.005	-0.09	0.046	-0.095	0.031	-0.003	0	-0.057	-0.095	0.224	0.093
1_MAX	-0.079	0.115	-0.122	-0.051	-0.099	0.057	0.109	0.119	-0.073	0.027	-0.122	0.119	0.096
2_MAX	-0.058	0.154	-0.111	-0.077	-0.111	0.077	0.115	0.113	-0.103	0	-0.111	0.154	0.106
3_MAX	-0.009	0.226	-0.109	-0.075	-0.129	0.013	0.085	0.089	-0.083	-0.004	-0.129	0.226	0.109
4_MAX	0.011	0.187	-0.114	-0.137	-0.067	-0.113	0.107	0.006	0.201	-0.081	-0.137	0.201	0.126
5_MAX	0.077	0.198	-0.098	-0.13	0.011	-0.165	0.11	-0.11	0.193	-0.088	-0.165	0.198	0.137
6_MAX	0.207	0.18	-0.061	-0.133	-0.001	-0.162	0.078	-0.145	0.133	-0.1	-0.162	0.207	0.141
7_MAX	0.354	0.116	-0.045	-0.121	-0.025	-0.18	0.018	-0.14	0.13	-0.103	-0.180	0.354	0.162
8_MAX	0.391	0.128	0.024	-0.125	0.001	-0.159	-0.062	-0.08	-0.046	-0.077	-0.159	0.391	0.160
9_MAX	0.352	0.066	0.008	-0.121	0.018	-0.121	-0.041	-0.043	-0.039	-0.078	-0.121	0.352	0.137
10_MAX	0.314	-0.135	0.018	-0.086	0.043	-0.093	0.003	-0.03	0.01	-0.046	-0.135	0.314	0.124
1_TE	0.021	0.085	-0.131	-0.116	-0.076	0.084	0.112	0.133	-0.096	-0.018	-0.131	0.133	0.100
2_TE	-0.12	0.195	-0.153	-0.071	-0.091	0.063	0.121	0.152	-0.09	-0.003	-0.153	0.195	0.124
3_TE	-0.056	0.232	-0.129	-0.103	-0.096	0.034	0.113	0.13	-0.096	-0.03	-0.129	0.232	0.122
4_TE	0.035	0.225	-0.112	-0.099	-0.065	-0.036	0.063	0.075	-0.021	-0.067	-0.112	0.225	0.102
5_TE	0.142	0.235	-0.08	-0.078	-0.015	-0.114	-0.068	-0.036	0.086	-0.075	-0.114	0.235	0.115
6_TE	0.325	0.196	-0.069	-0.112	-0.015	-0.115	-0.107	-0.077	0.057	-0.087	-0.115	0.325	0.150
7_TE	0.323	0.103	-0.002	-0.067	-0.042	-0.105	-0.077	-0.083	-0.002	-0.044	-0.105	0.323	0.128
8_TE	0.332	0.121	0.04	-0.114	-0.006	-0.143	-0.043	-0.073	-0.047	-0.069	-0.143	0.332	0.139
9_TE	0.365	0.092	0.03	-0.123	-0.001	-0.134	-0.023	-0.069	-0.041	-0.095	-0.134	0.365	0.146
10_TE	0.348	-0.052	0.048	-0.115	0.018	-0.116	0.005	-0.041	-0.01	-0.083	-0.116	0.348	0.134
Span	-0.01	0.428	0.277	0.243	0.161	-0.312	0.018	0.057	-0.195	-0.666	-0.666	0.428	0.321

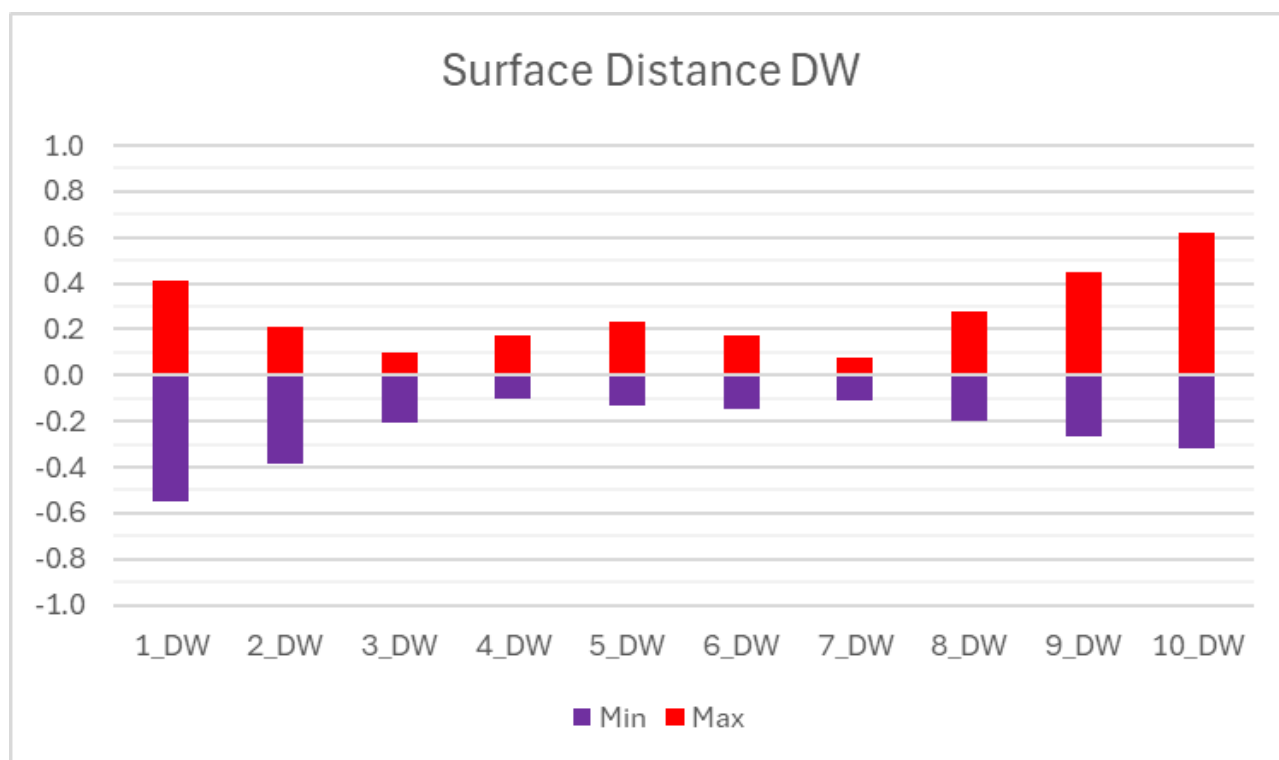
Maximum and minimum 'Surface Distances' on the upper surface at each cross section (mm):



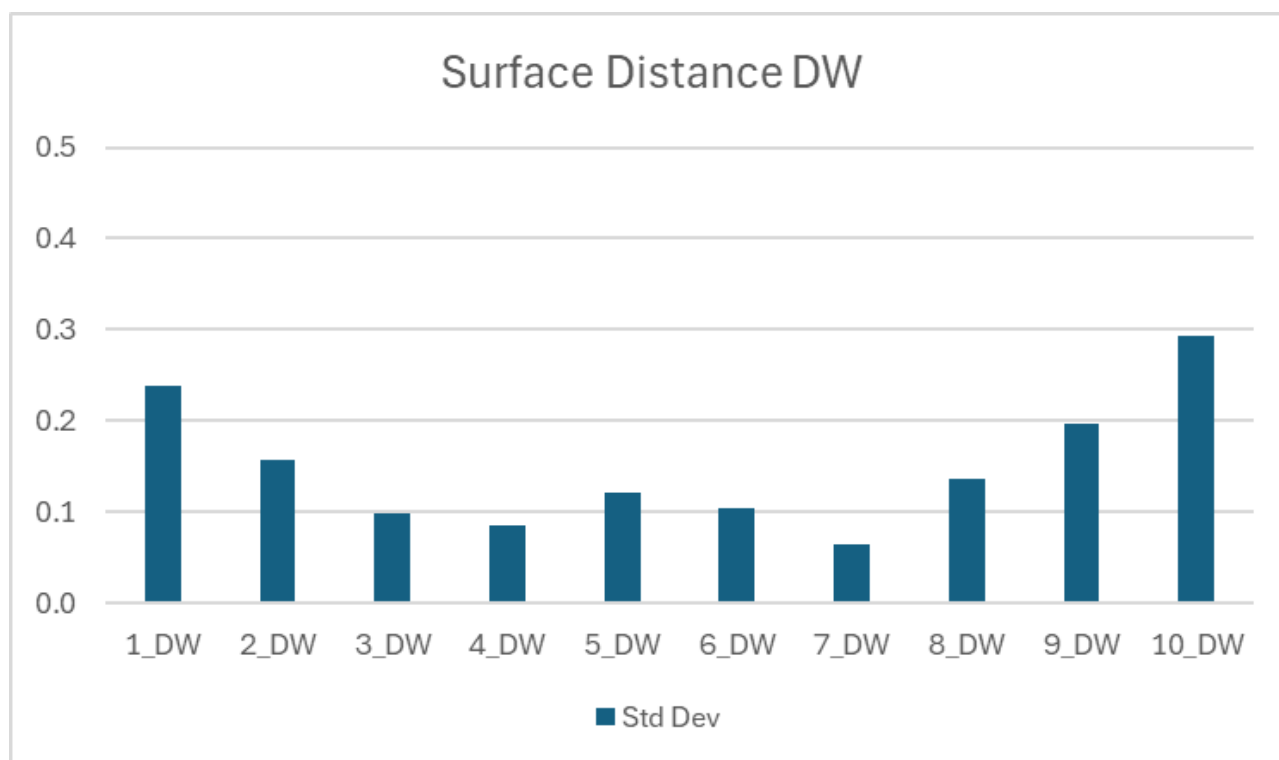
Standard deviation of 'Surface Distances' on the upper surface at each cross section (mm):



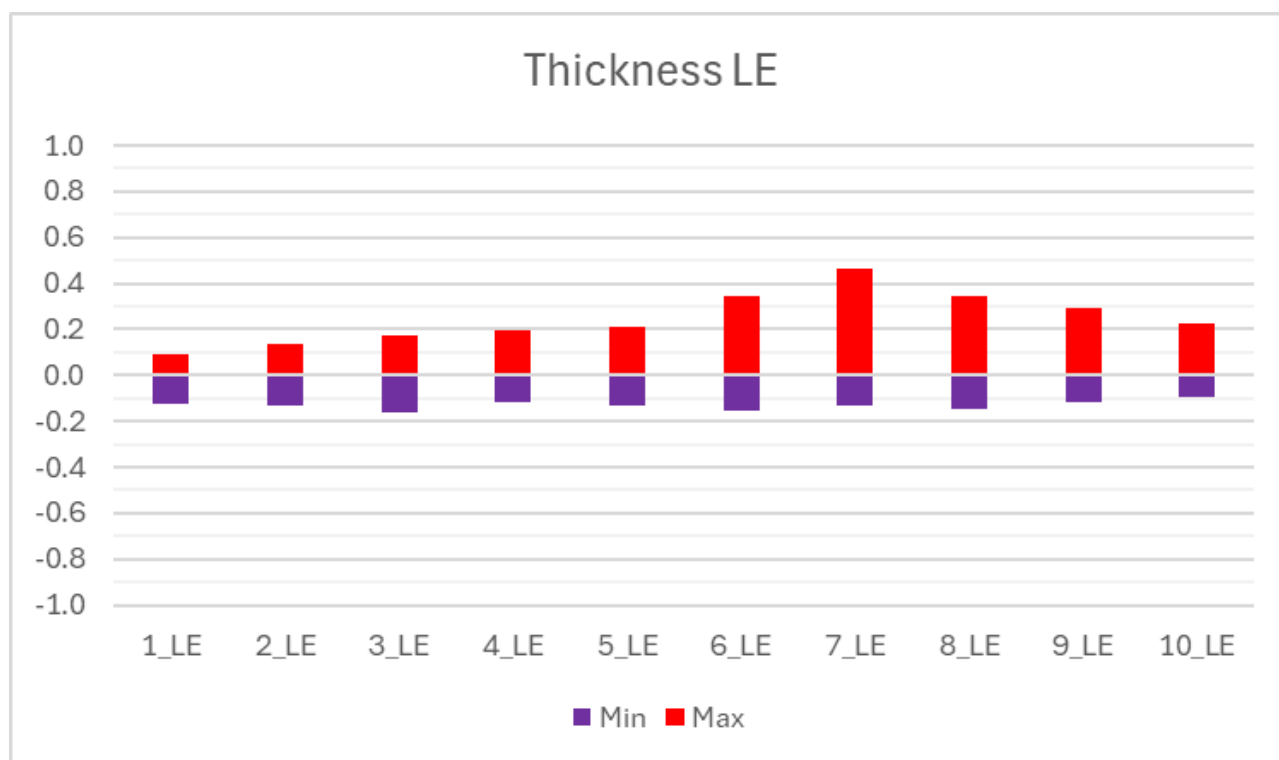
Maximum and minimum 'Surface Distances' on the lower surface at each cross section (mm):



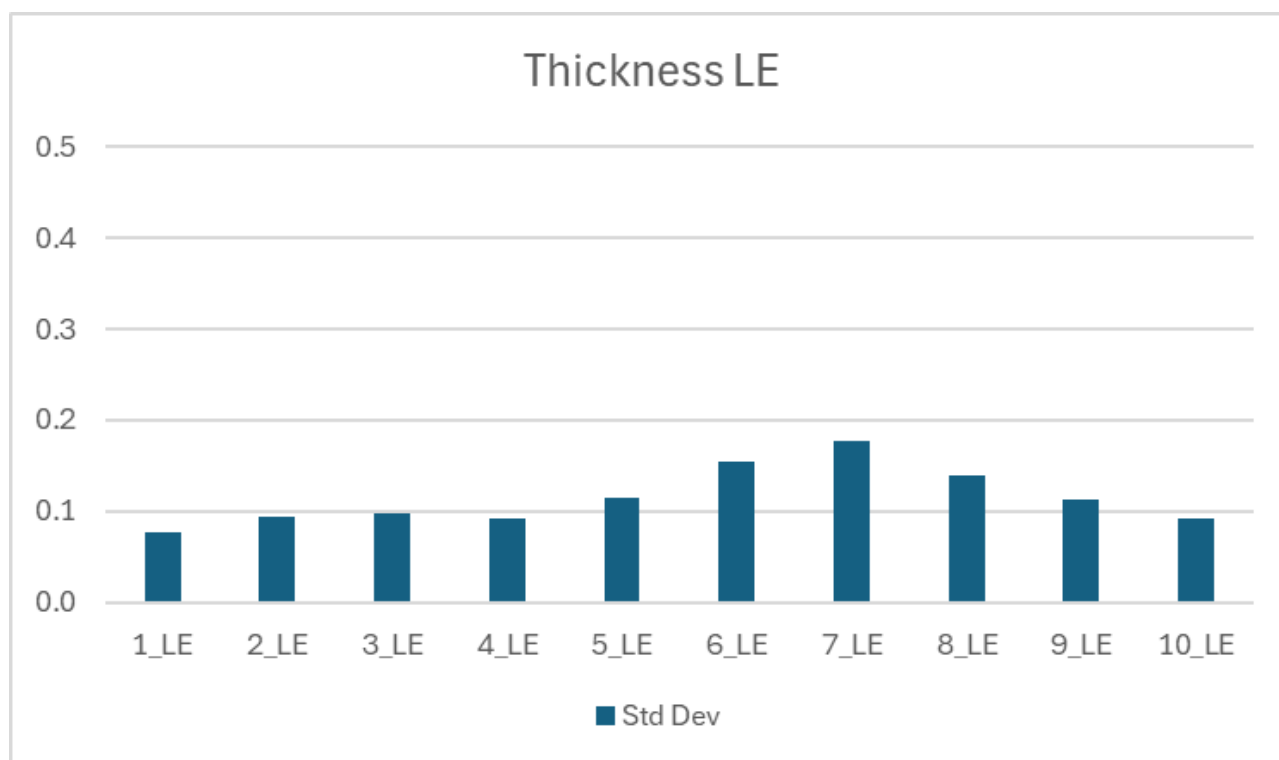
Standard deviation of 'Surface Distances' on the lower surface at each cross section (mm):



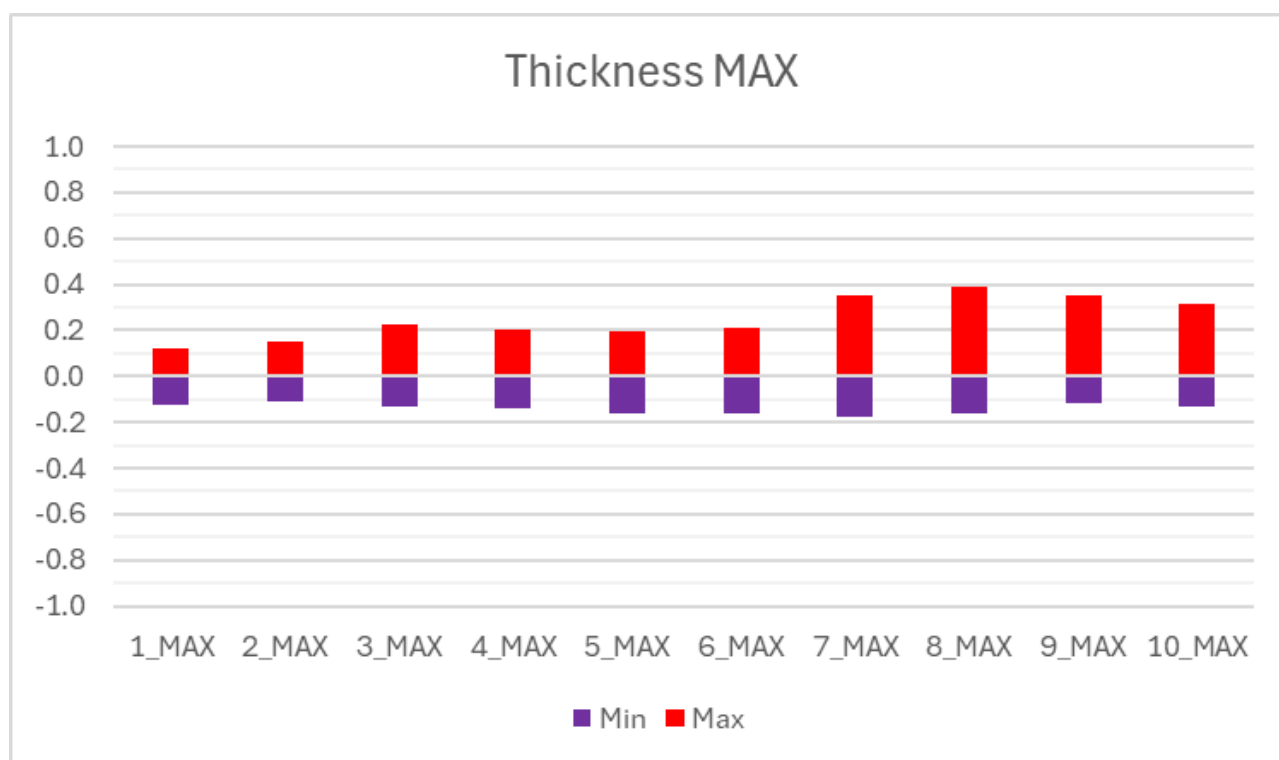
Maximum and minimum Thickness at the 'Leading Edge point' at each cross section (mm):



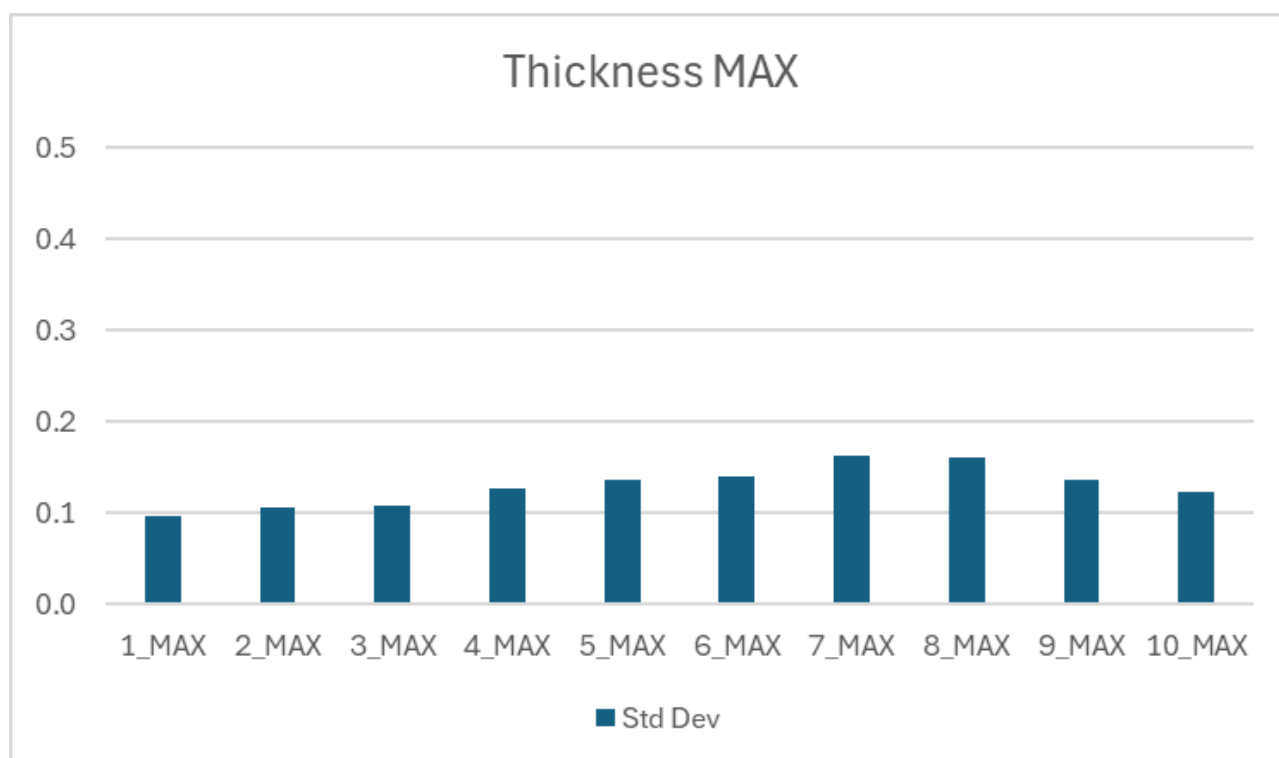
Standard deviation of Thickness at the 'Leading Edge point' at each cross section (mm):



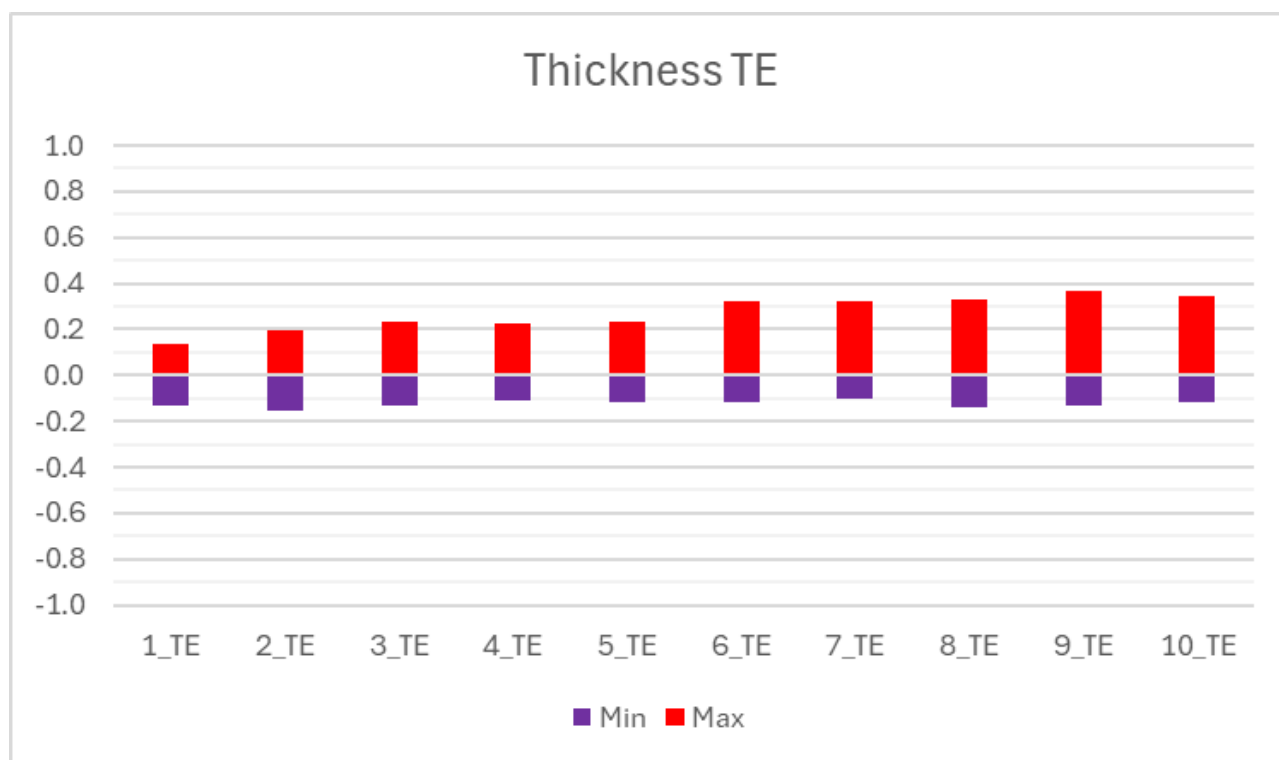
Maximum and minimum Thickness at the 'Maximum thickness point' at each cross section (mm):



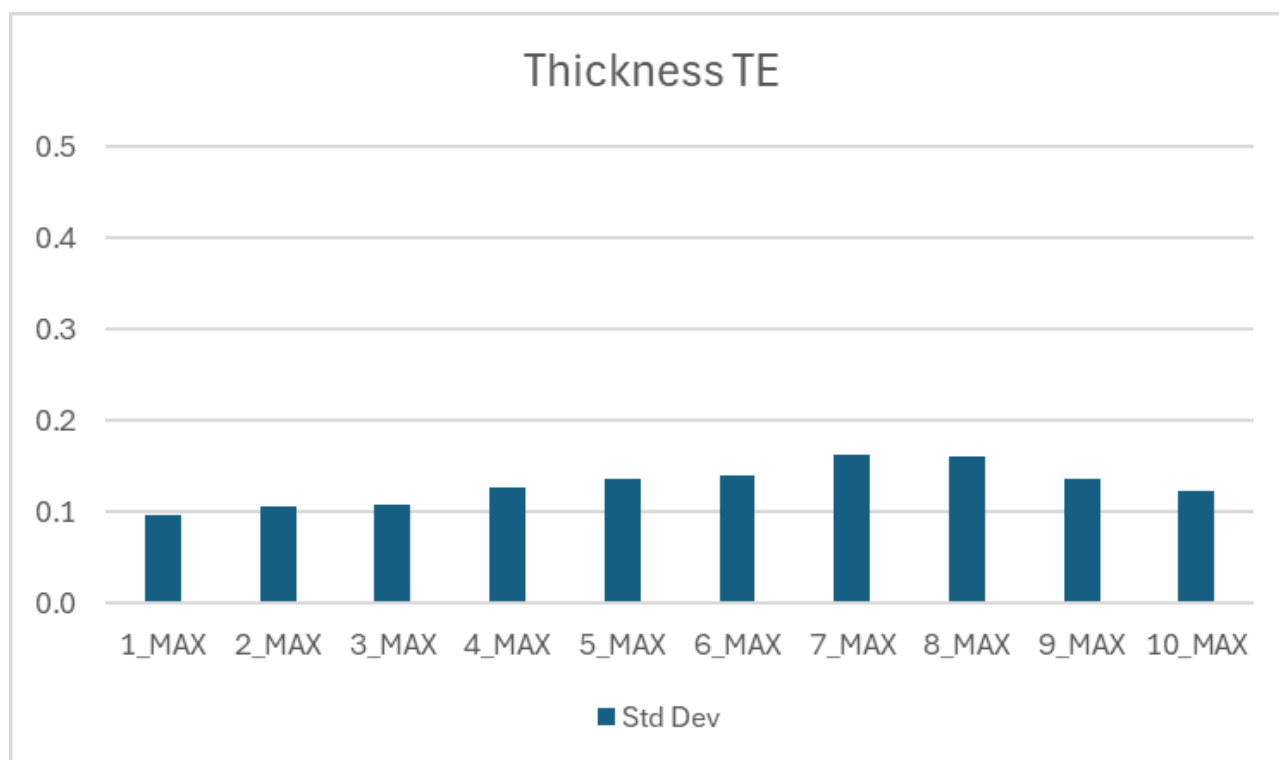
Standard deviation of Thickness at the 'Maximum thickness point' at each cross section (mm):



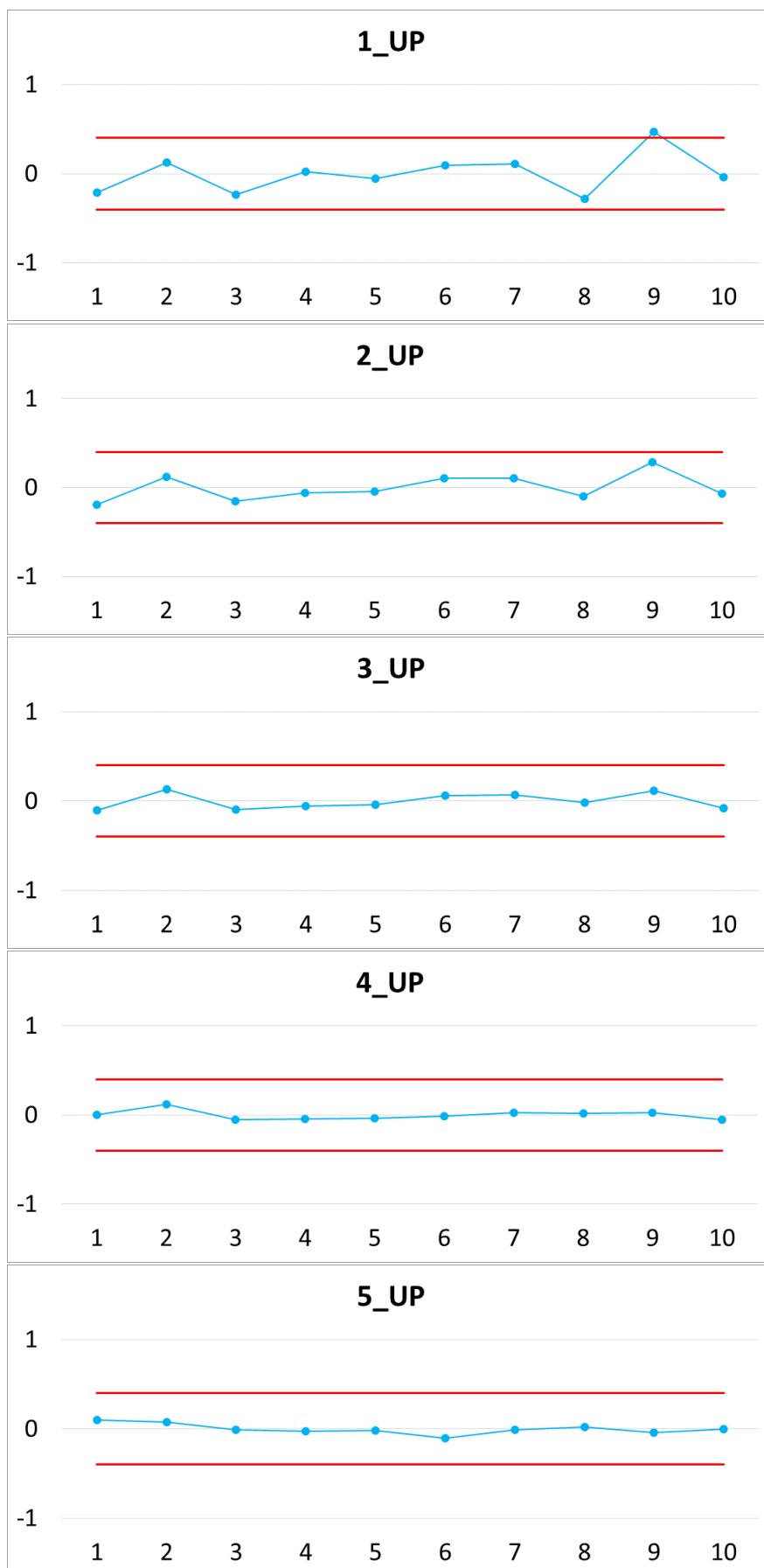
Maximum and minimum Thickness at the 'Trailing Edge point' at each cross section (mm):

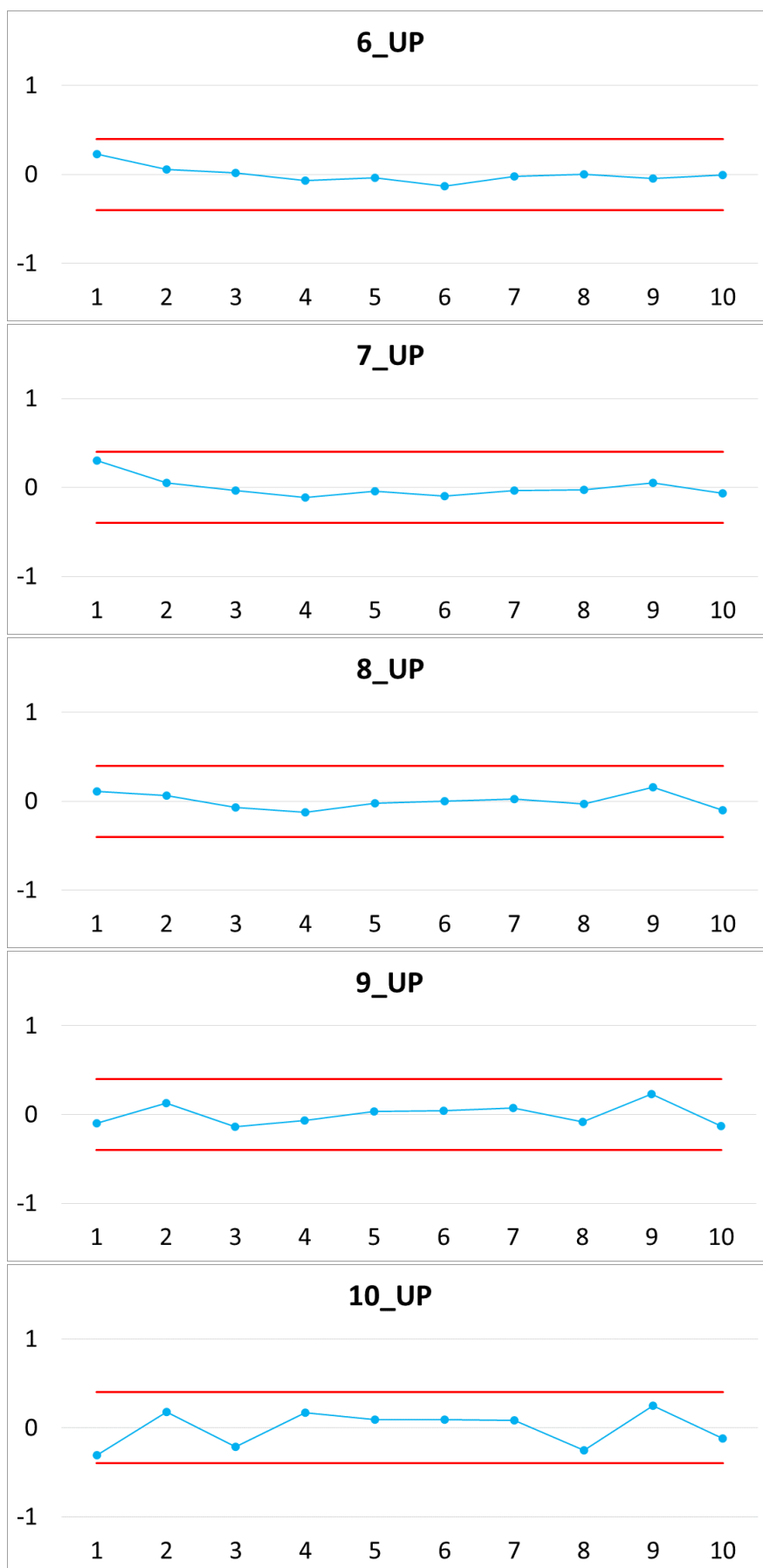


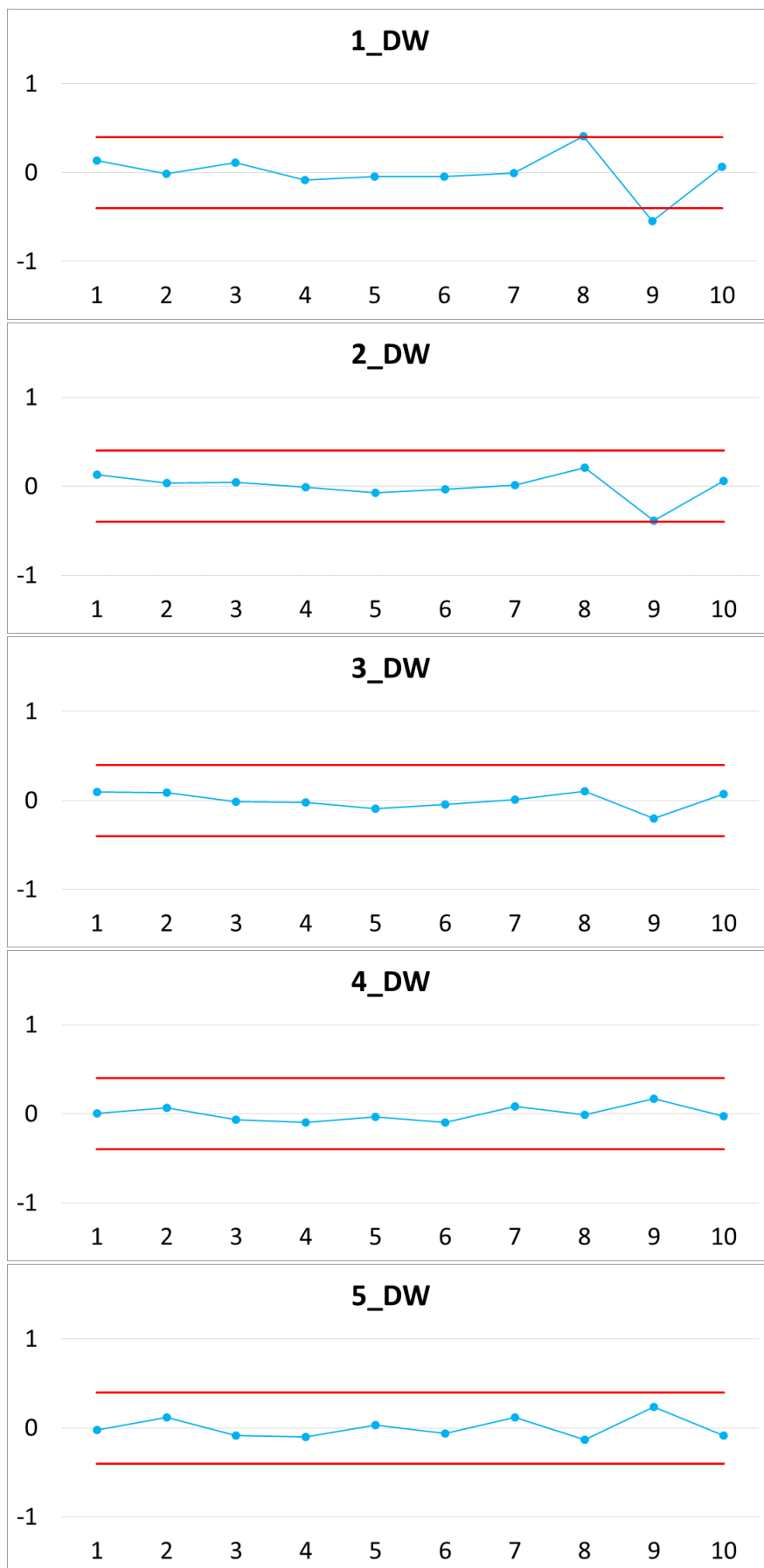
Standard deviation of Thickness at the 'Trailing Edge point' at each cross section (mm):

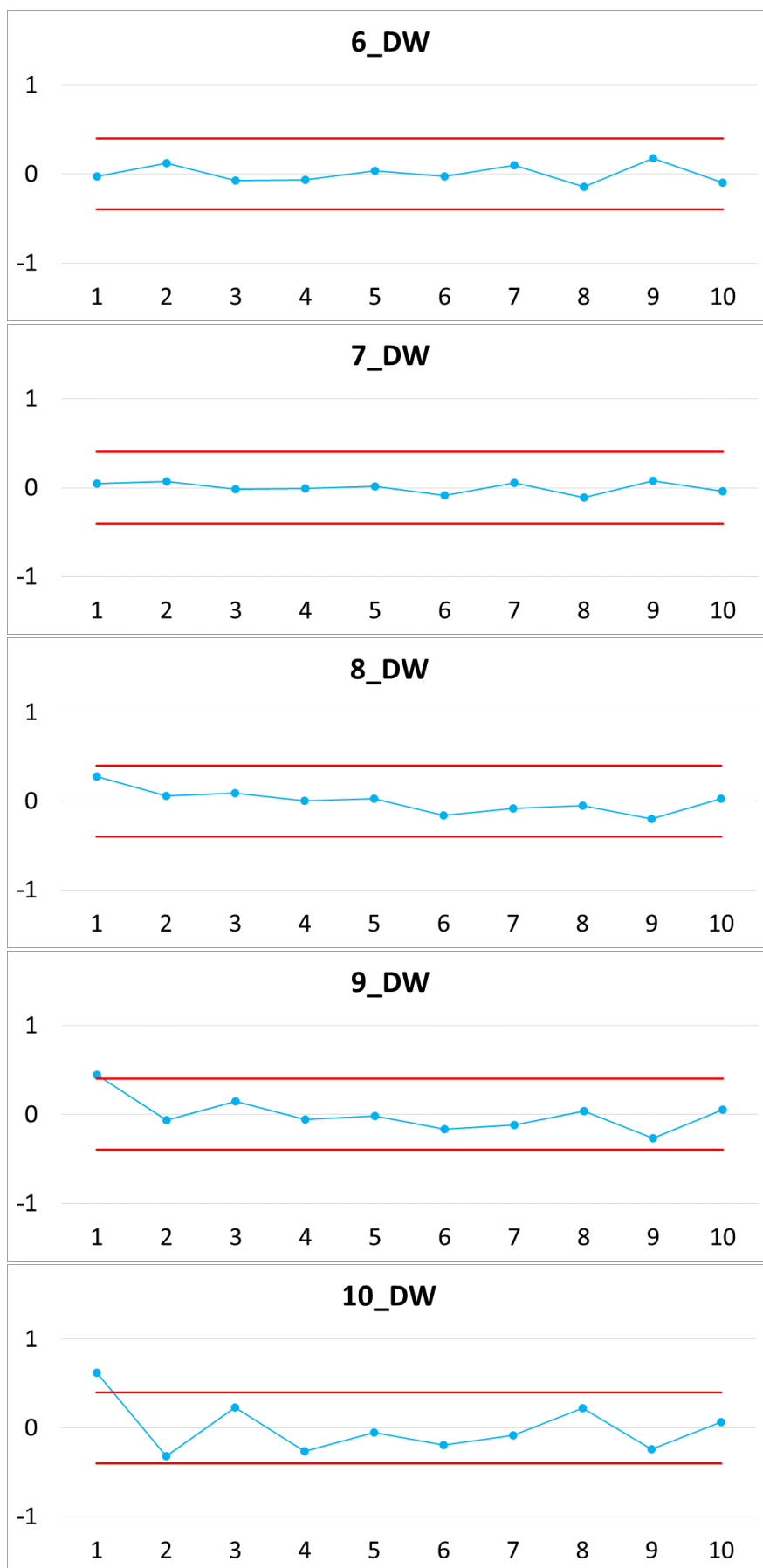


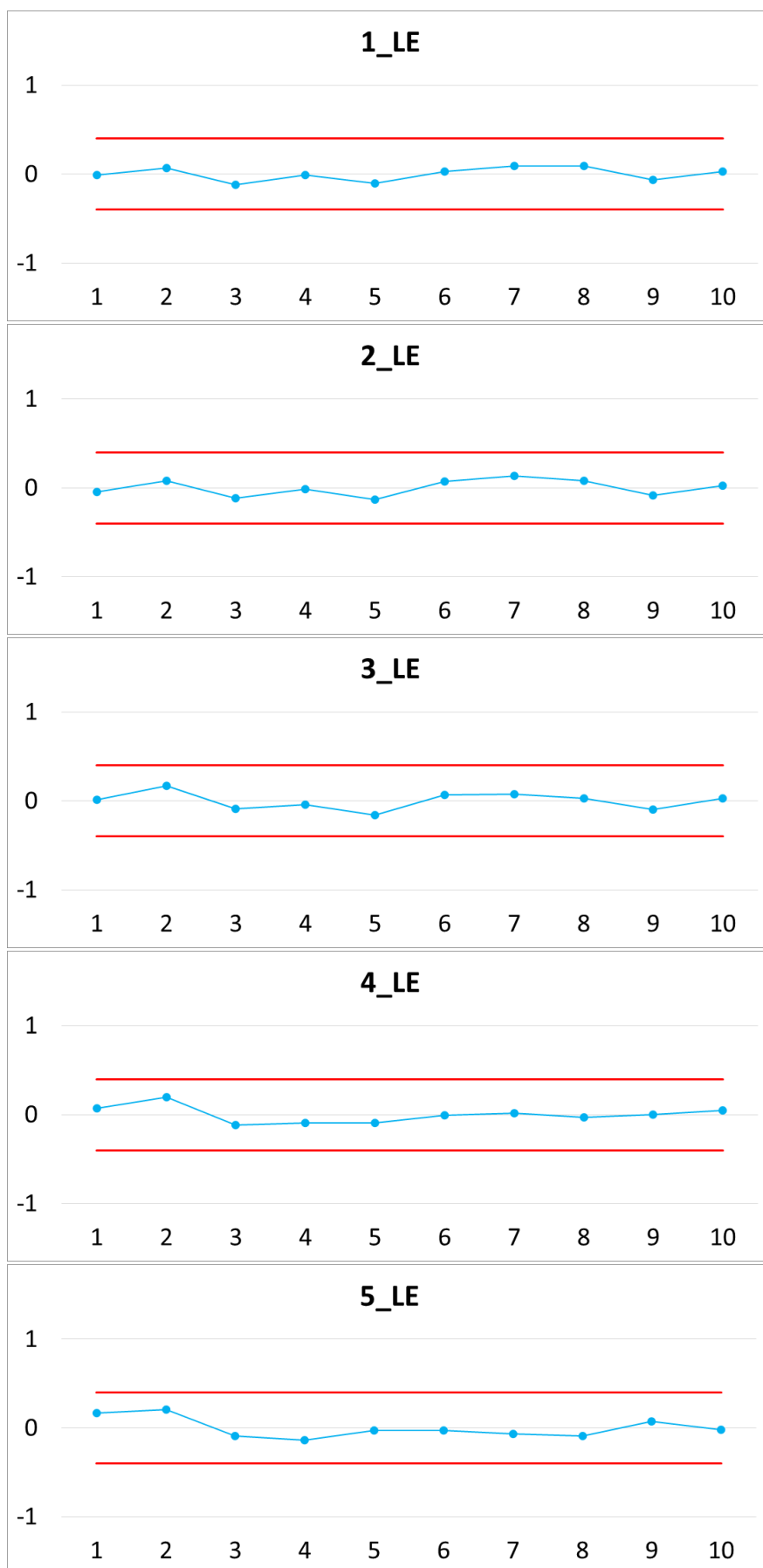
- Blue Lines: Normalised values (mm) for each control point
- Red Lines: ± 0.4 mm for visualisation purposes
- X-Axis: 1 to 10 foils

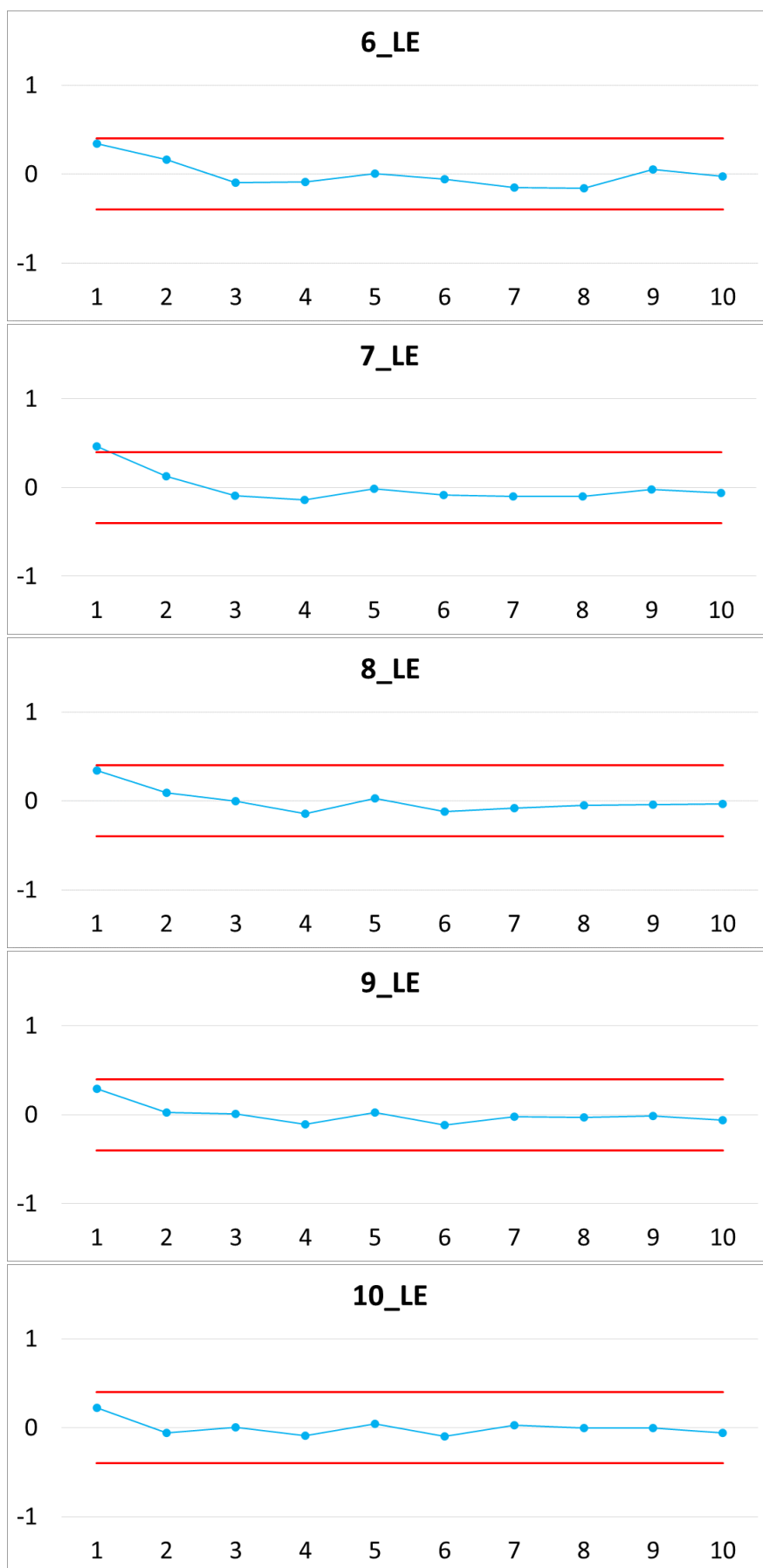


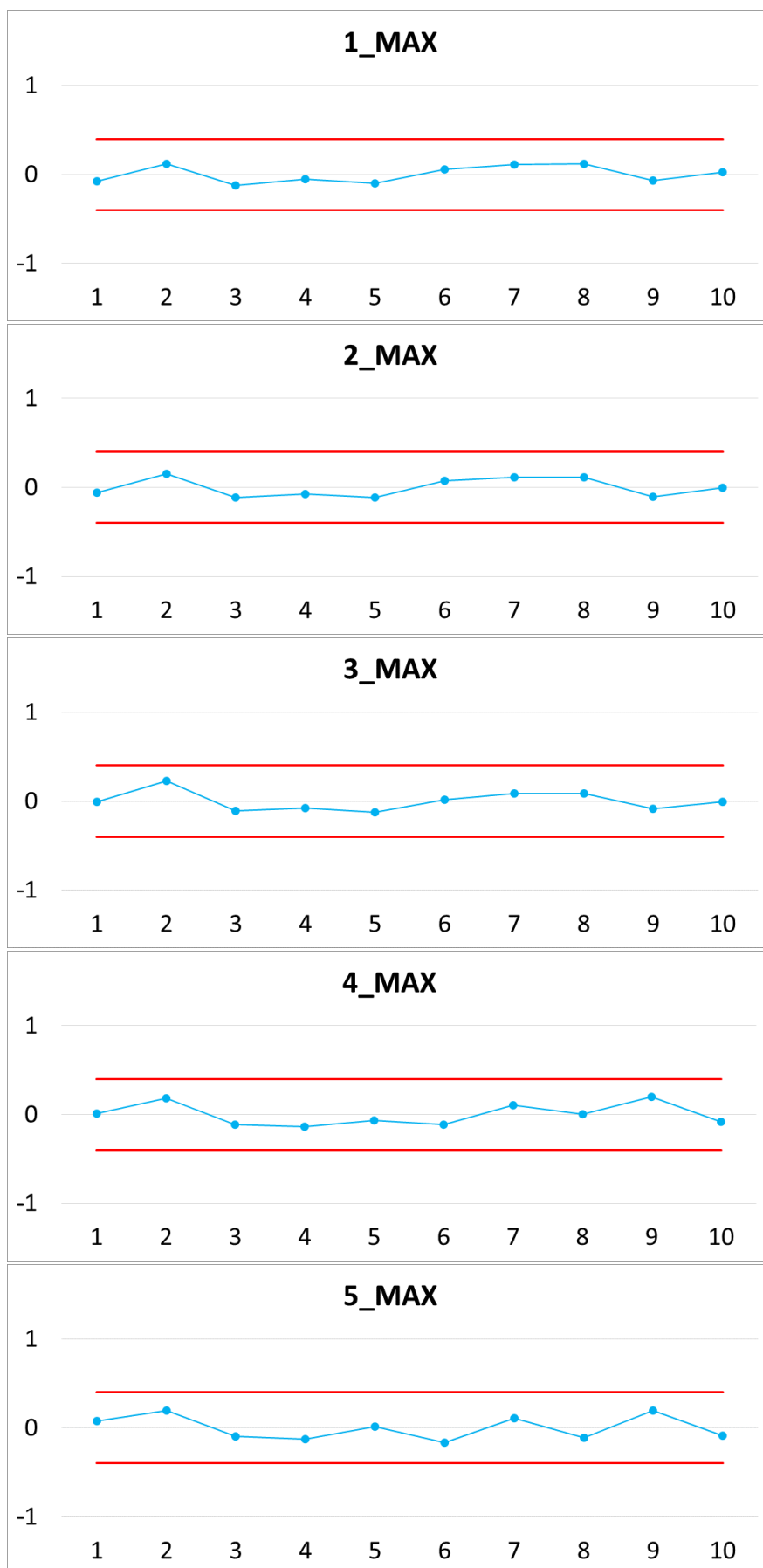


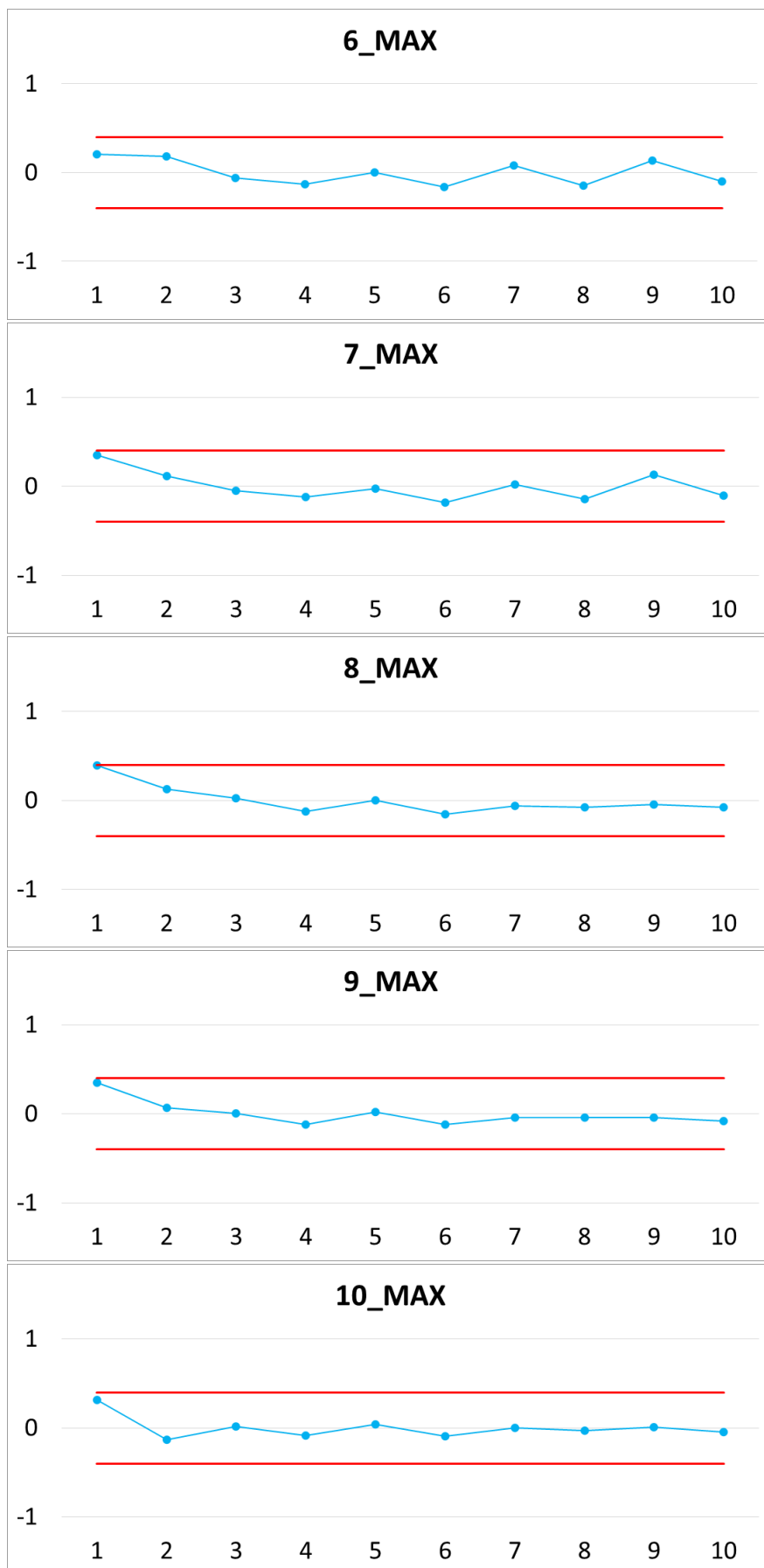


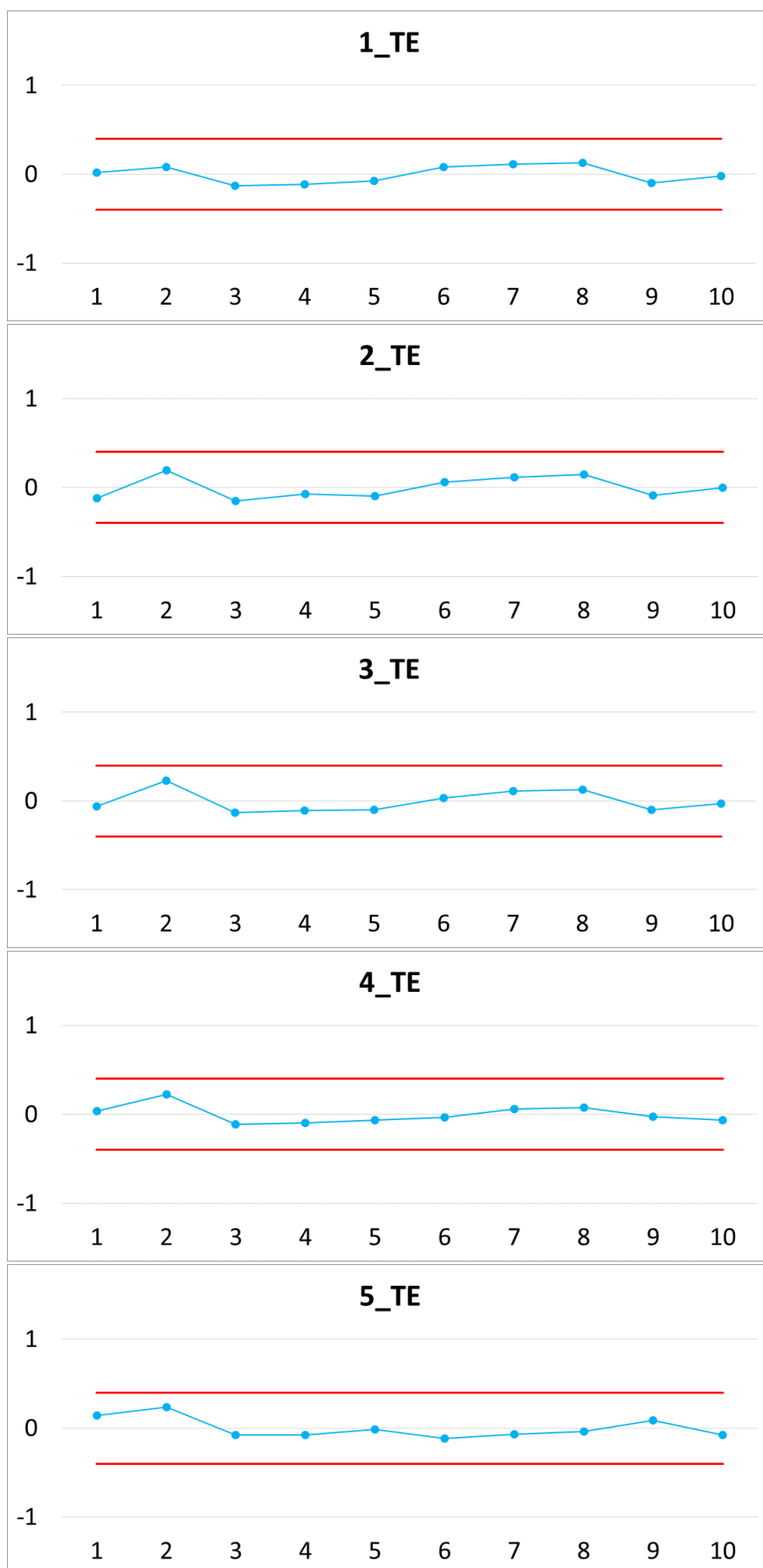


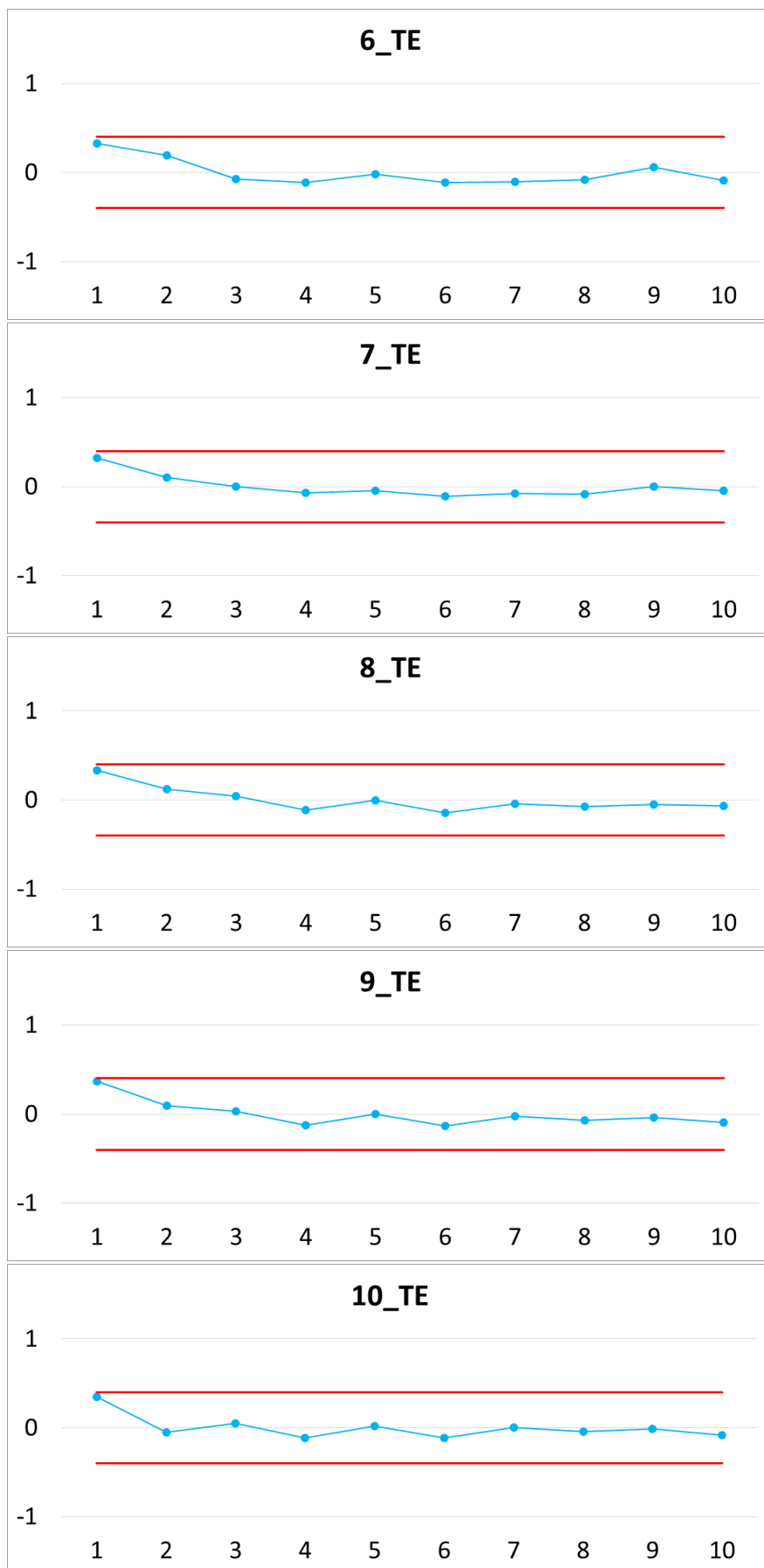


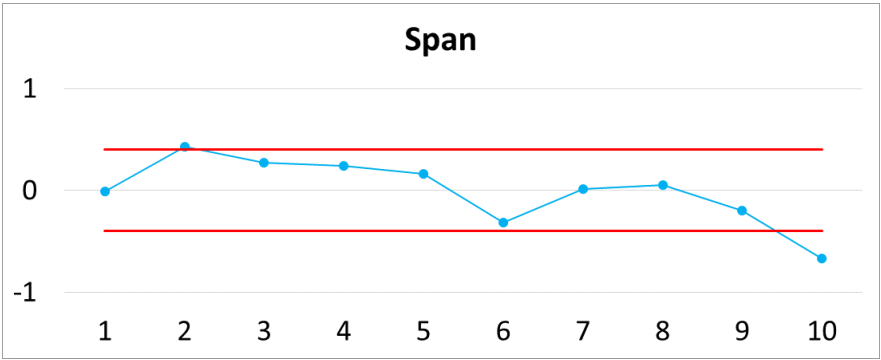


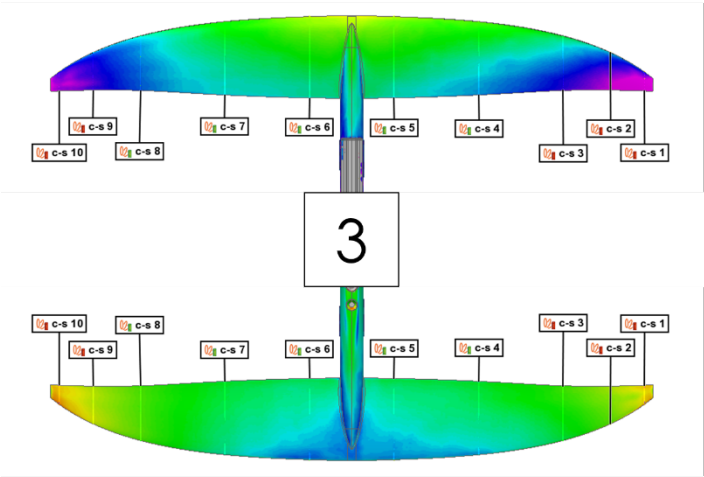
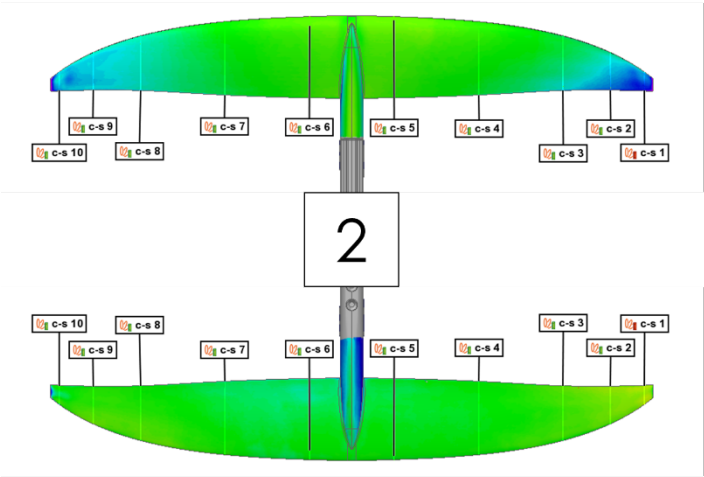
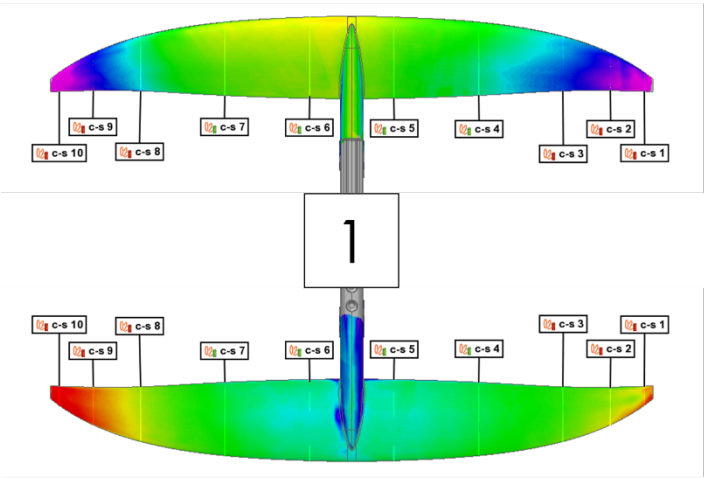


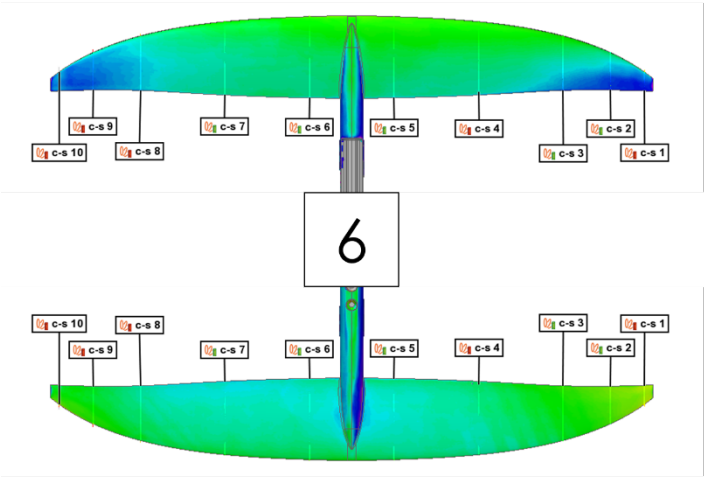
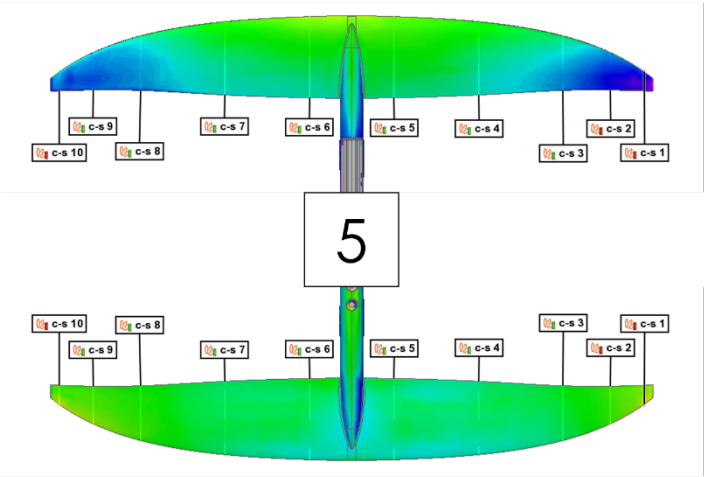
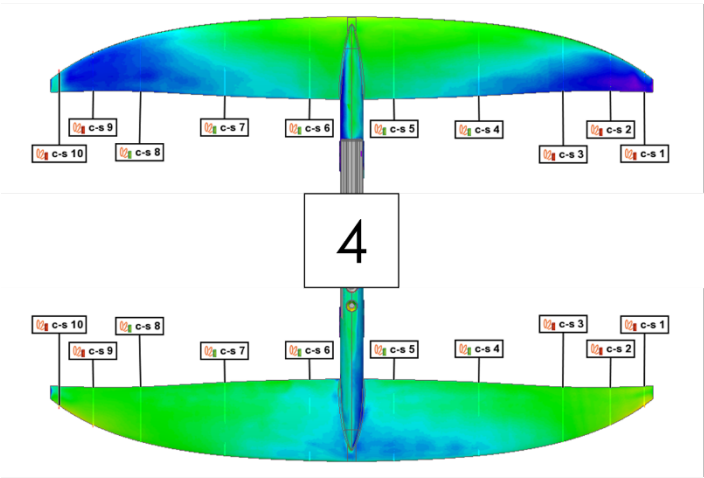


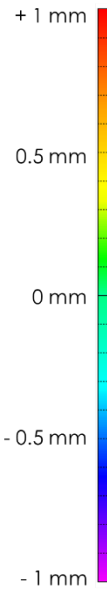
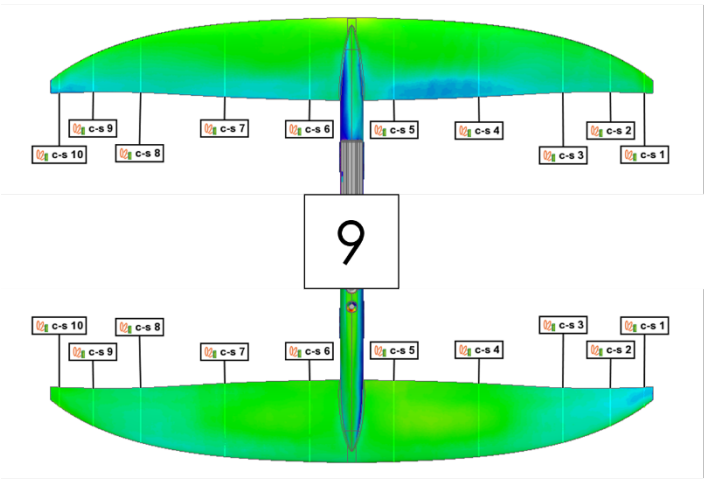
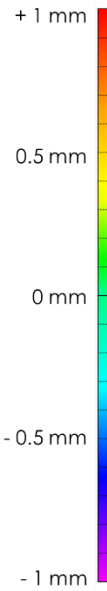
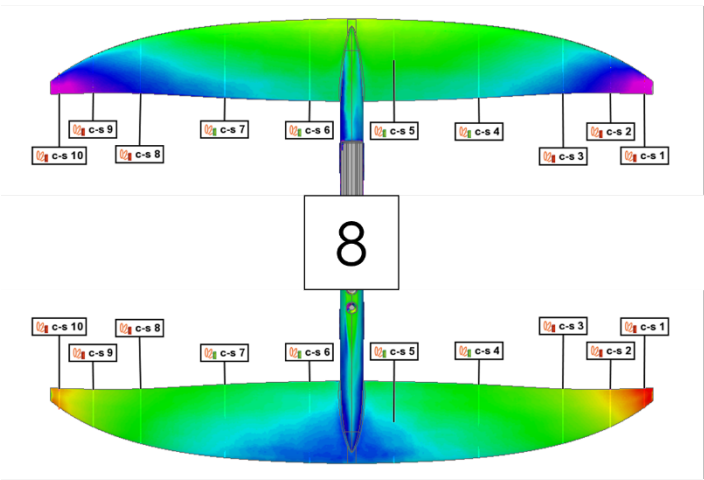
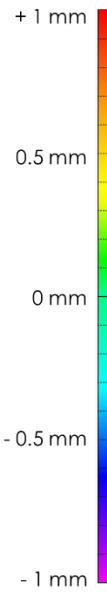
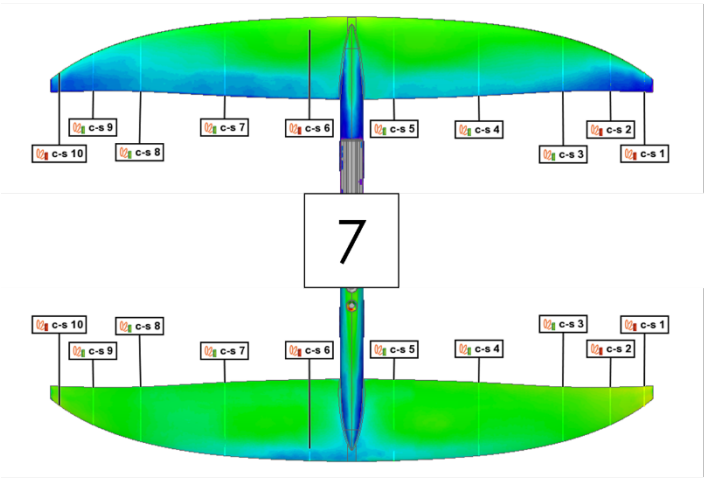












World Sailing Manufacturer Control System
Scanner Report: IKA Formula Kite – Chubanga Frontwing V4

