

World Sailing Manufacturer Control System

Title: Scanner Report for Hydrofoil Registration with Class

Olympic Class: IKA Formula Kite

Equipment Item: Levitaz Rearwing R5 V2

Project				
World Sailing Manufacturer Control System				
Title				
Scanner Report: IKA Formula Kite – Levitaz Rearwing R5 V2				
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 Levitaz, 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 Rearwing.

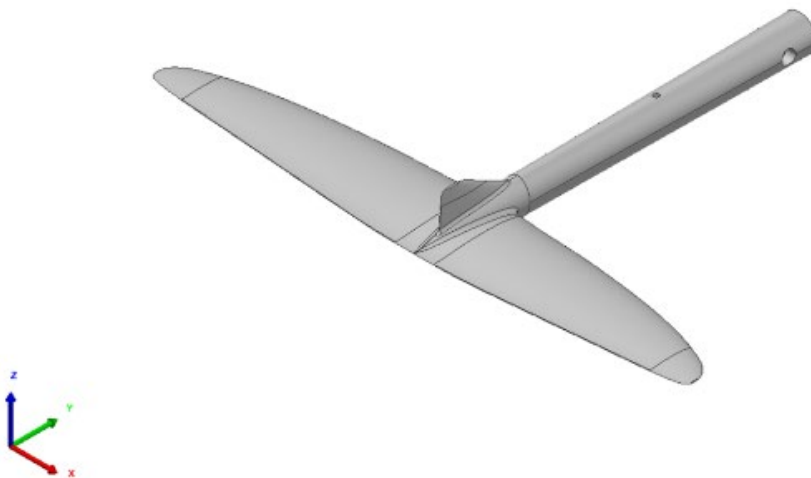


Figure 1 - Definition of the Coordinate System

Cross Sections

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

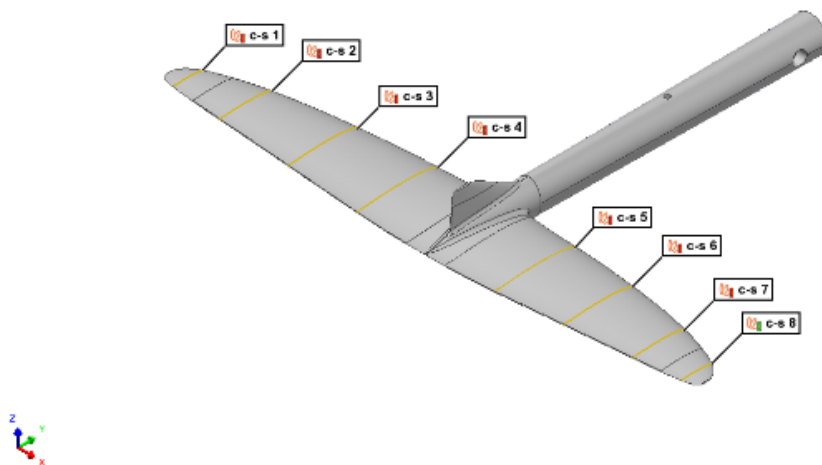


Figure 2 - Definition of Cross Sections

Name	Positioning
c-s 1	10 mm from the tip
c-s 2	150 mm from the symmetry plane (X=0)
c-s 3	100 mm from the symmetry plane (X=0)
c-s 4	50 mm from the symmetry plane (X=0)
c-s 5	50 mm from the symmetry plane (X=0)
c-s 6	100 mm from the symmetry plane (X=0)
c-s 7	150 mm from the symmetry plane (X=0)
c-s 8	10 mm from the tip

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

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

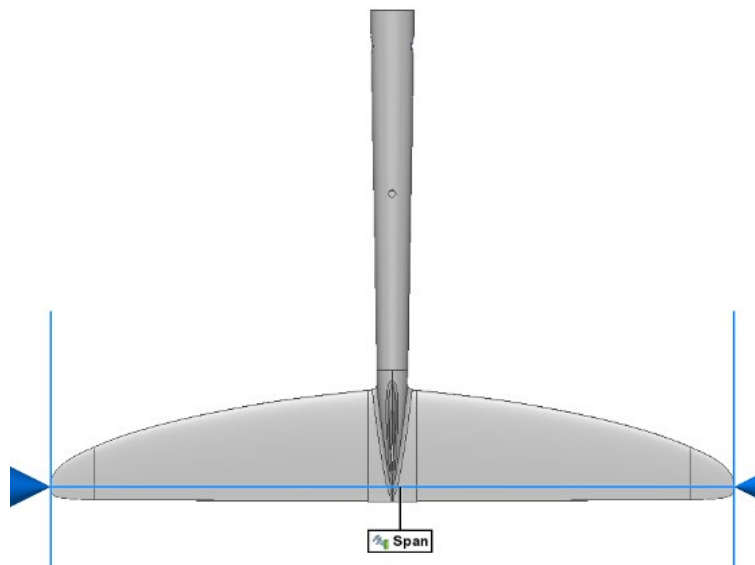


Figure 4 – Calliper to measure the Span

Surface Distance Points

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

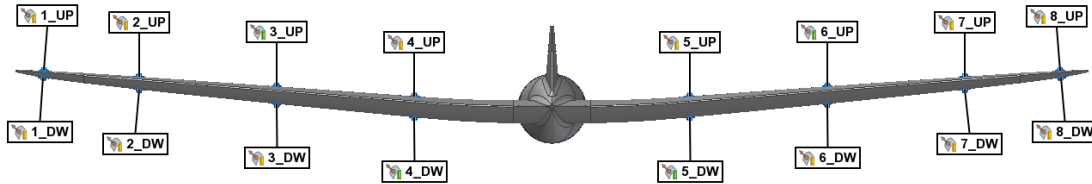


Figure 5 - Surface Distance Points definition

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).

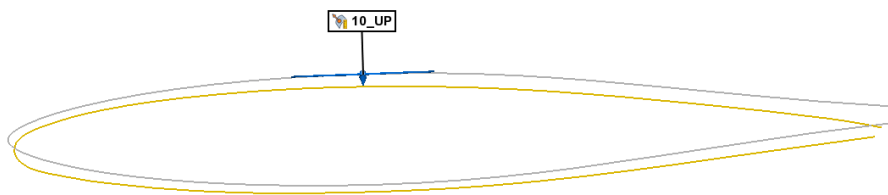


Figure 6 - Definition of Surface Distance Points on a Cross Section

Colour Map

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

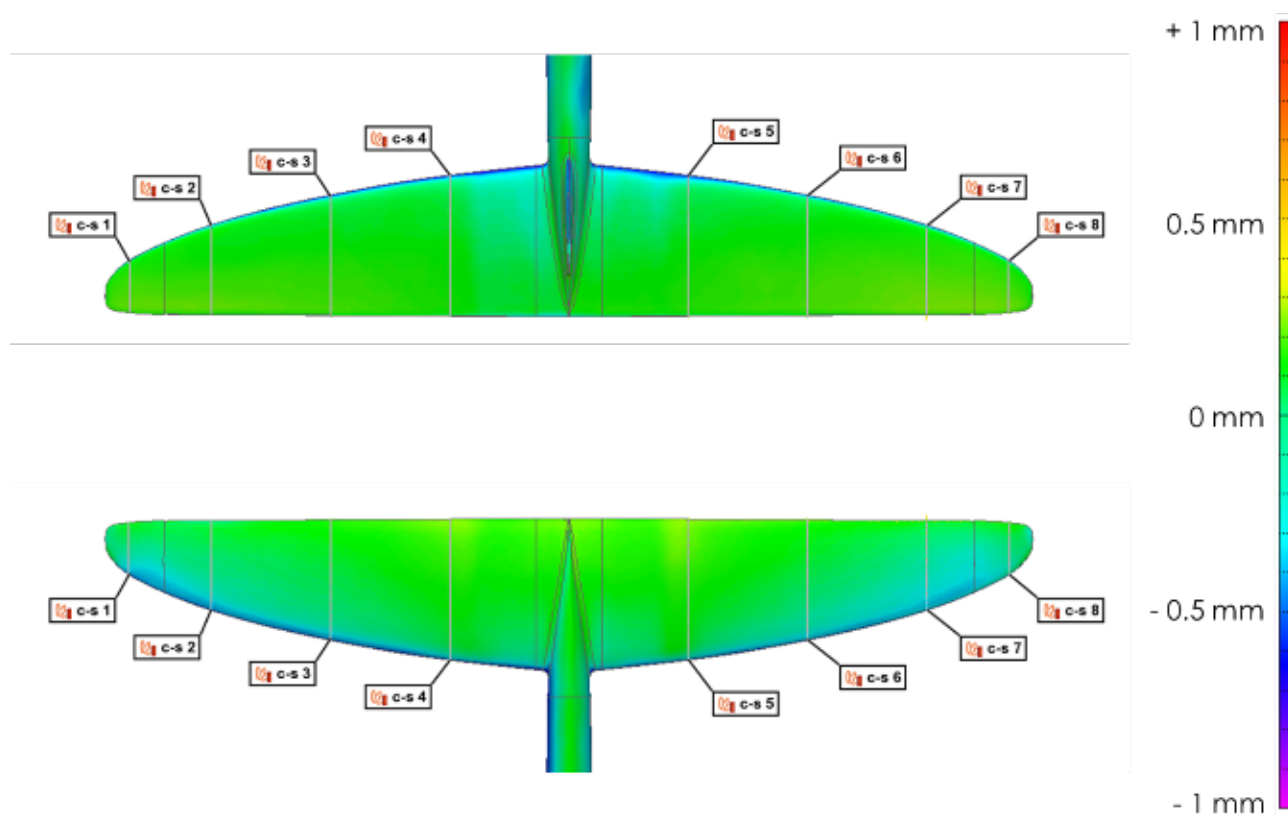


Figure 7 - Colour Map of the Upper (top) and Lower (bottom) surfaces of the Rearwing

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 Rearwing the following measurement (Value) 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	

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:

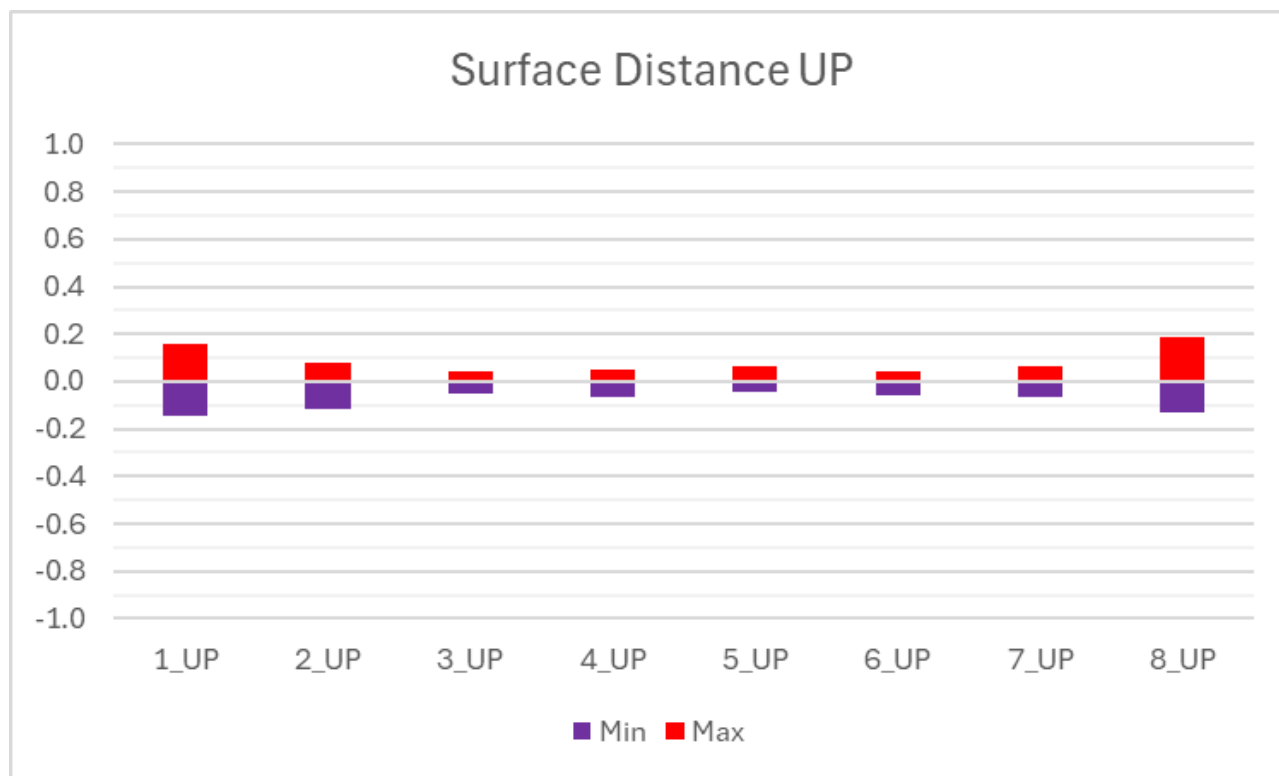
$$Norm.Value = Value - Mean$$

Results

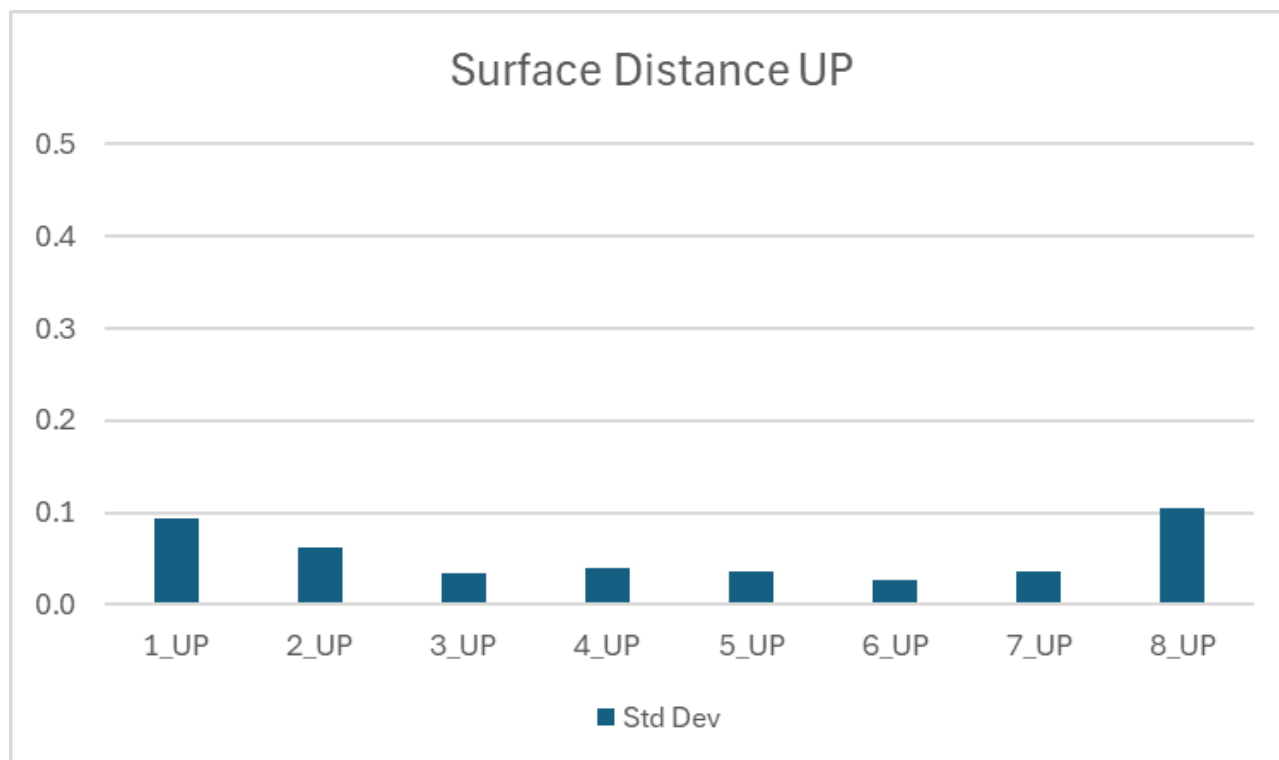
The table in the next page shows the normalised values (in mm) for each foil, minimum and maximum deviations and the standard deviation for each control. ± 0.4 mm has been selected for visualisation purposes. The maximum, minimum and standard deviation values are also plotted.

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	0.017	0.07	0.016	-0.139	-0.008	-0.058	-0.143	0.083	0.006	0.156	-0.143	0.156	0.094
2_UP	0.009	0.079	0.019	-0.04	0.059	-0.052	-0.114	-0.007	-0.031	0.079	-0.114	0.079	0.062
3_UP	-0.029	0.042	0.045	0.019	0.037	-0.05	-0.018	-0.026	-0.033	0.011	-0.050	0.045	0.035
4_UP	-0.062	0.003	0.051	0.033	0.051	-0.037	0.027	-0.011	-0.04	-0.019	-0.062	0.051	0.040
5_UP	-0.038	-0.021	0.036	0.067	0.006	0.001	0.018	-0.032	0.01	-0.046	-0.046	0.067	0.035
6_UP	-0.004	-0.011	0.032	-0.002	0.004	0.002	-0.004	-0.056	0.043	-0.005	-0.056	0.043	0.026
7_UP	0.015	0.037	-0.009	-0.066	-0.001	-0.012	-0.042	-0.008	0.019	0.062	-0.066	0.062	0.037
8_UP	-0.092	0.057	-0.014	-0.113	0.065	0.011	-0.13	0.102	-0.078	0.19	-0.130	0.190	0.105
1_DW	-0.033	-0.056	0.052	0.094	0.039	0.015	0.119	-0.131	0.041	-0.141	-0.141	0.119	0.088
2_DW	-0.037	-0.074	0.063	0.009	0.014	0.017	0.065	0.013	0.016	-0.082	-0.082	0.065	0.050
3_DW	-0.024	-0.001	0.063	-0.023	0.032	-0.019	0.008	0.006	-0.029	-0.015	-0.029	0.063	0.029
4_DW	-0.004	0.026	0.09	-0.036	0.041	-0.038	-0.015	-0.011	-0.043	-0.011	-0.043	0.090	0.042
5_DW	-0.04	0.012	0.075	-0.015	0.053	-0.043	-0.015	0.011	-0.06	0.018	-0.060	0.075	0.043
6_DW	-0.062	0.061	0.033	-0.016	0.076	-0.04	-0.011	0.014	-0.057	-0.001	-0.062	0.076	0.047
7_DW	-0.034	0.014	0.028	0.032	0.033	0.062	0.021	-0.024	-0.048	-0.084	-0.084	0.062	0.045
8_DW	0.072	-0.012	0.014	0.034	-0.051	0.087	0.122	-0.138	0.074	-0.201	-0.201	0.122	0.104
1_LE	-0.01	0.034	0.087	-0.056	0.023	-0.028	-0.042	-0.044	0.018	0.016	-0.056	0.087	0.044
2_LE	-0.006	0.075	0.079	-0.07	0.043	-0.029	-0.048	-0.026	-0.036	0.016	-0.070	0.079	0.052
3_LE	-0.027	0.096	0.098	-0.032	0.037	-0.034	-0.015	-0.054	-0.097	0.026	-0.097	0.098	0.064
4_LE	-0.029	0.072	0.14	0.027	0.031	-0.058	-0.005	-0.073	-0.135	0.028	-0.135	0.140	0.078
5_LE	-0.047	0.083	0.126	0.008	0.054	-0.048	-0.016	-0.053	-0.109	0.004	-0.109	0.126	0.071
6_LE	-0.028	0.103	0.072	-0.028	0.048	-0.02	-0.031	-0.062	-0.057	0.005	-0.062	0.103	0.056
7_LE	0.021	0.084	0.018	-0.06	0.035	0.051	-0.039	-0.062	-0.035	-0.011	-0.062	0.084	0.049
8_LE	0.007	0.066	-0.007	-0.096	0.012	0.113	-0.012	-0.055	-0.028	-0.003	-0.096	0.113	0.058
1_MAX	-0.016	0.013	0.067	-0.045	0.031	-0.043	-0.024	-0.048	0.048	0.015	-0.048	0.067	0.041
2_MAX	-0.029	0.005	0.083	-0.031	0.073	-0.035	-0.049	0.006	-0.015	-0.004	-0.049	0.083	0.045
3_MAX	-0.053	0.041	0.109	-0.004	0.068	-0.069	-0.011	-0.02	-0.061	-0.005	-0.069	0.109	0.058
4_MAX	-0.066	0.028	0.142	-0.003	0.092	-0.075	0.012	-0.022	-0.083	-0.03	-0.083	0.142	0.073
5_MAX	-0.077	-0.009	0.112	0.053	0.059	-0.042	0.004	-0.02	-0.049	-0.027	-0.077	0.112	0.058
6_MAX	-0.066	0.051	0.064	-0.017	0.079	-0.038	-0.015	-0.041	-0.015	-0.006	-0.066	0.079	0.049
7_MAX	-0.018	0.052	0.021	-0.033	0.033	0.051	-0.02	-0.031	-0.029	-0.022	-0.033	0.052	0.035
8_MAX	-0.02	0.045	0.001	-0.079	0.015	0.098	-0.007	-0.036	-0.003	-0.011	-0.079	0.098	0.047
1_TE	-0.08	-0.037	0.073	-0.03	0.043	-0.049	0.01	0.014	0.06	-0.002	-0.080	0.073	0.050
2_TE	-0.063	-0.042	0.081	0.002	0.05	-0.056	-0.007	0.034	0.005	-0.004	-0.063	0.081	0.046
3_TE	-0.057	-0.059	0.1	0	0.062	-0.045	-0.005	0.016	-0.023	0.008	-0.059	0.100	0.051
4_TE	-0.045	-0.119	0.111	0.009	0.082	-0.011	0.001	0	-0.015	-0.013	-0.119	0.111	0.063
5_TE	-0.132	-0.045	0.105	0.041	0.044	-0.014	0.034	-0.034	-0.004	0.008	-0.132	0.105	0.064
6_TE	-0.106	0.013	0.07	0.029	0.06	-0.03	-0.012	0.009	-0.014	-0.015	-0.106	0.070	0.050
7_TE	-0.075	-0.008	0.016	-0.002	0.051	-0.006	-0.002	0.012	-0.019	0.028	-0.075	0.051	0.033
8_TE	-0.034	-0.003	-0.008	-0.021	0.005	0.057	0.003	0.005	0.018	-0.018	-0.034	0.057	0.025
Span	0.207	0.069	-0.052	-0.166	0.293	0.045	-0.02	-0.053	0.003	-0.322	-0.322	0.293	0.174

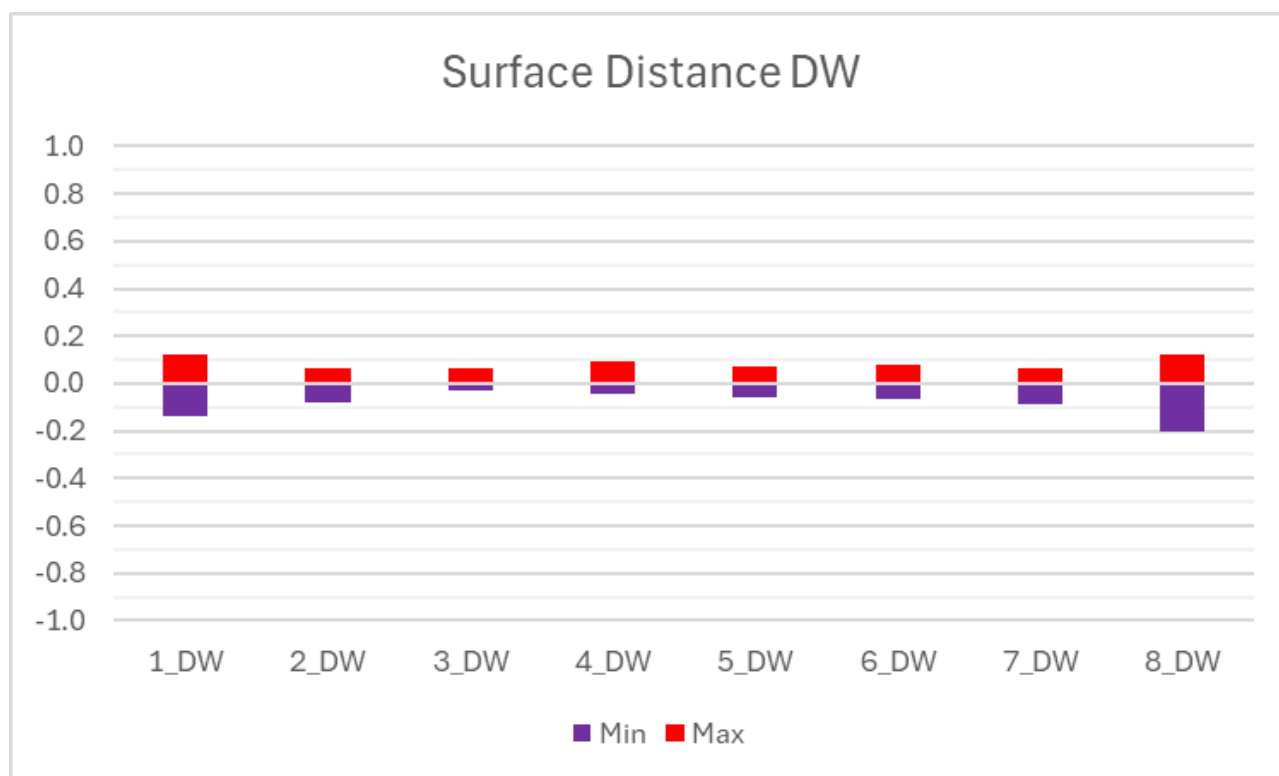
Maximum and minimum 'Surface Distances' on the upper surface at each cross section (mm):



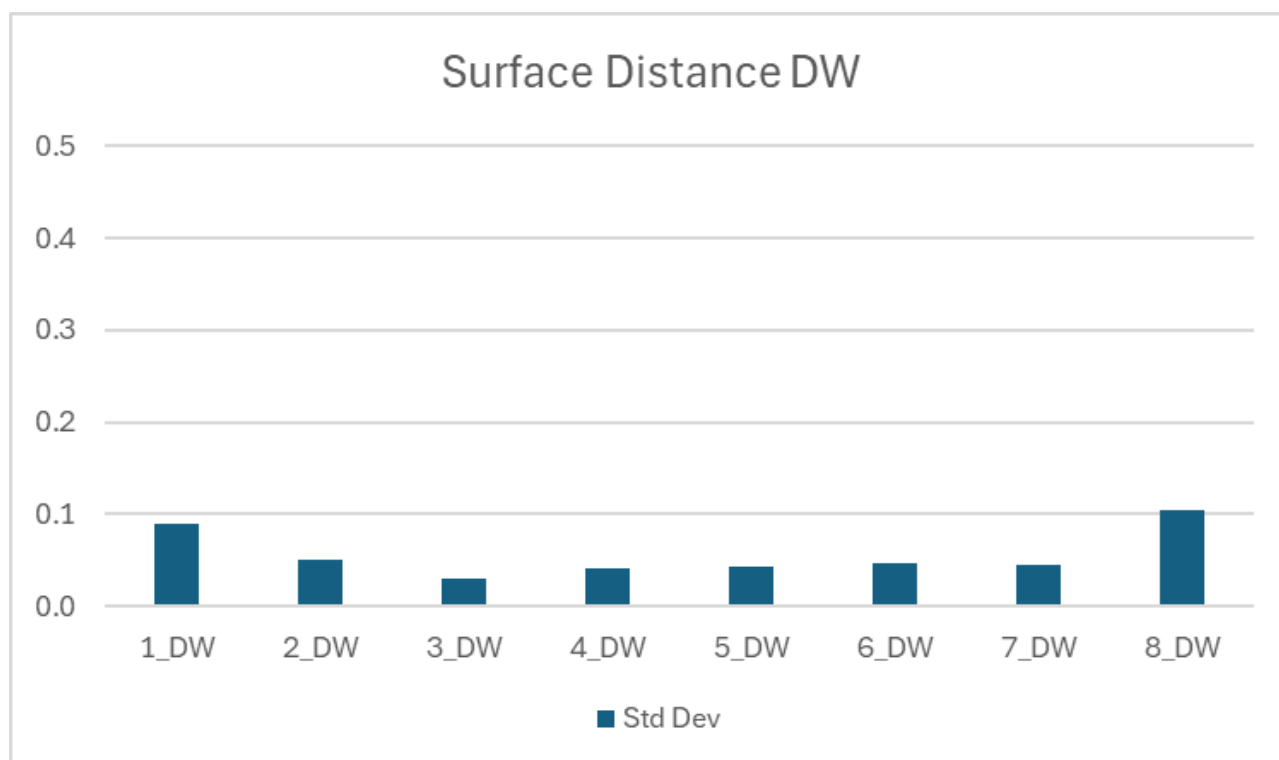
Standard deviation of 'Surface Distances' on the upper surface at each cross section (mm):



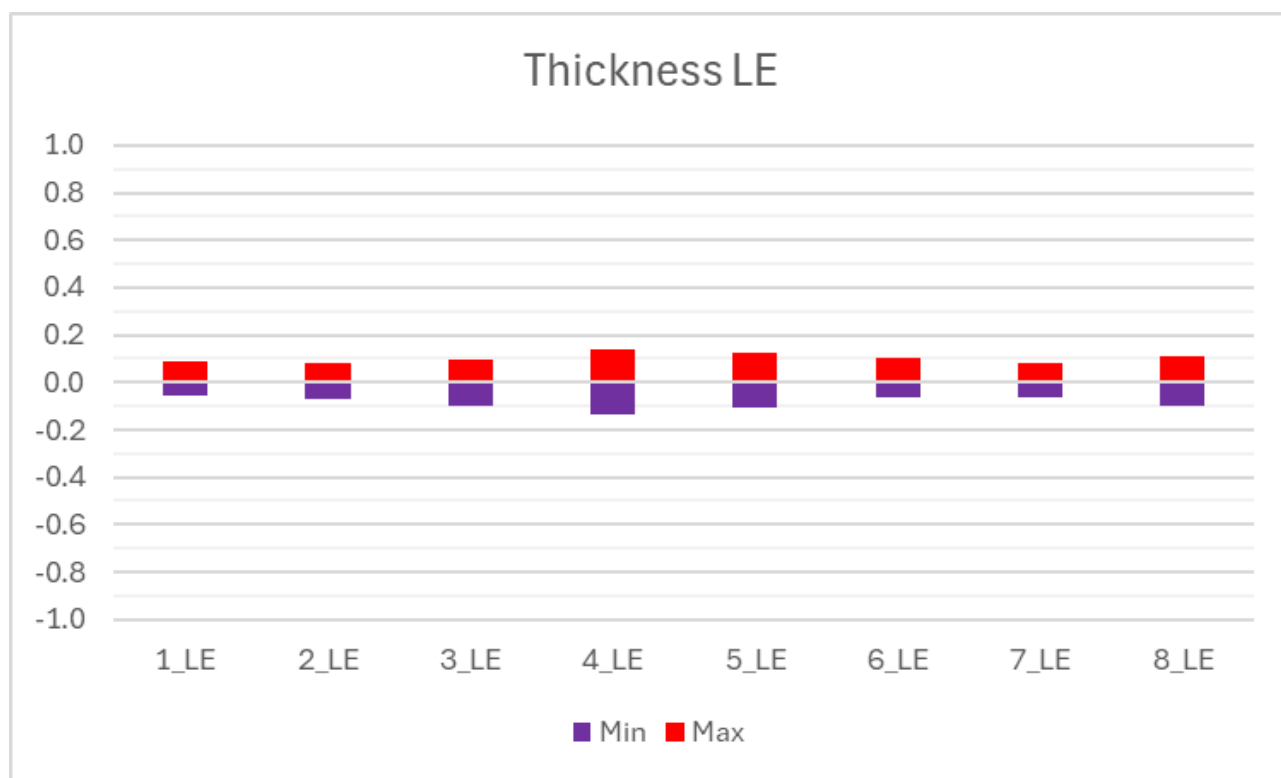
Maximum and minimum 'Surface Distances' on the lower surface at each cross section (mm):



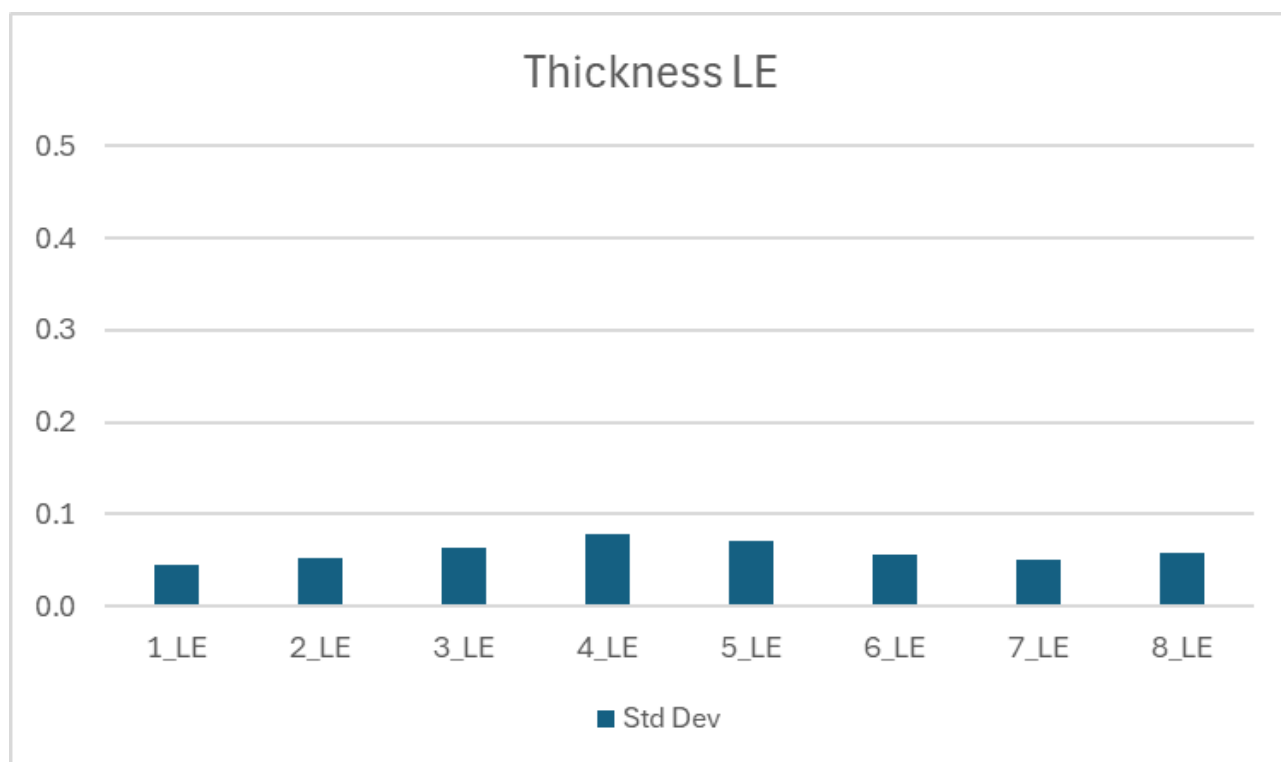
Standard deviation of 'Surface Distances' on the lower surface at each cross section (mm):



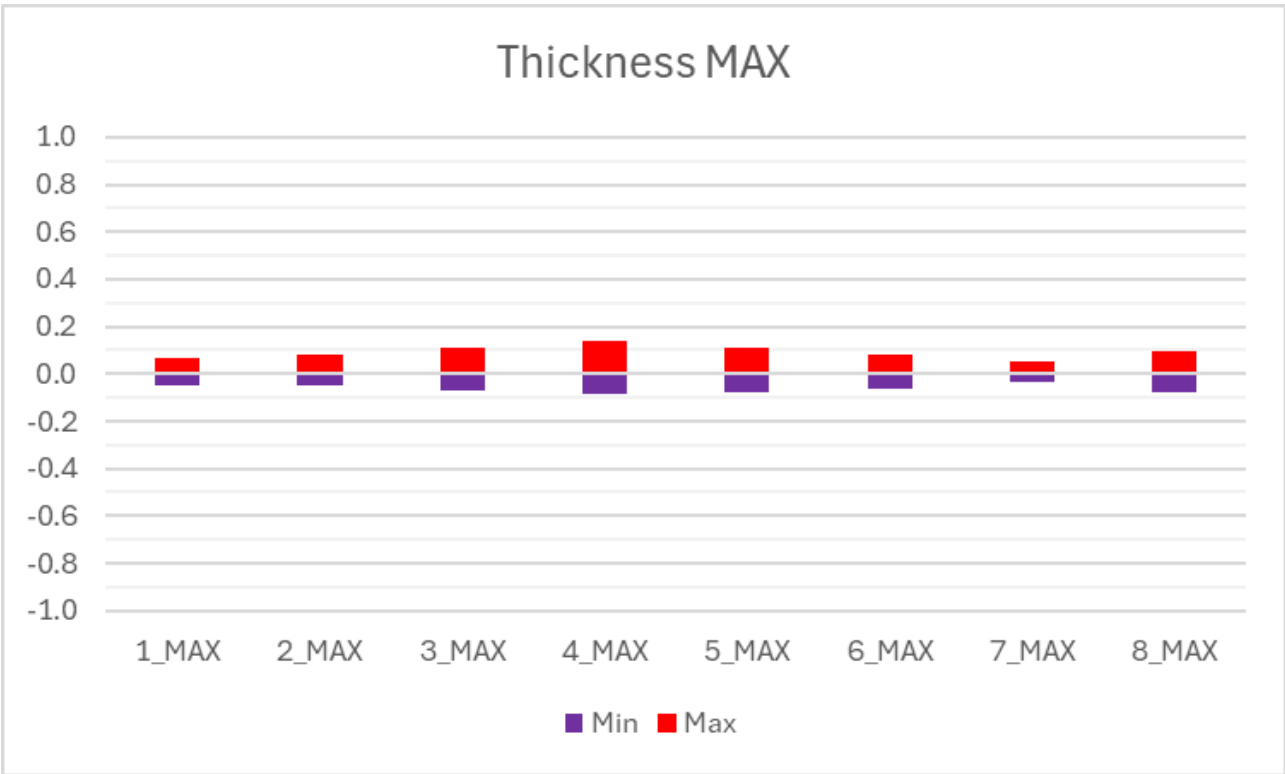
Maximum and minimum Thickness at the 'Leading Edge point' at each cross section (mm):



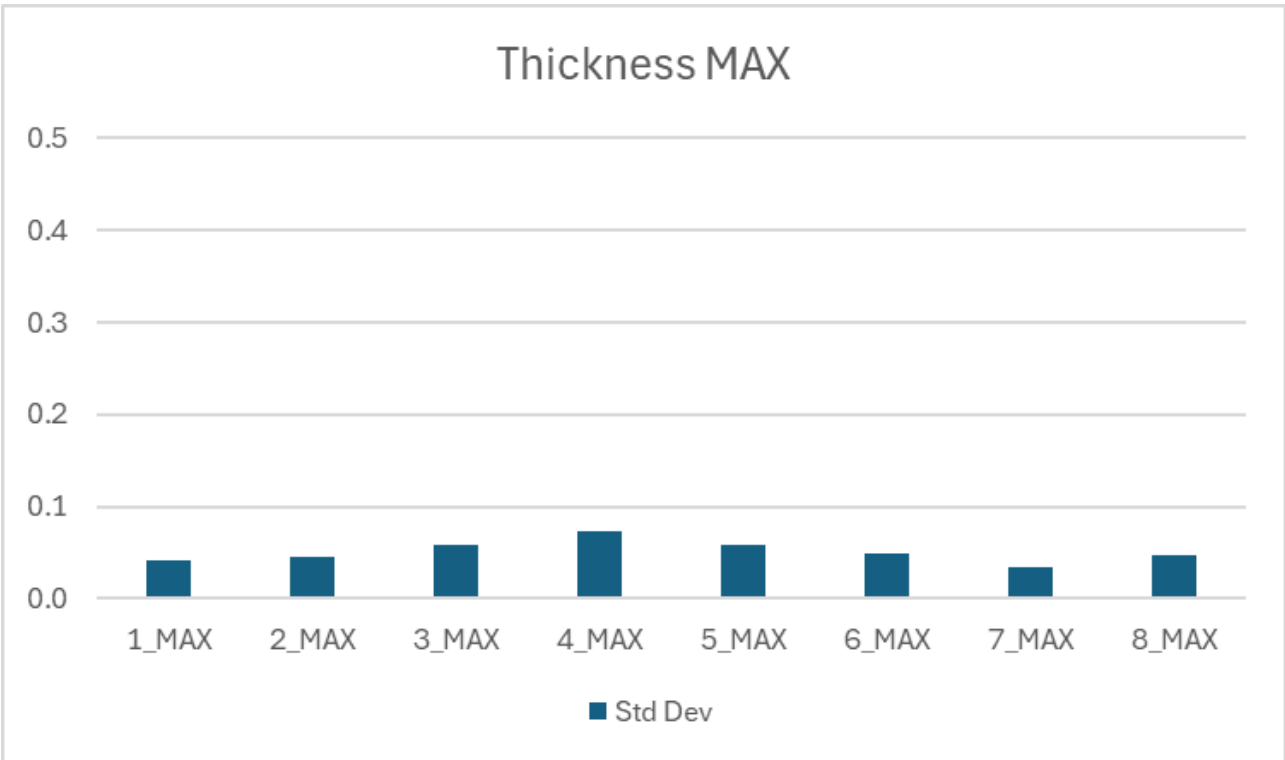
Standard deviation of Thickness at the 'Leading Edge point' at each cross section (mm):



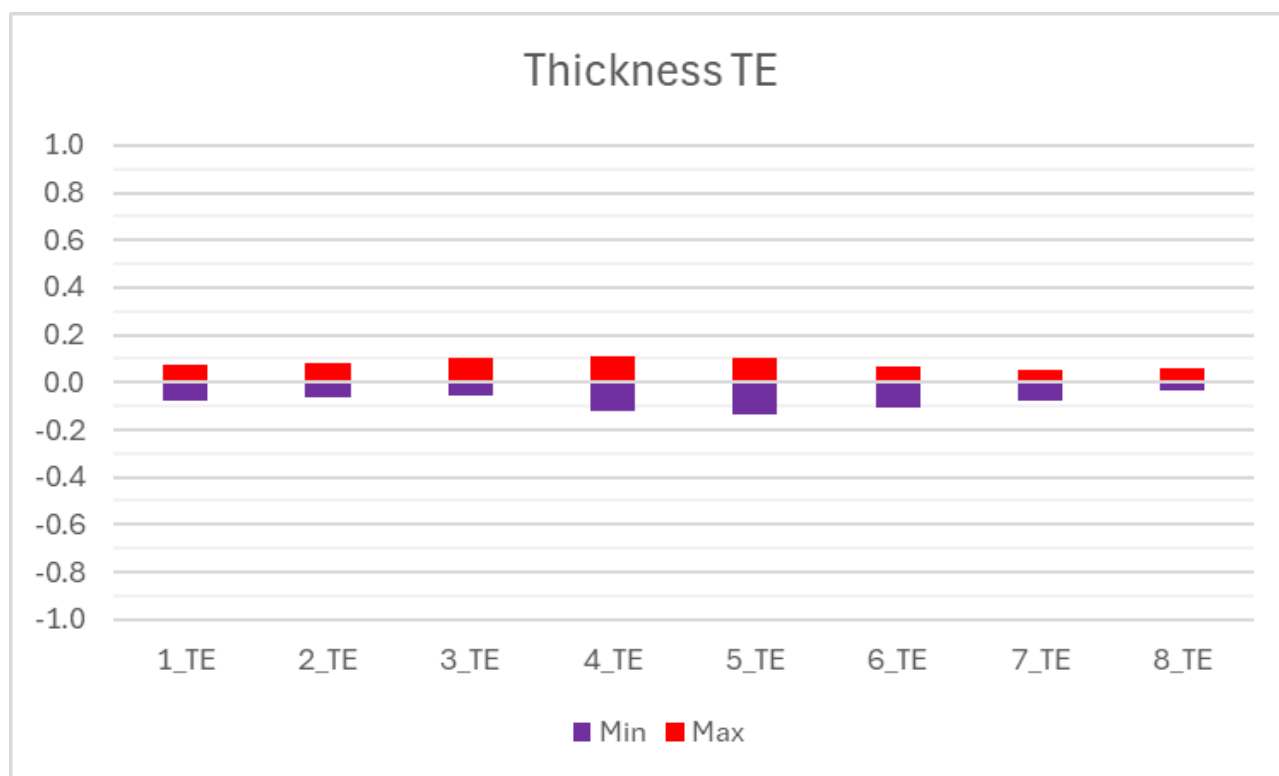
Maximum and minimum Thickness at the 'Maximum thickness point' at each cross section (mm):



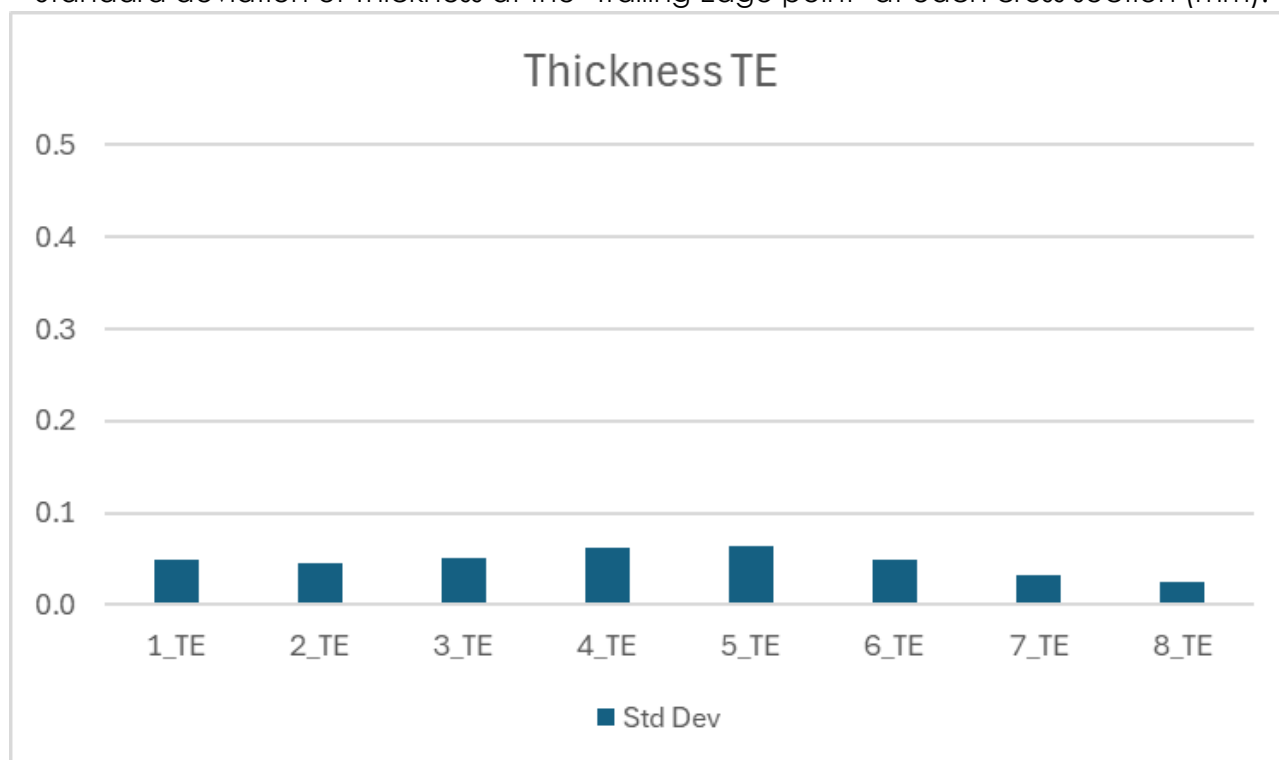
Standard deviation of Thickness at the 'Maximum thickness point' at each cross section (mm):



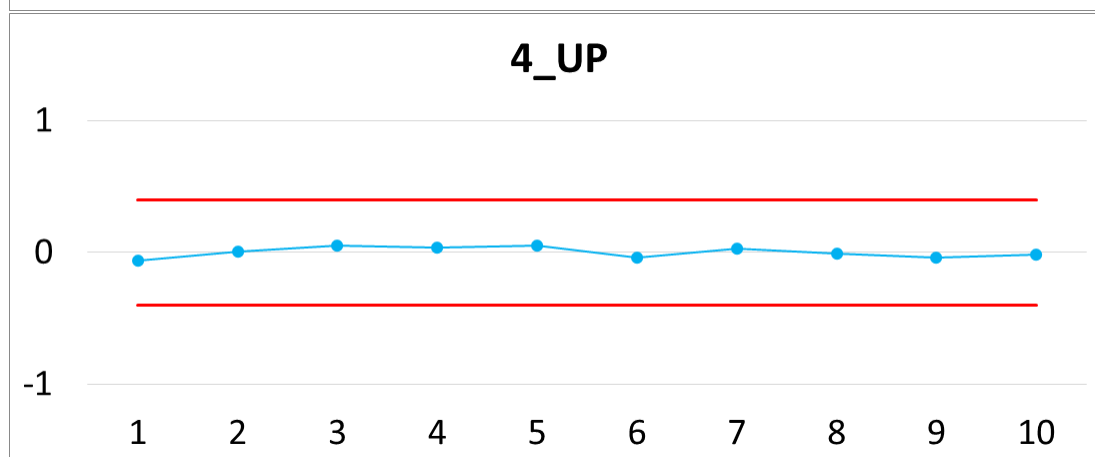
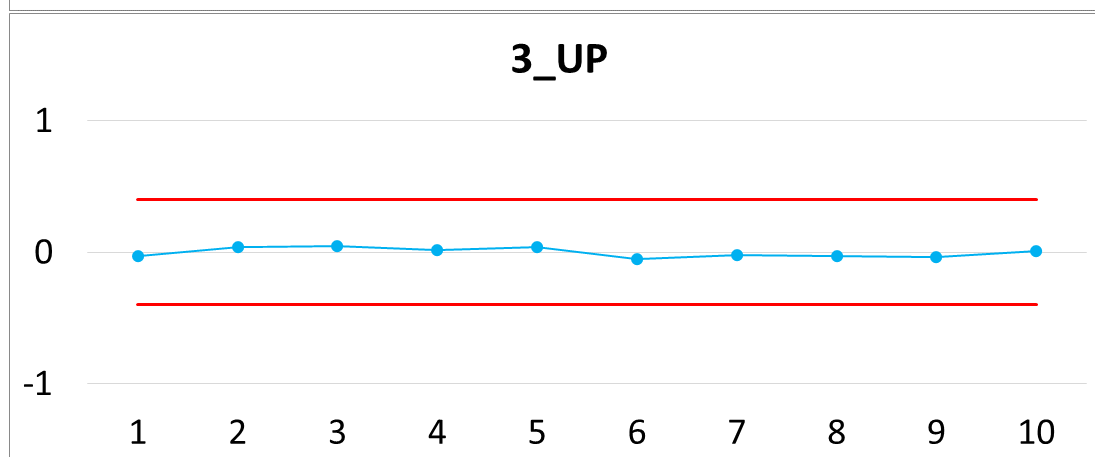
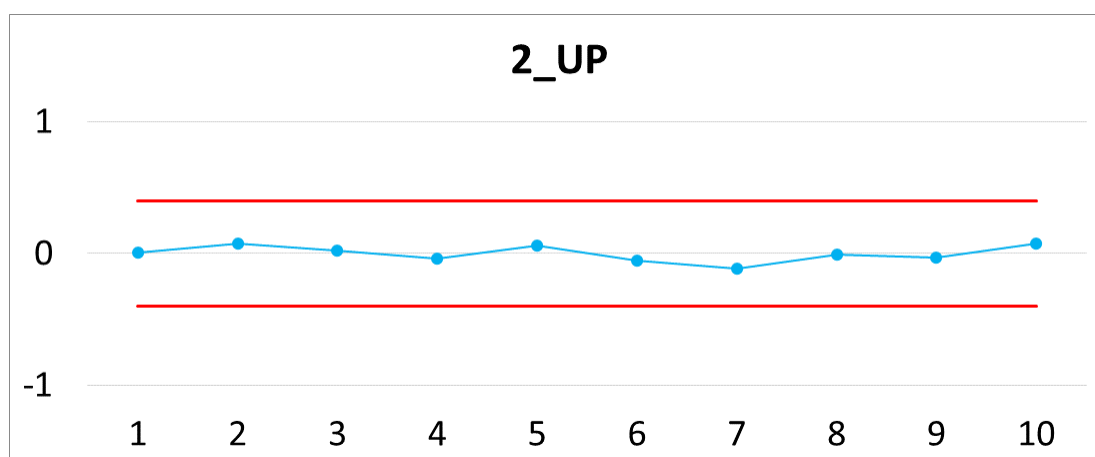
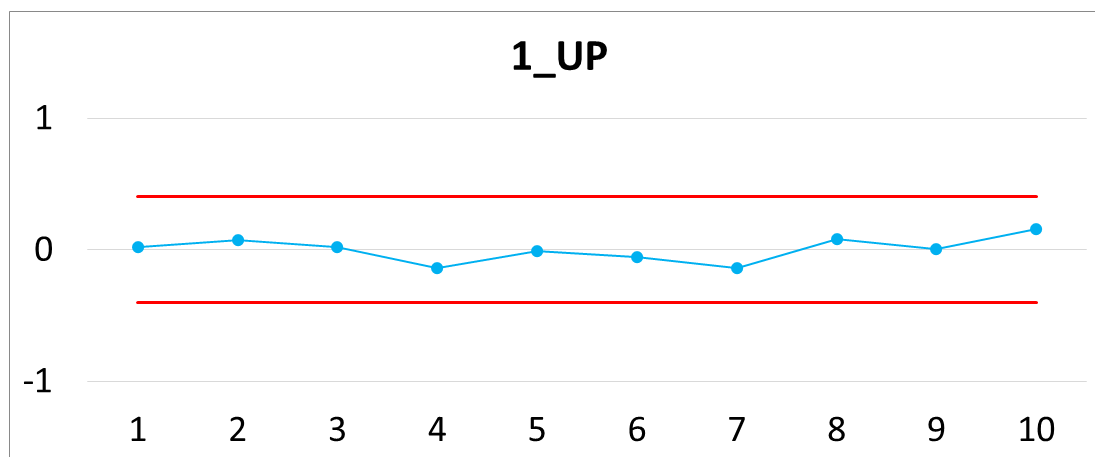
Maximum and minimum Thickness at the 'Trailing Edge point' at each cross section (mm):

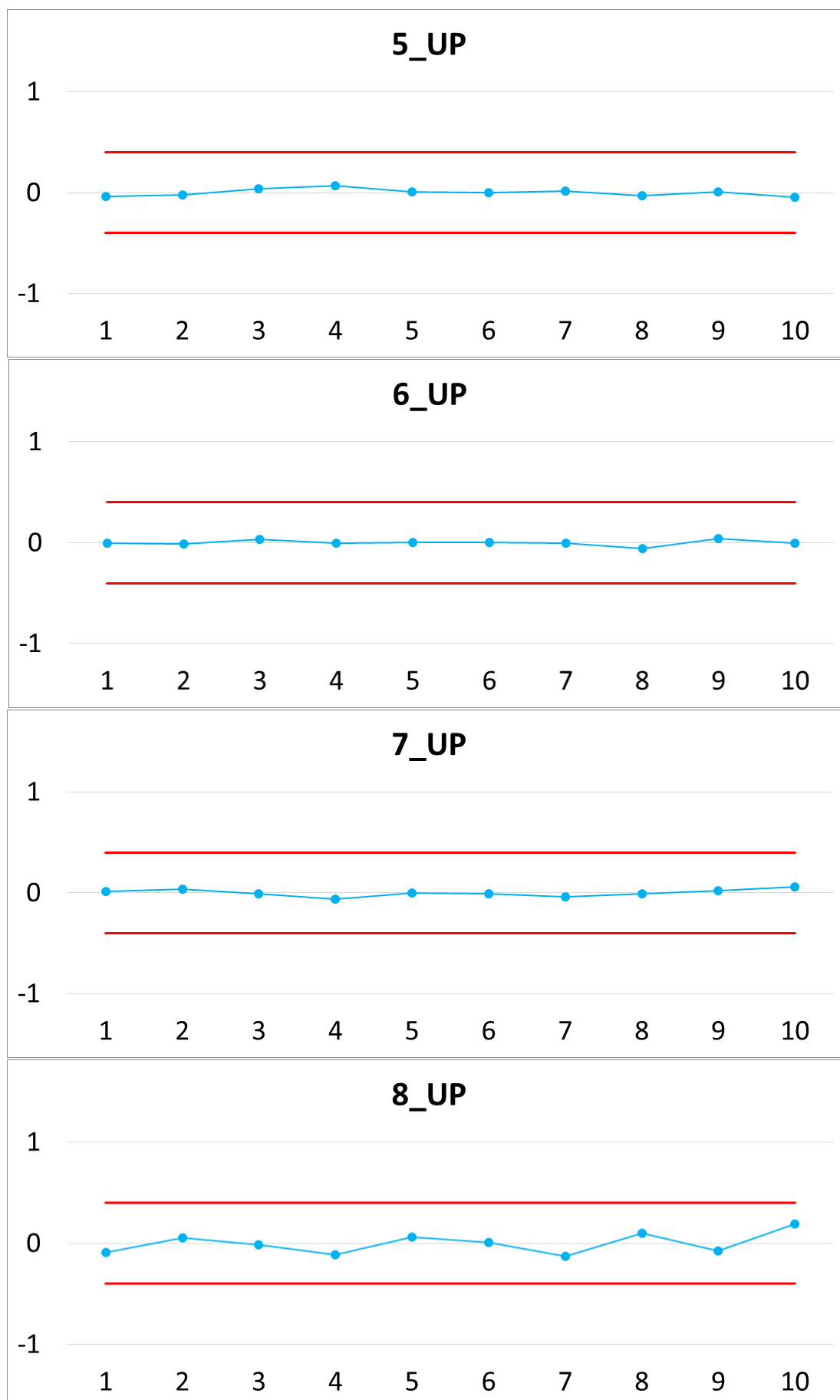


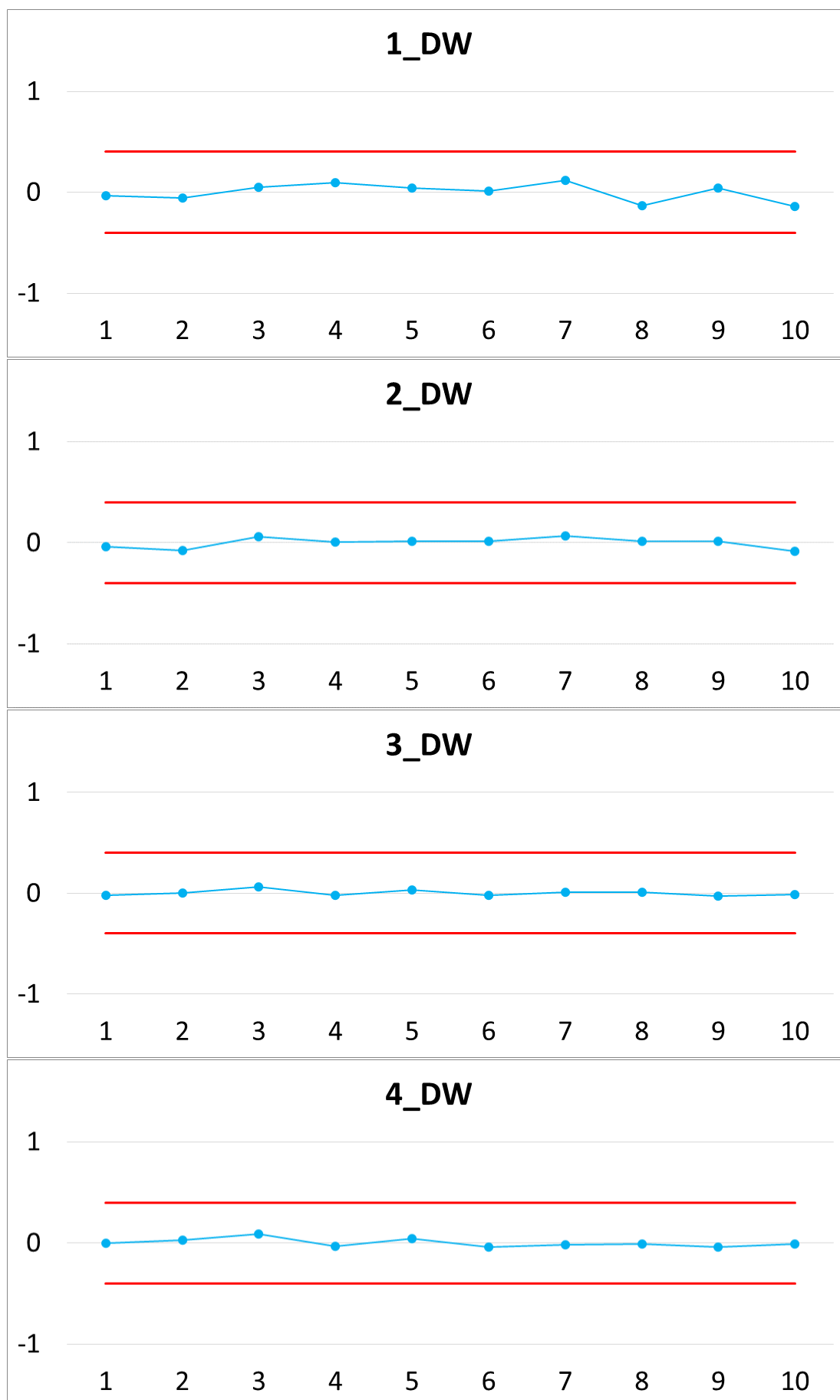
Standard deviation of Thickness at the 'Trailing Edge point' at each cross section (mm):

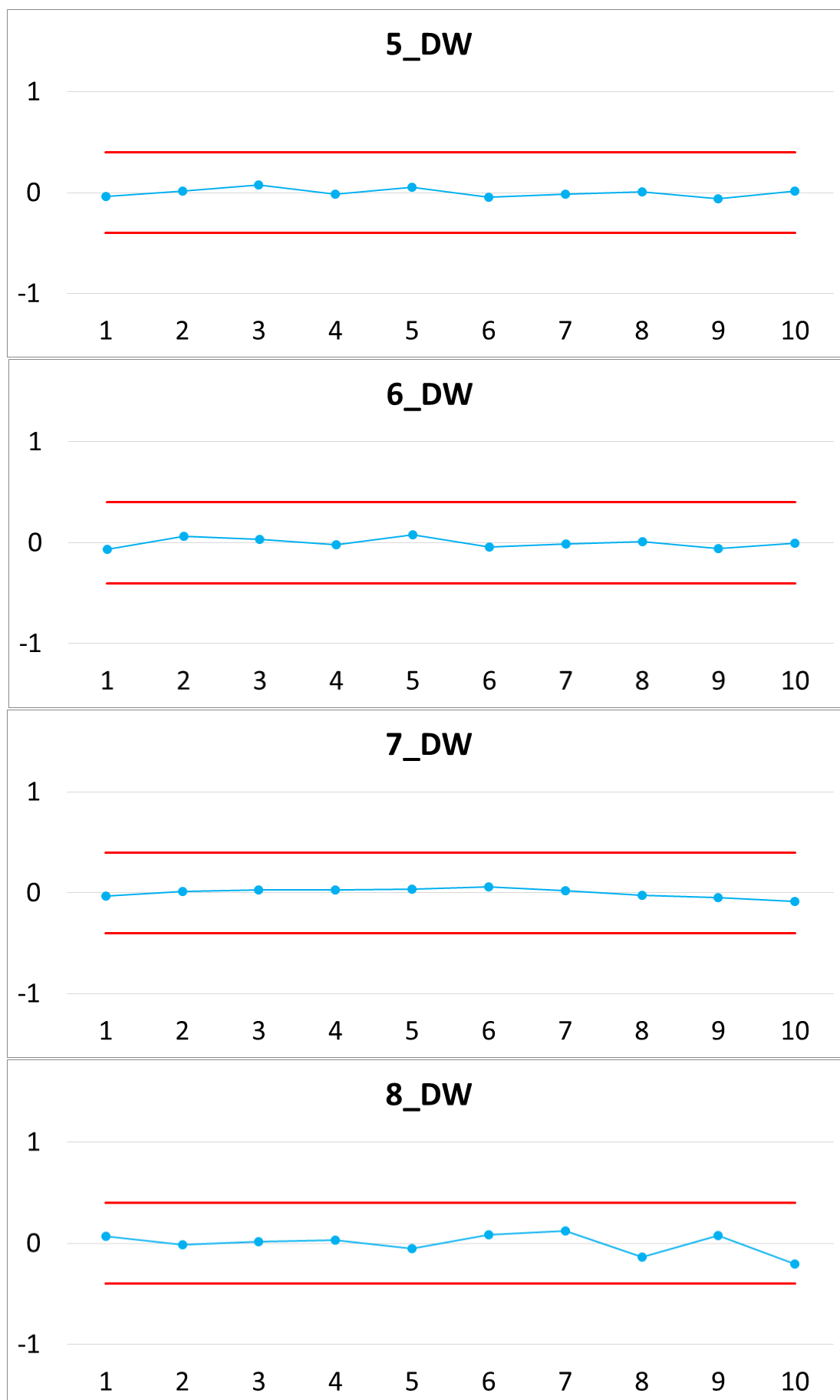


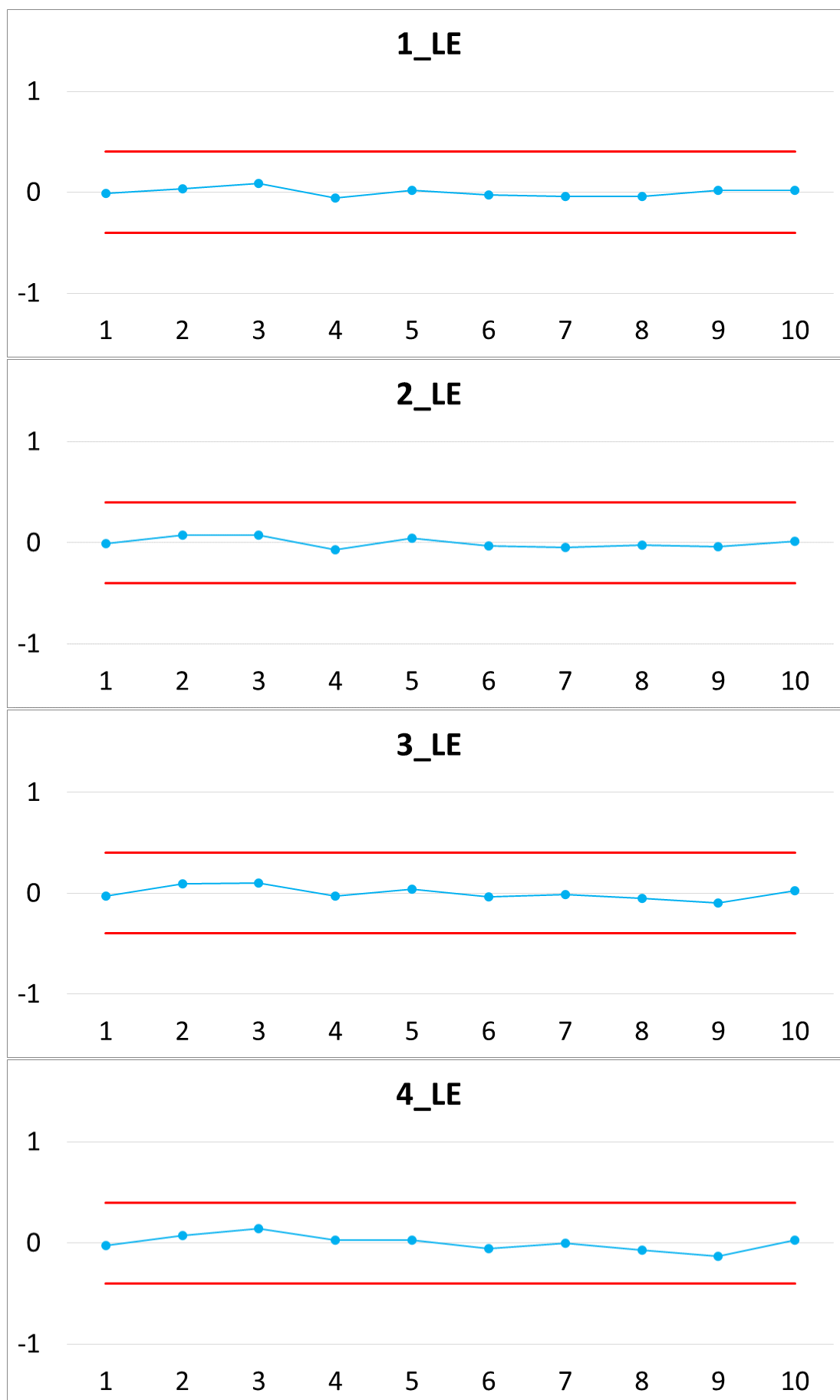
- Blue Lines: Normalised values (mm) for each control point
- Red Lines: ± 0.4 mm for visualisation purposes
- X-Axis: 1 to 10 foils

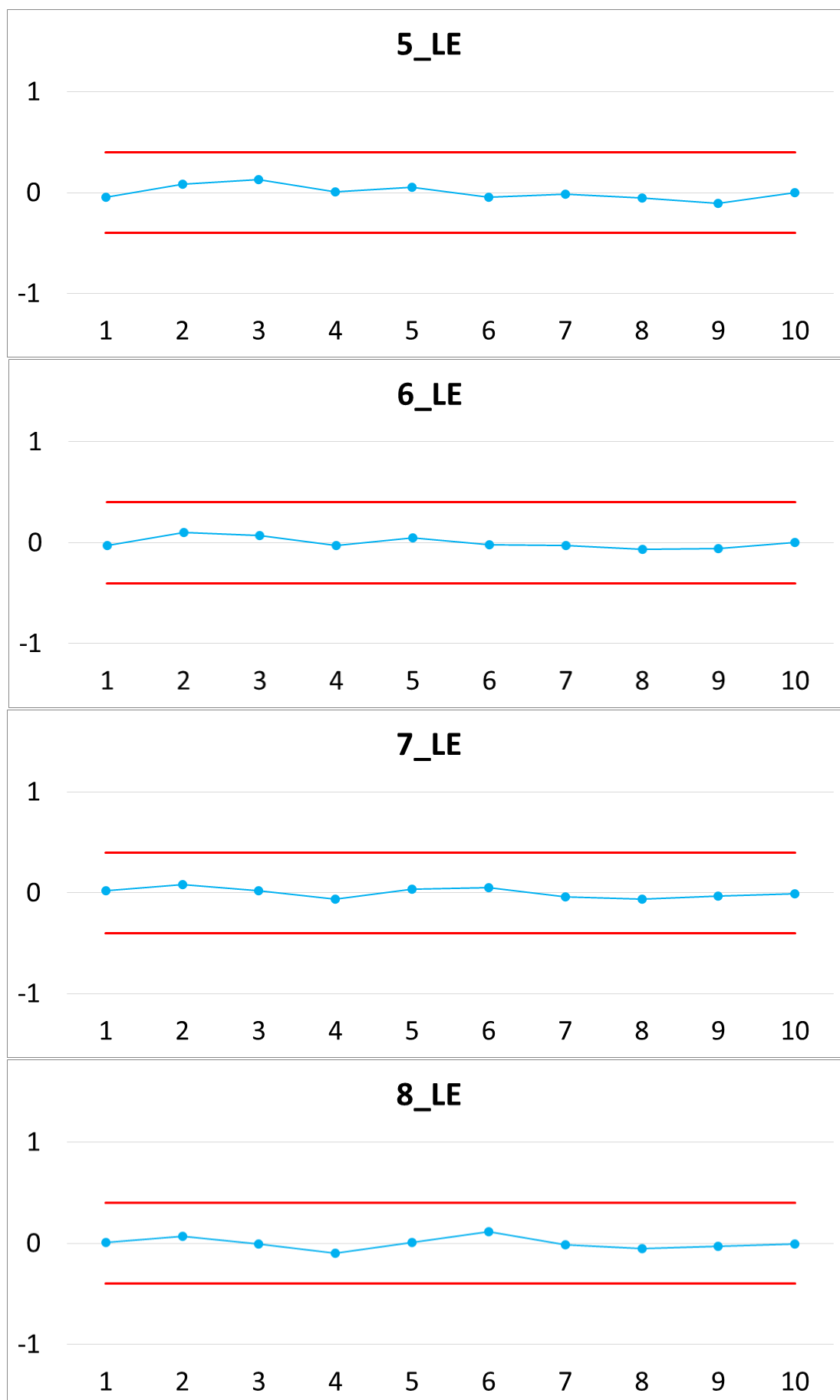


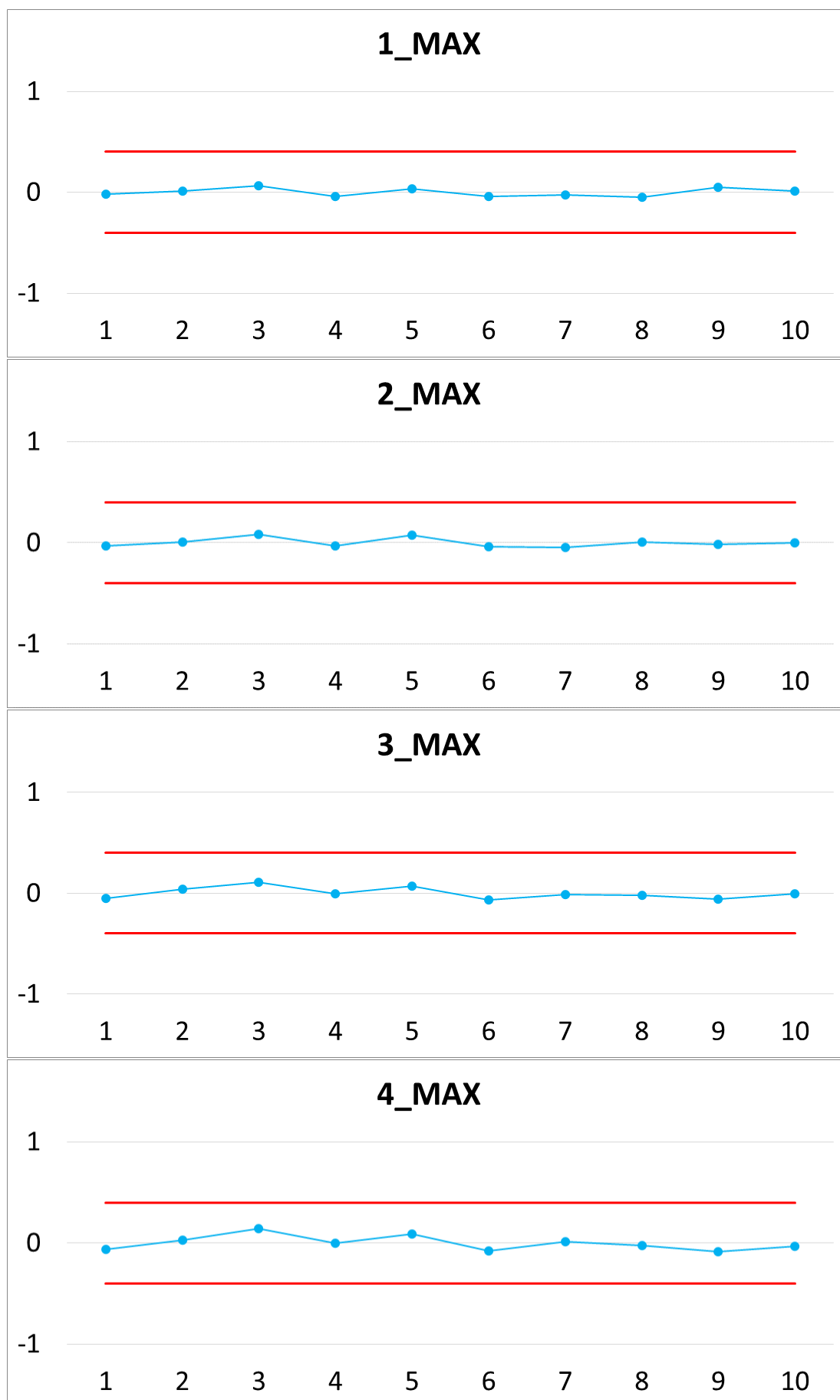


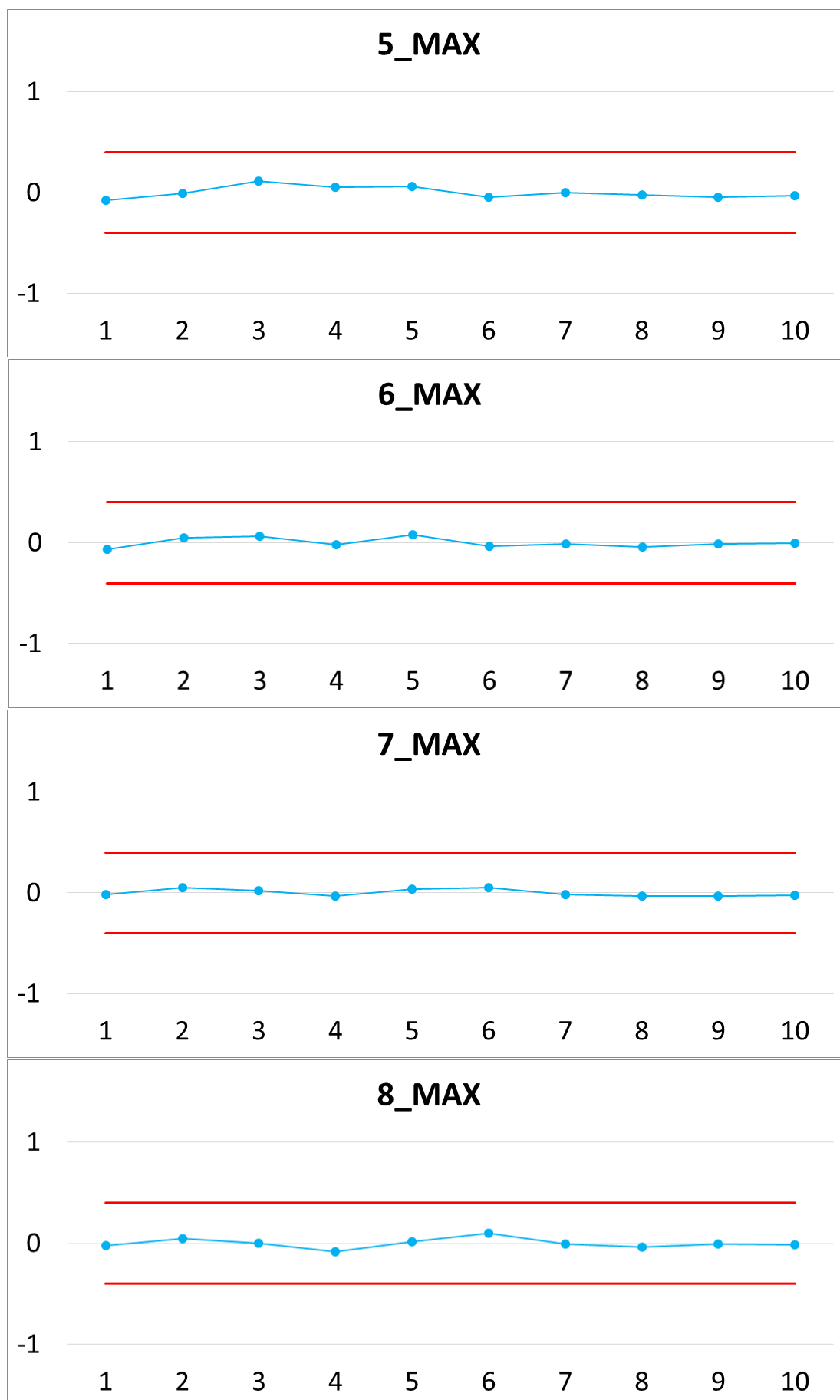


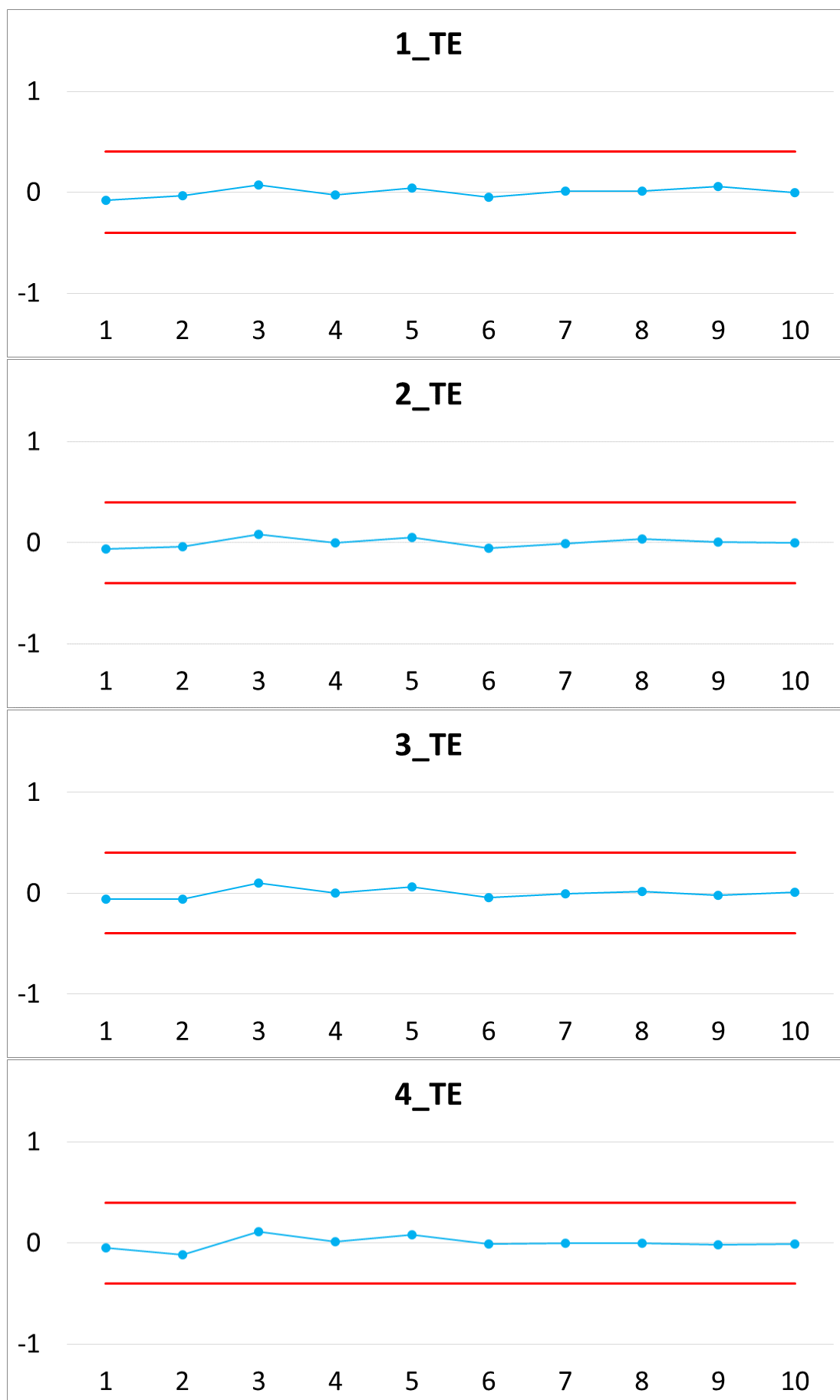


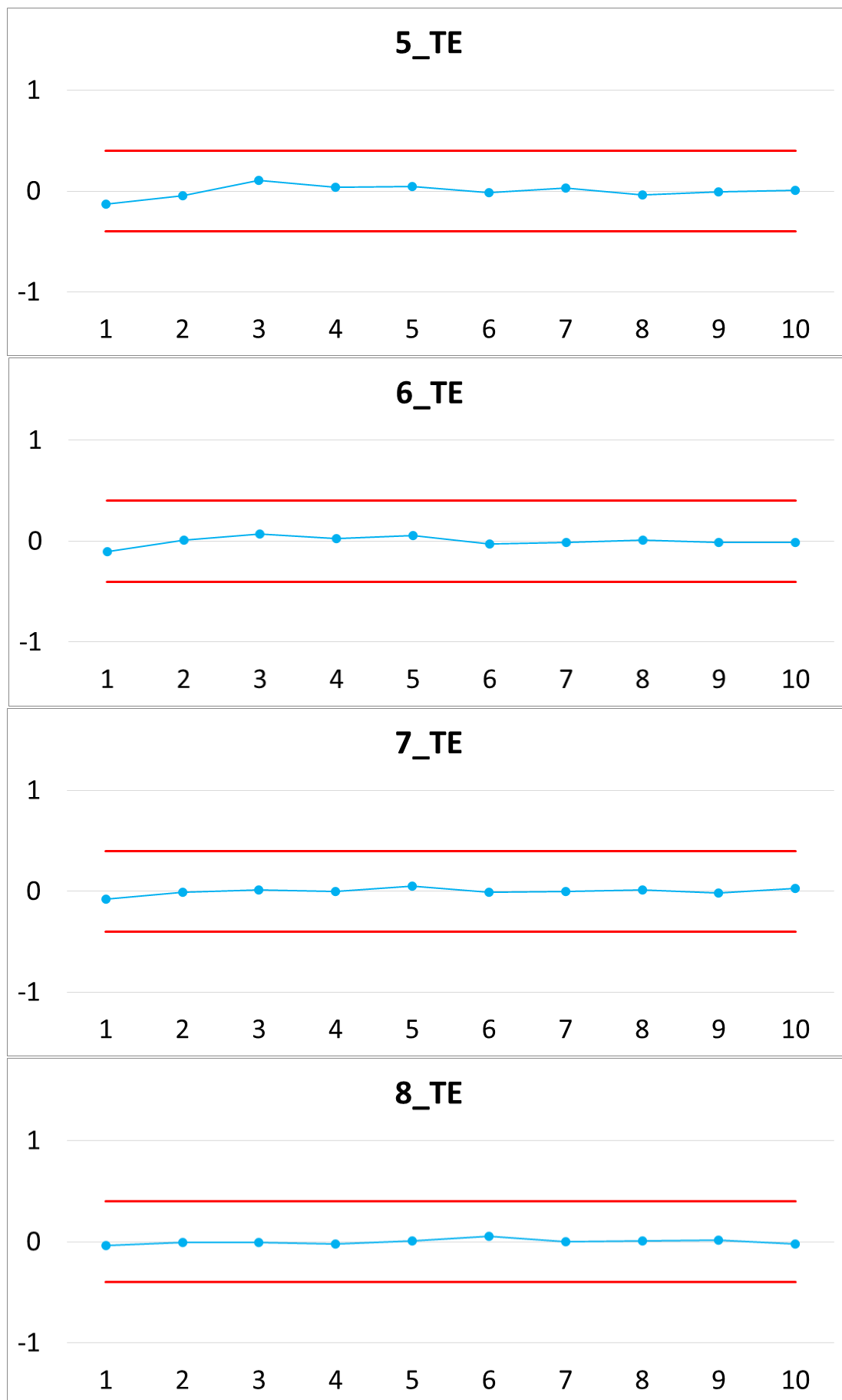


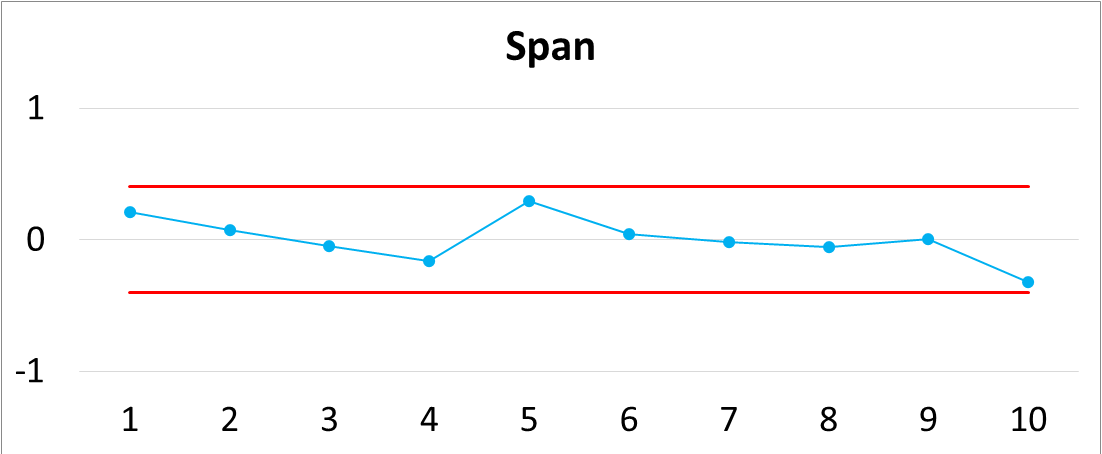


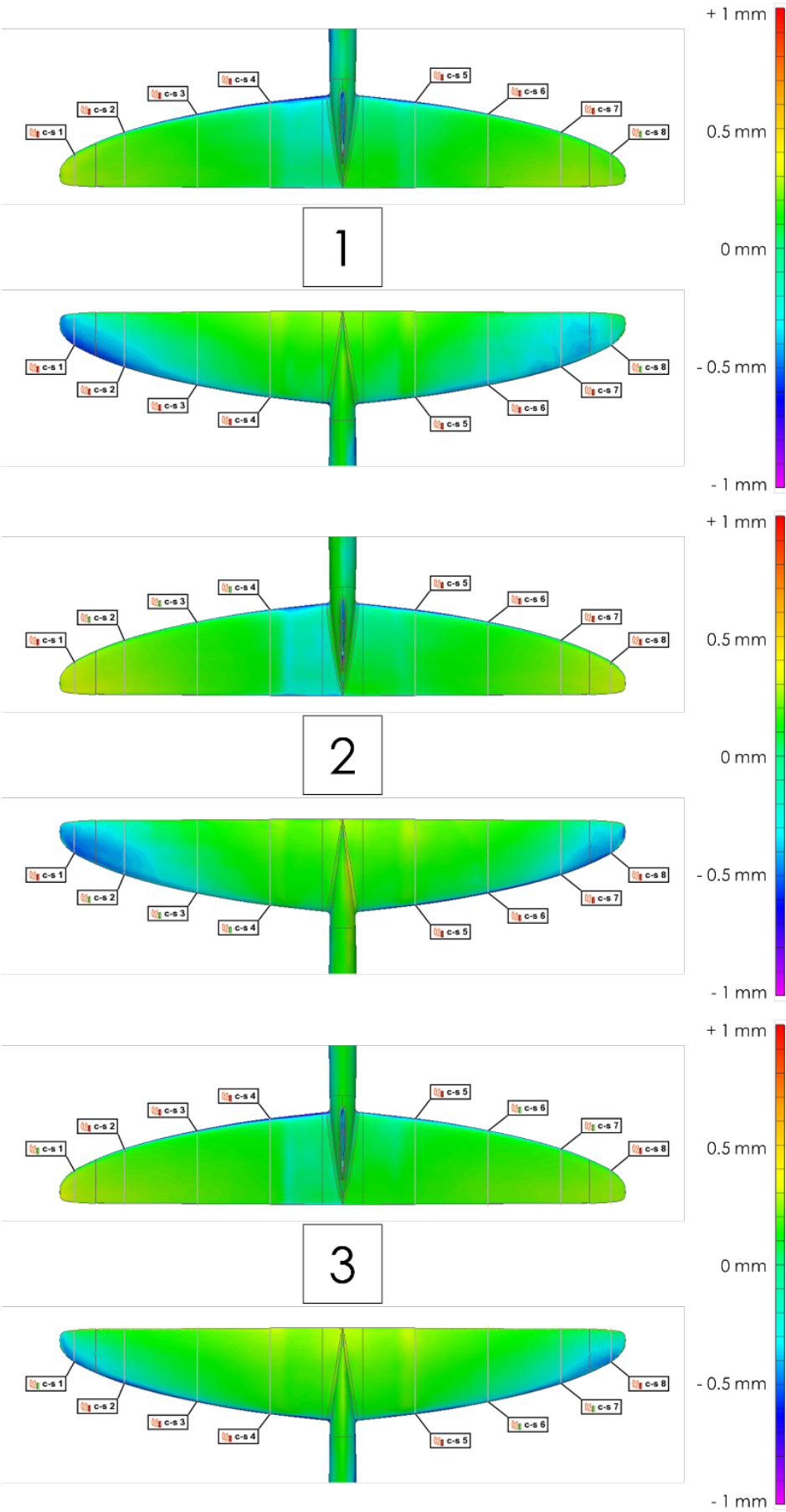


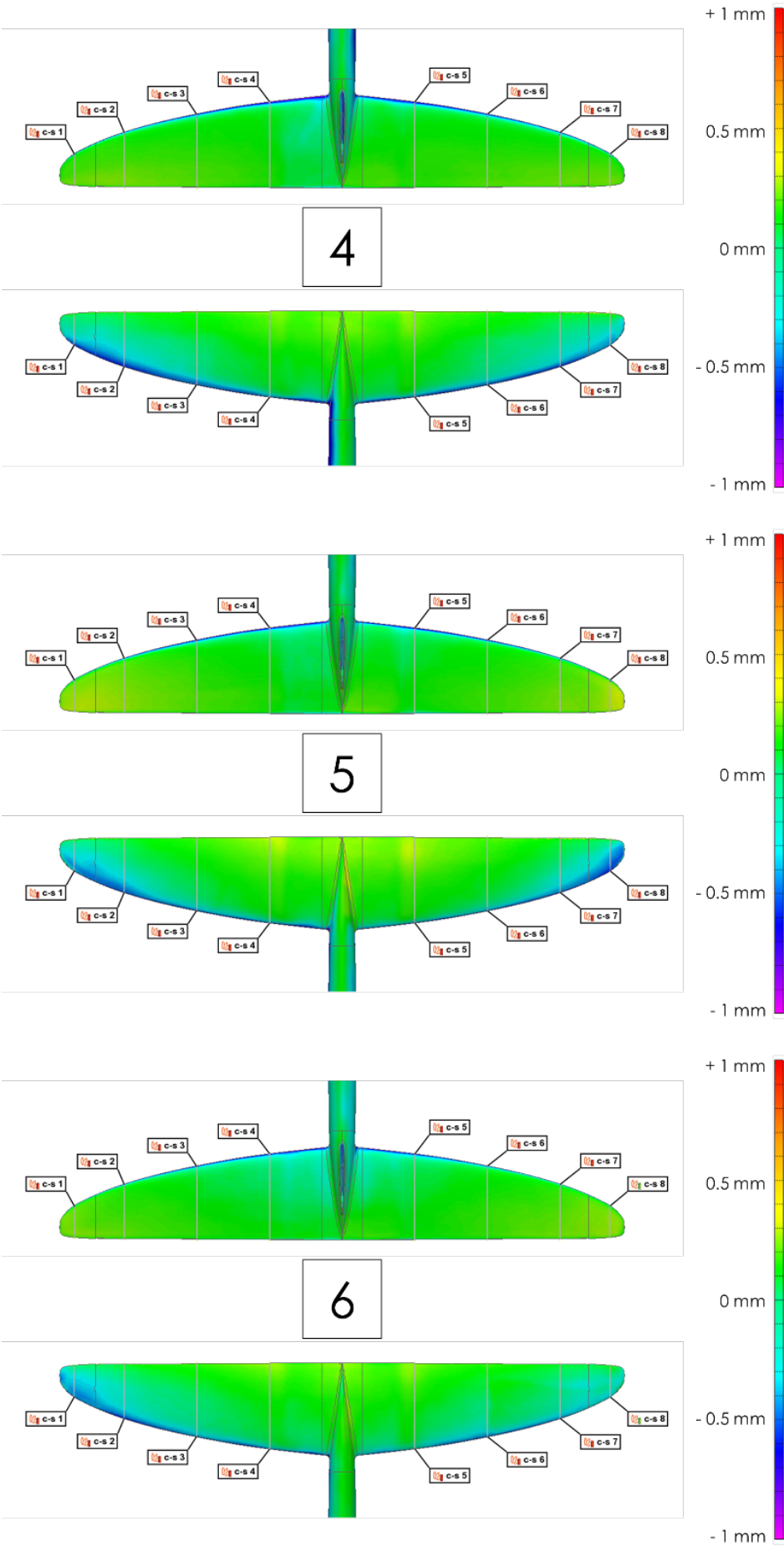


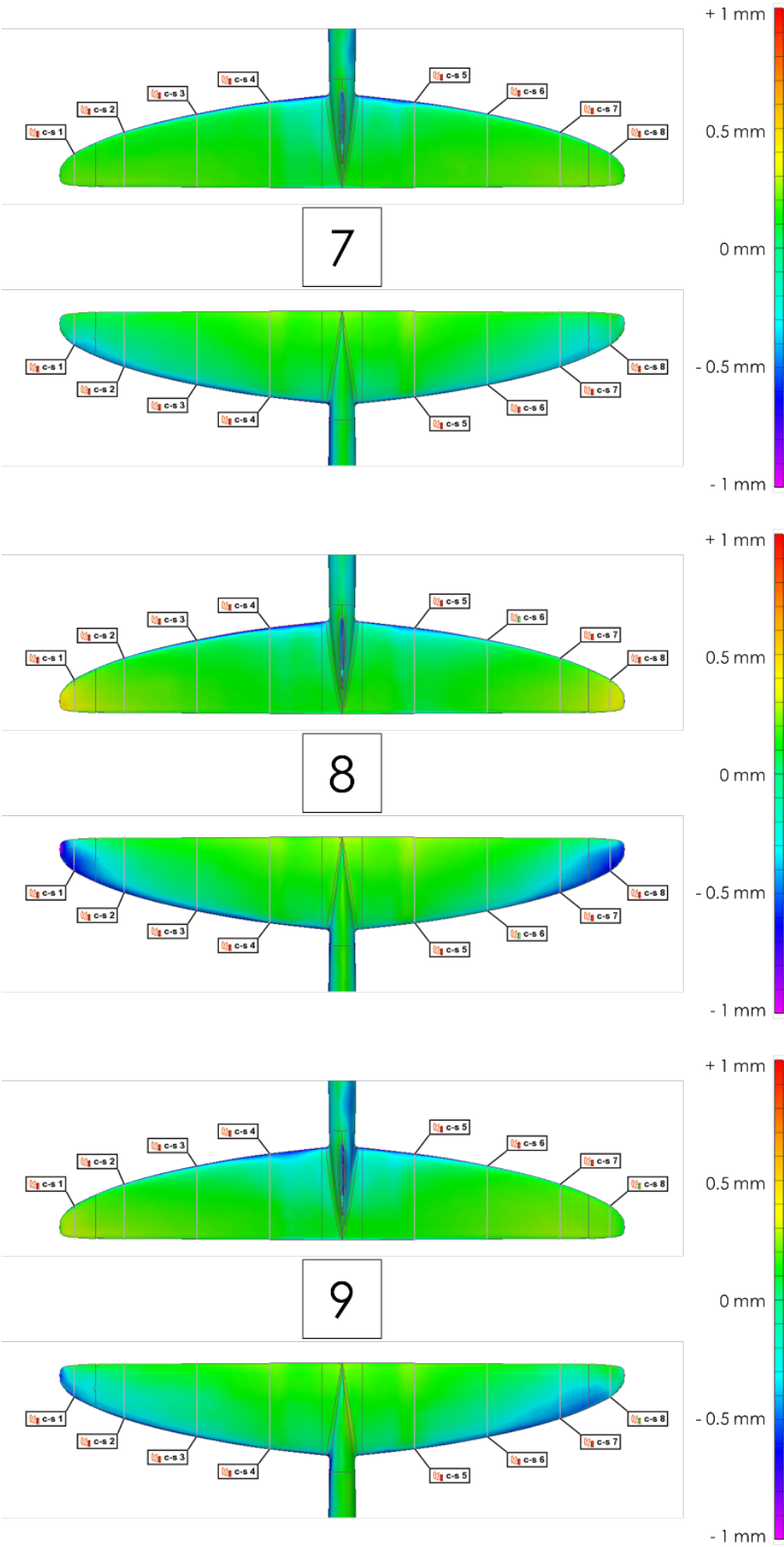












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