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 Rearwing V4

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

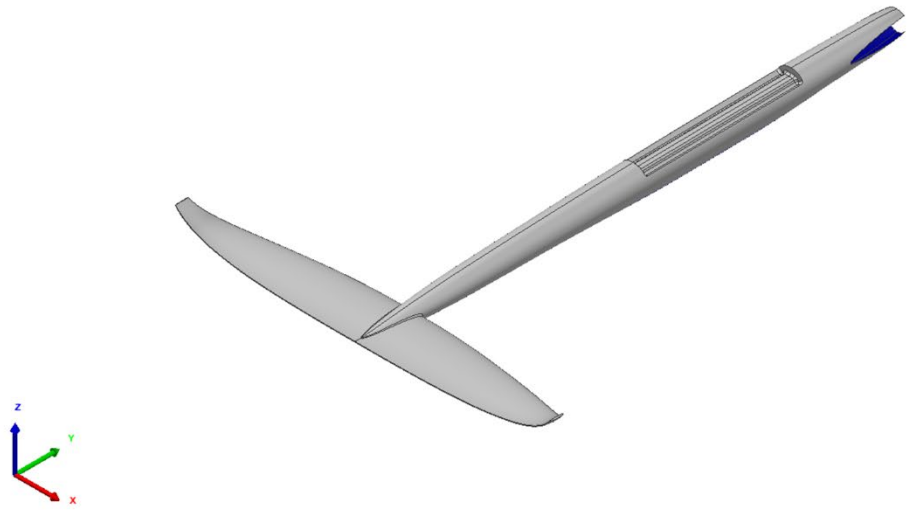

Figure 1 - Definition of the Coordinate System

Cross Sections

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

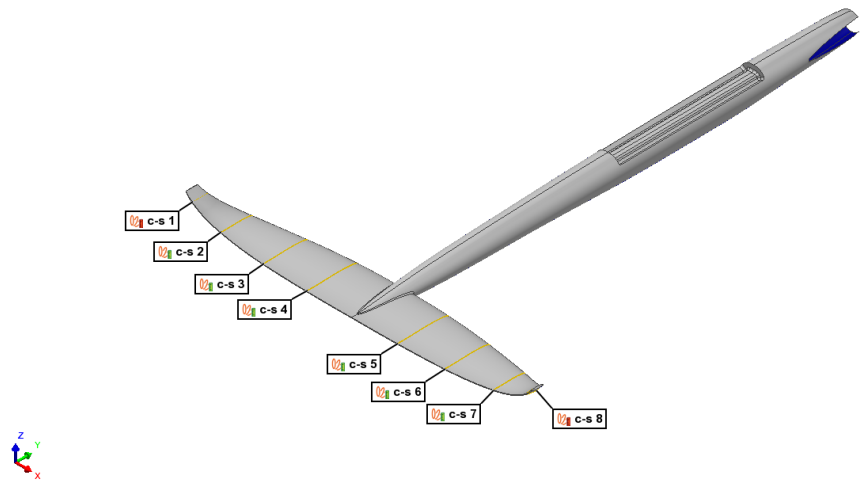

Figure 2 - Definition of Cross Sections

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 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	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.

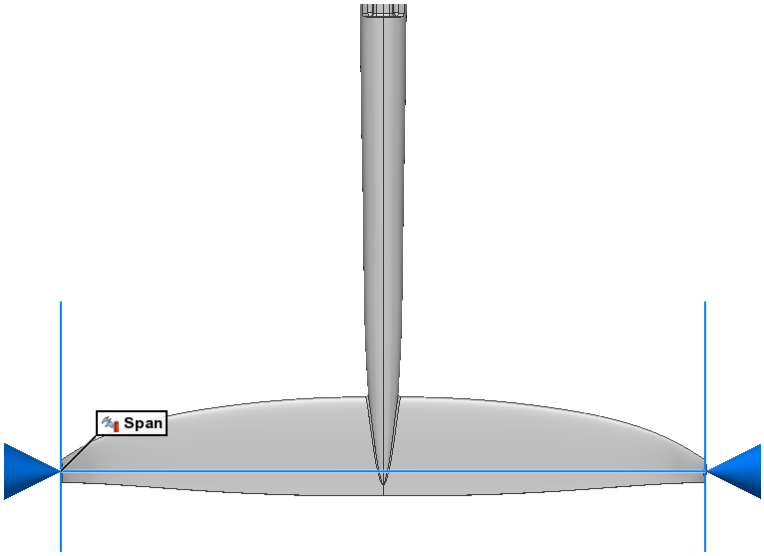

Figure 4 – Calliper to measure the Span

Surface Distance Points

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

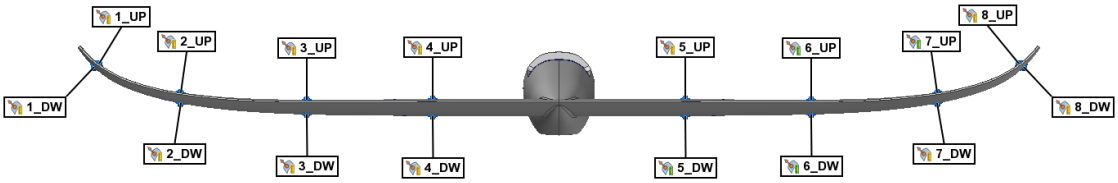

Figure 5 - Surface Distance Points definition

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).

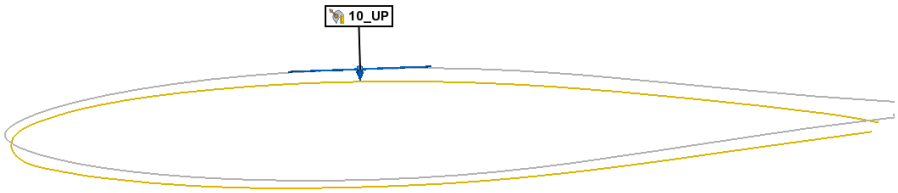

Figure 6 - Definition of Surface Distance Points on a Cross Section

Colour Map

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

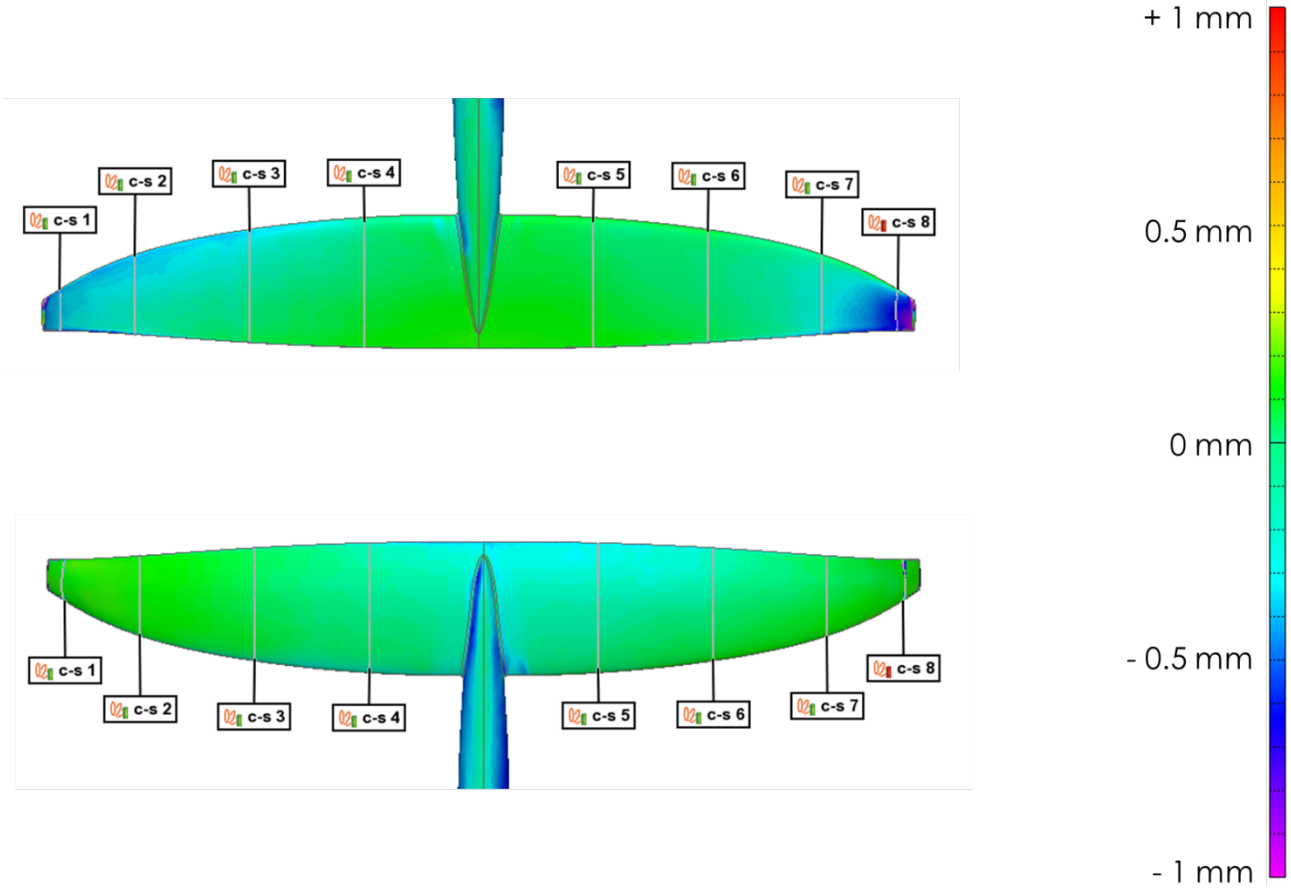

Figure 7 - Colour Map of the Upper (top) and Lower (bottom) surfaces of the Rearwing

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 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	

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.

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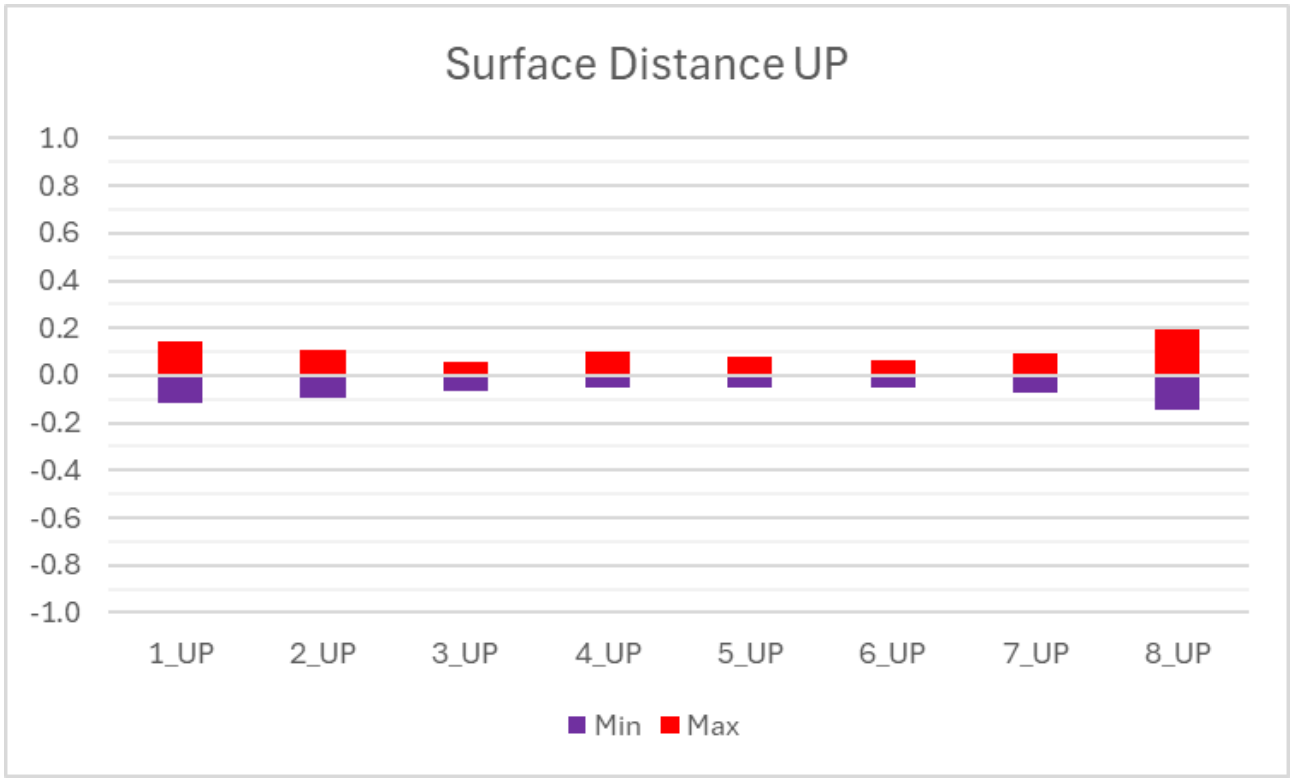
World Sailing Manufacturer Control System

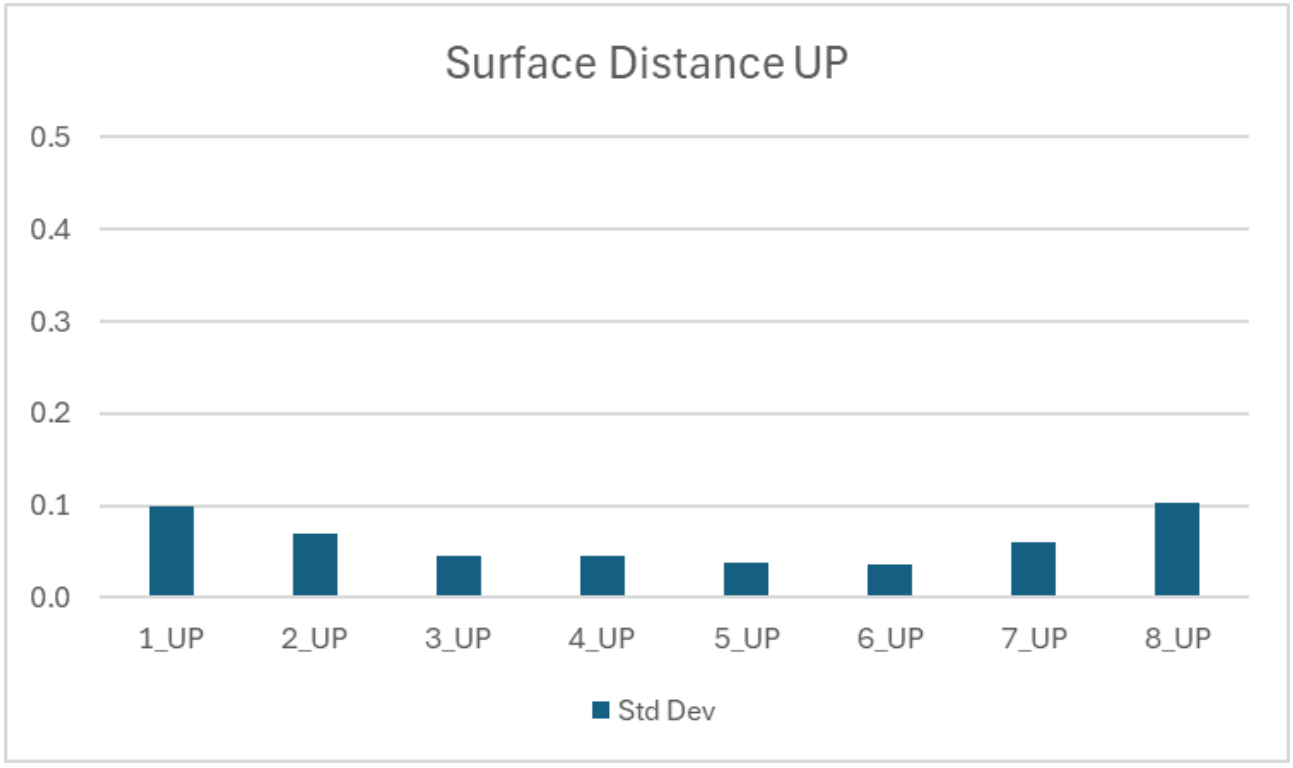
Scanner Report: IKA Formula Kite – Chubanga Rearwing V4

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	-0.04	0.147	0.143	-0.116	0.091	-0.086	0	0.04	-0.111	-0.063	-0.116	0.147	0.100
2_UP	0.03	0.084	0.108	-0.008	0.071	-0.091	-0.05	-0.059	-0.042	-0.041	-0.091	0.108	0.069
3_UP	0.025	-0.013	0.057	0.004	0.042	-0.066	-0.006	-0.039	0.06	-0.063	-0.066	0.060	0.046
4_UP	-0.017	-0.029	0.021	-0.011	0.03	-0.05	0.027	-0.012	0.099	-0.054	-0.054	0.099	0.046
5_UP	-0.019	-0.026	0.035	-0.051	0.027	-0.023	-0.008	0.008	0.079	-0.023	-0.051	0.079	0.038
6_UP	0.036	-0.008	0.066	-0.049	0.021	-0.038	-0.021	-0.005	0.023	-0.025	-0.049	0.066	0.036
7_UP	0.073	0.005	0.097	-0.006	0.069	-0.051	-0.048	-0.073	-0.05	-0.011	-0.073	0.097	0.060
8_UP	-0.028	-0.048	0.105	-0.044	0.054	0.064	-0.087	-0.147	-0.069	0.198	-0.147	0.198	0.103
1_DW	-0.037	-0.063	-0.087	-0.01	-0.05	-0.029	0.074	0.185	0.086	-0.07	-0.087	0.185	0.087
2_DW	-0.082	-0.062	-0.048	-0.037	-0.054	0.06	0.056	0.097	0.115	-0.041	-0.082	0.115	0.073
3_DW	-0.027	0.025	-0.023	-0.021	-0.01	0.016	-0.013	0.039	0.014	-0.001	-0.027	0.039	0.023
4_DW	0.018	0.029	0.014	-0.011	0.007	0.008	-0.057	-0.013	-0.032	0.04	-0.057	0.040	0.029
5_DW	0.036	0.03	-0.019	0.013	-0.011	-0.001	-0.039	-0.045	-0.023	0.059	-0.045	0.059	0.034
6_DW	0.023	0.011	-0.051	0.008	-0.002	0.026	-0.01	-0.004	-0.028	0.029	-0.051	0.029	0.025
7_DW	0.001	-0.063	-0.08	0.004	-0.046	0.065	0.007	0.049	0.039	0.022	-0.080	0.065	0.049
8_DW	-0.044	-0.112	-0.117	-0.124	0.034	0.069	0.096	0.166	0.06	-0.03	-0.124	0.166	0.100
1_LE	-0.057	0.134	0.001	-0.12	0.018	-0.11	0.067	0.224	-0.076	-0.082	-0.120	0.224	0.113
2_LE	0.041	0.058	-0.041	-0.042	-0.054	0.015	-0.03	0.003	0.033	0.013	-0.054	0.058	0.039
3_LE	0.059	0.068	-0.068	0.016	-0.064	-0.03	-0.057	-0.013	0.048	0.045	-0.068	0.068	0.053
4_LE	0.057	0.013	-0.099	0.018	-0.052	-0.018	-0.045	-0.01	0.052	0.086	-0.099	0.086	0.057
5_LE	0.04	0.047	-0.145	0.012	-0.063	0.02	-0.02	0.027	0.009	0.071	-0.145	0.071	0.063
6_LE	0.079	0.048	-0.114	0.018	-0.061	0.018	0.018	0.048	-0.053	-0.002	-0.114	0.079	0.059
7_LE	0.064	-0.011	-0.068	0.049	-0.016	0.01	-0.004	0.049	-0.043	-0.033	-0.068	0.064	0.043
8_LE	-0.039	-0.159	-0.033	-0.116	0.045	0.128	0.039	0.035	-0.062	0.162	-0.159	0.162	0.101
1_MAX	-0.079	0.089	0.062	-0.13	0.044	-0.123	0.075	0.23	-0.031	-0.137	-0.137	0.230	0.120
2_MAX	-0.053	0.022	0.06	-0.046	0.017	-0.032	0.006	0.038	0.074	-0.083	-0.083	0.074	0.052
3_MAX	-0.002	0.012	0.033	-0.017	0.032	-0.049	-0.019	-0.001	0.074	-0.065	-0.065	0.074	0.041
4_MAX	0.001	-0.001	0.035	-0.022	0.038	-0.042	-0.031	-0.025	0.067	-0.015	-0.042	0.067	0.035
5_MAX	0.016	0.004	0.016	-0.038	0.017	-0.024	-0.048	-0.037	0.056	0.036	-0.048	0.056	0.035
6_MAX	0.06	0.003	0.015	-0.042	0.018	-0.012	-0.032	-0.009	-0.005	0.005	-0.042	0.060	0.028
7_MAX	0.074	-0.06	0.016	-0.002	0.022	0.014	-0.042	-0.025	-0.011	0.01	-0.060	0.074	0.037
8_MAX	-0.074	-0.164	-0.012	-0.171	0.092	0.137	0.009	0.017	-0.011	0.178	-0.171	0.178	0.116
1_TE	-0.094	0.029	0.113	-0.137	0.084	-0.162	0.139	0.215	0.012	-0.196	-0.196	0.215	0.141
2_TE	-0.072	-0.007	0.126	-0.076	0.114	-0.088	0.061	0.052	0.128	-0.239	-0.239	0.128	0.119
3_TE	-0.081	0.008	0.095	-0.085	0.127	-0.058	0.025	0.029	0.14	-0.2	-0.200	0.140	0.107
4_TE	-0.05	-0.025	0.113	-0.075	0.09	-0.052	-0.009	-0.013	0.123	-0.107	-0.107	0.123	0.081
5_TE	0.023	0.005	0.085	-0.116	0.083	-0.02	-0.046	-0.04	0.039	-0.015	-0.116	0.085	0.061
6_TE	0.057	-0.043	0.072	-0.112	0.086	0.012	-0.045	-0.05	0.024	0.002	-0.112	0.086	0.063
7_TE	0.097	-0.072	0.068	-0.077	0.078	0.02	-0.081	-0.073	0.037	0.005	-0.081	0.097	0.071
8_TE	-0.037	-0.144	-0.02	-0.157	0.096	0.058	-0.099	-0.027	0.054	0.273	-0.157	0.273	0.128
Span	-0.783	0.338	-0.079	-0.199	0.076	0.08	0.32	0.025	0.277	-0.06	-0.783	0.338	0.328

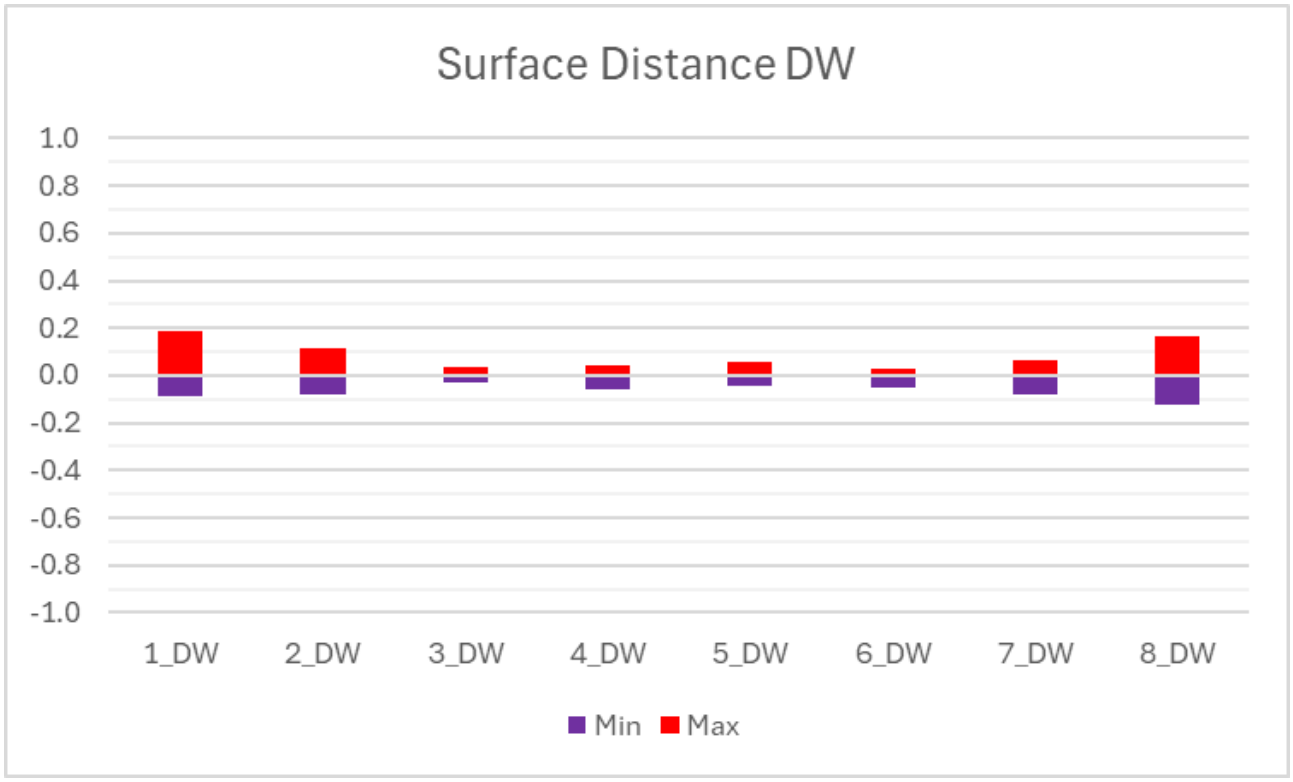
Maximum and minimum 'Surface Distances' on the upper surface at each cross section (mm):



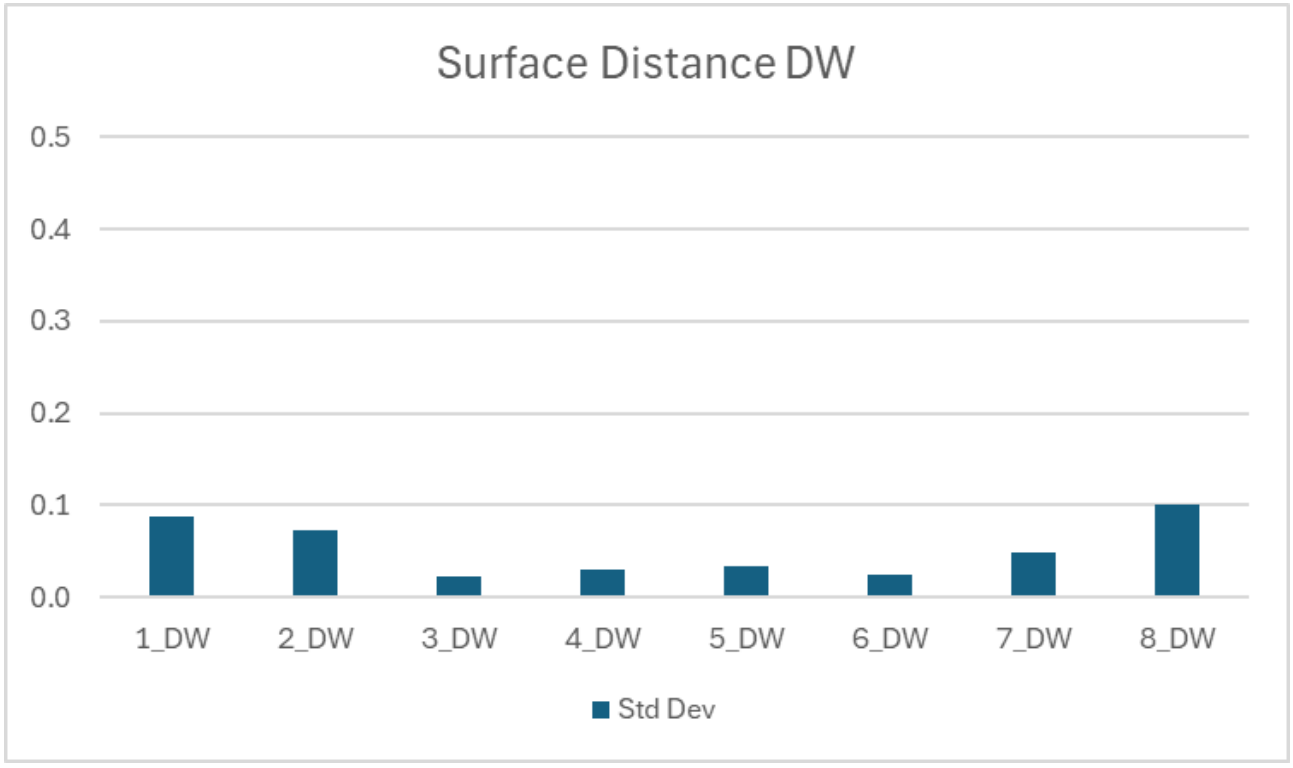
Standard deviation of 'Surface Distances' on the upper surface at each cross section (mm):



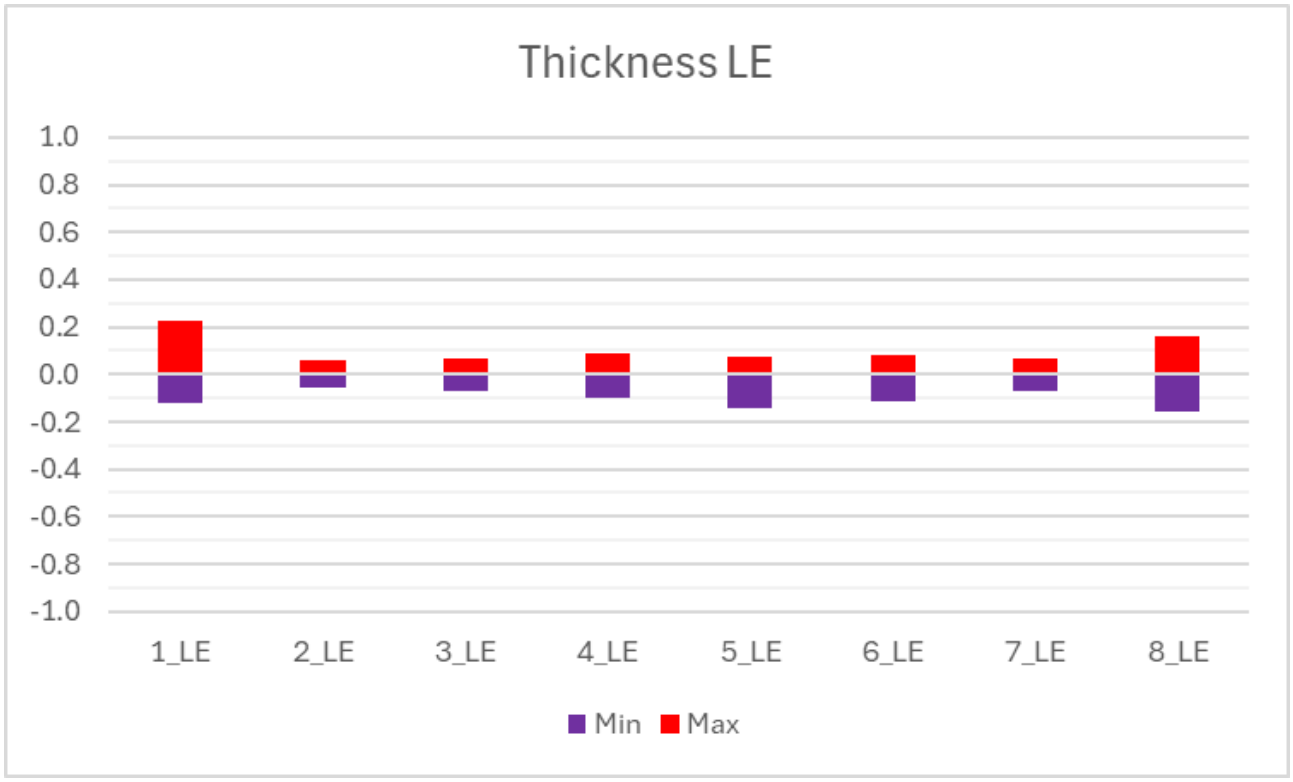
Maximum and minimum 'Surface Distances' on the lower surface at each cross section (mm):



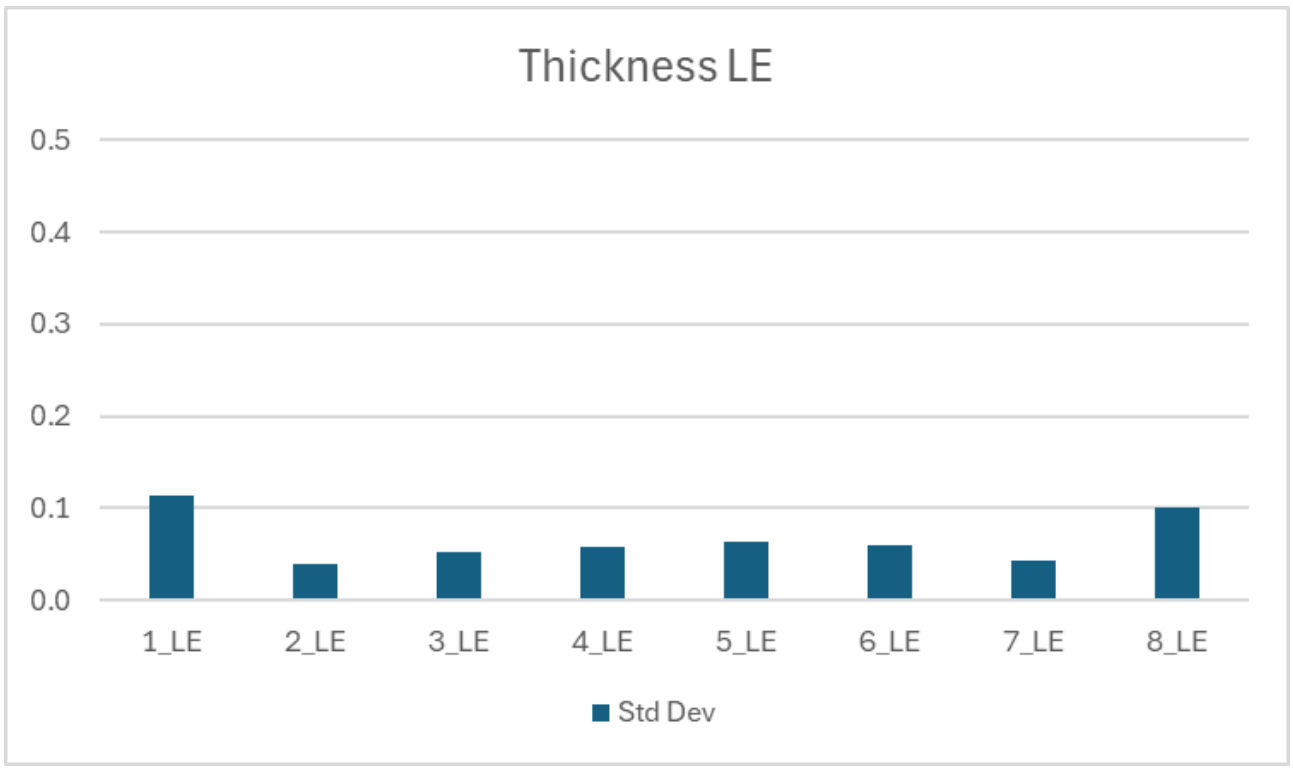
Standard deviation of 'Surface Distances' on the lower surface at each cross section (mm):



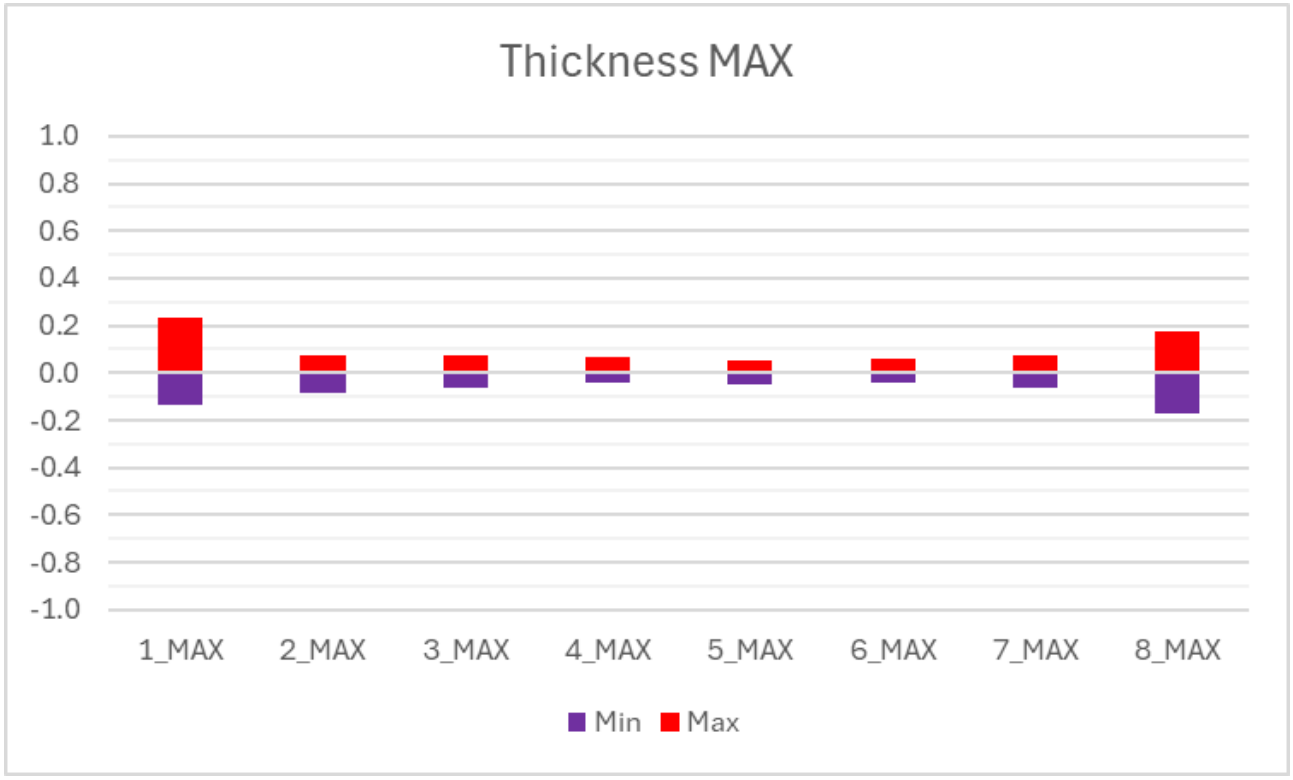
Maximum and minimum Thickness at the 'Leading Edge point' at each cross section (mm):



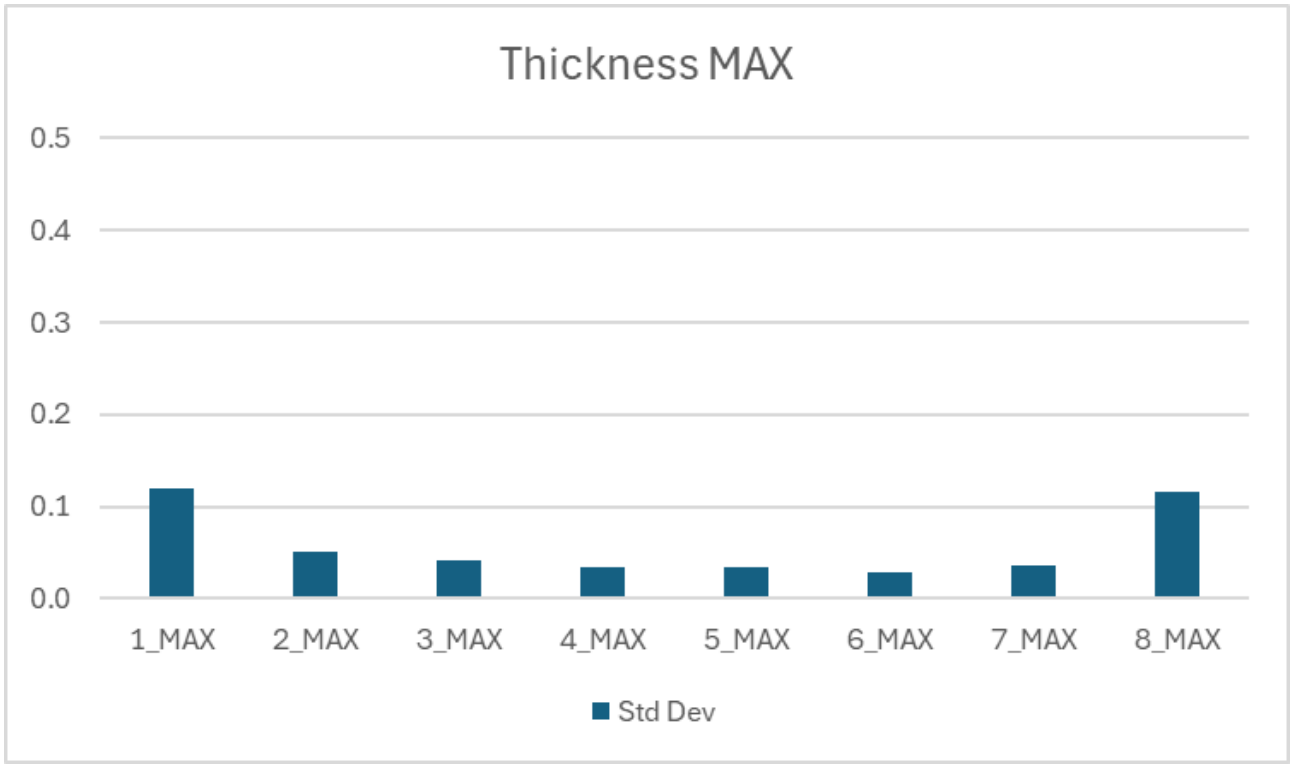
Standard deviation of Thickness at the 'Leading Edge point' at each cross section (mm):



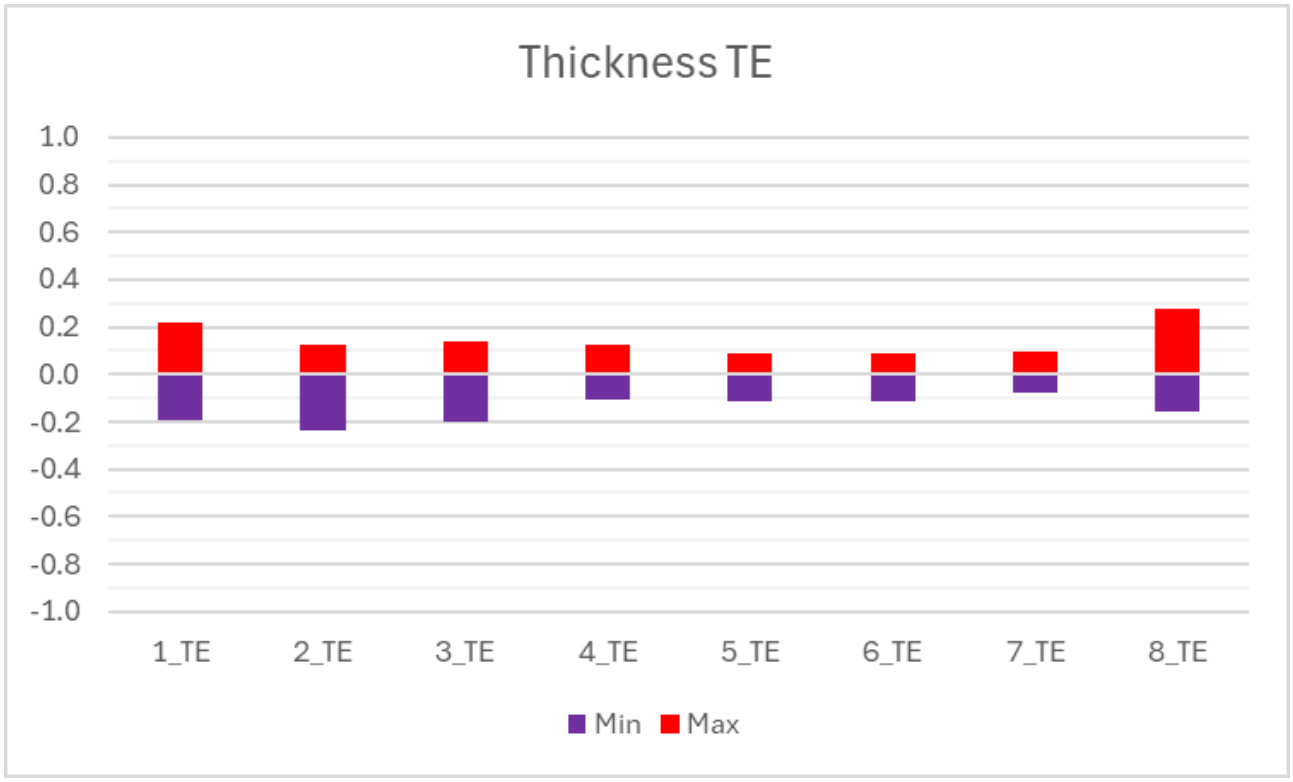
Maximum and minimum Thickness at the 'Maximum thickness point' at each cross section (mm):



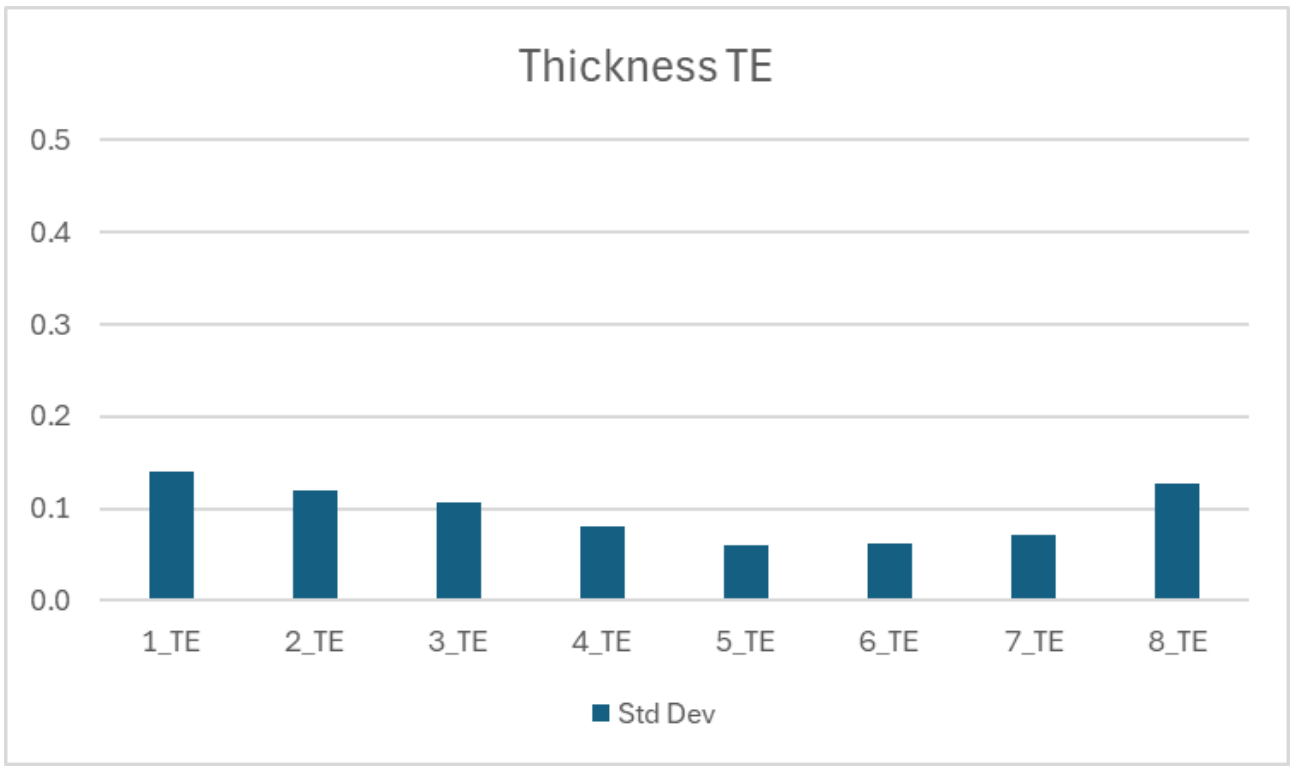
Standard deviation of Thickness at the 'Maximum thickness point' at each cross section (mm):



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



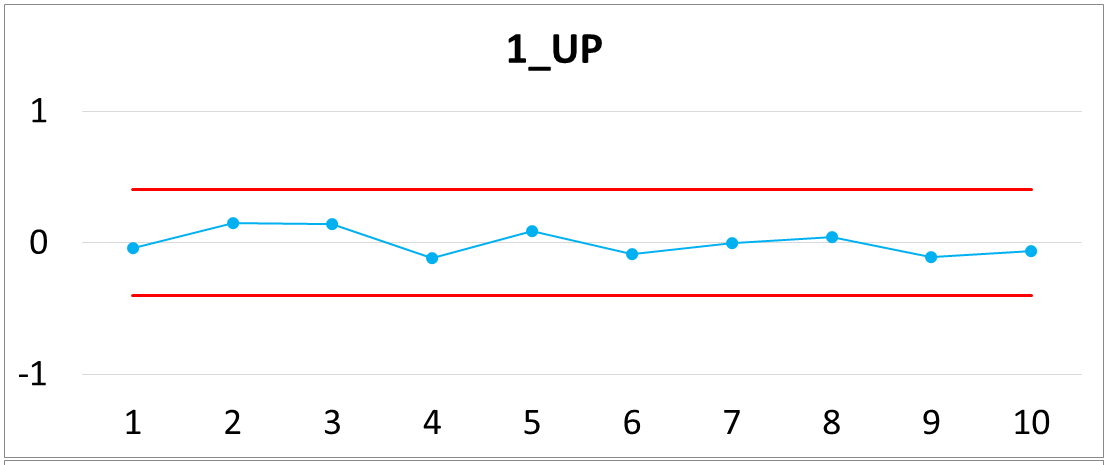
Standard deviation of Thickness at the 'Trailing Edge point' at each cross section (mm):

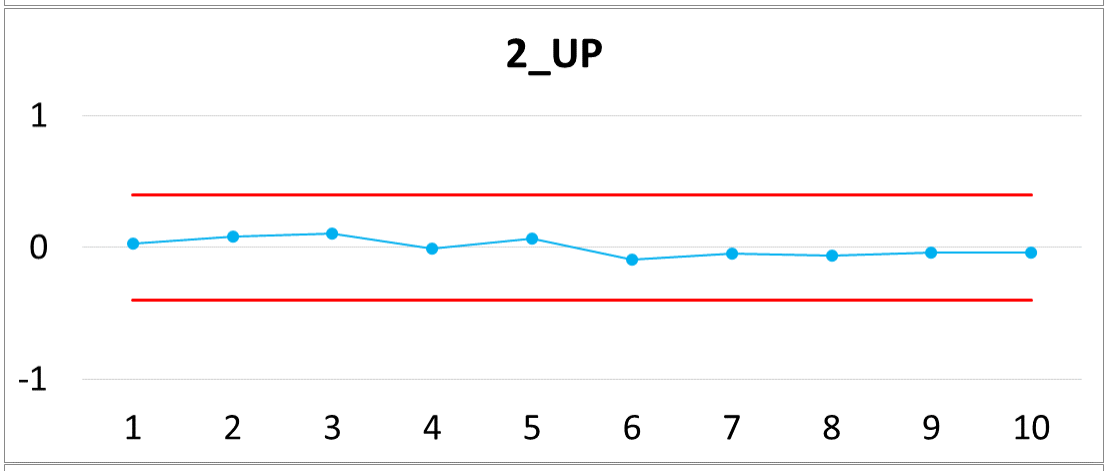


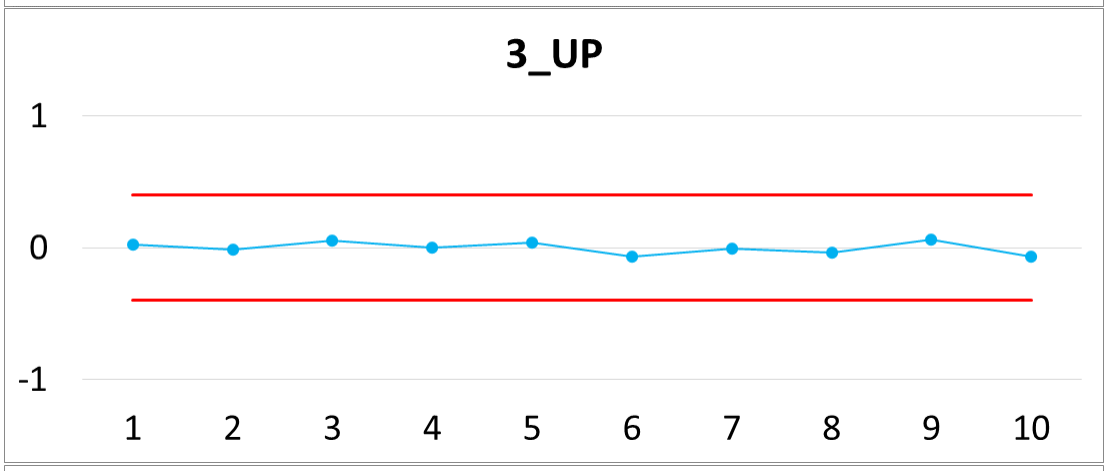
World Sailing Manufacturer Control System

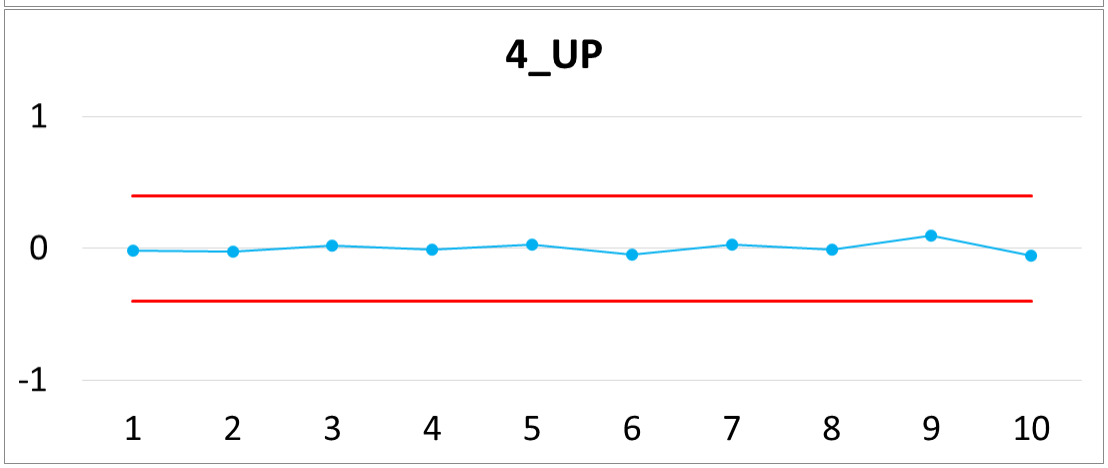
Scanner Report: IKA Formula Kite – Chubanga Rearwing V4

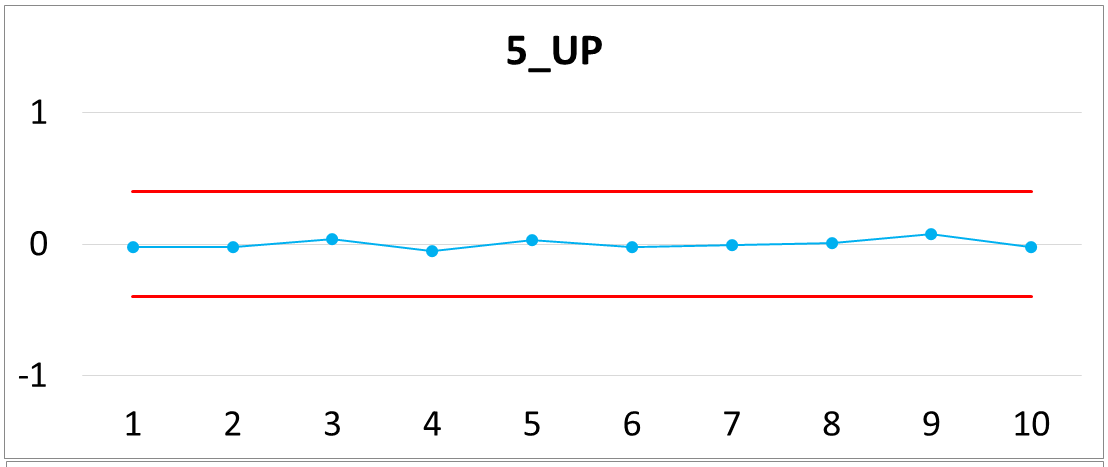
- Blue Lines: Normalised values (mm) for each control point
- Red Lines: ±0.4 mm for visualisation purposes
- X-Axis: 1 to 10 foils

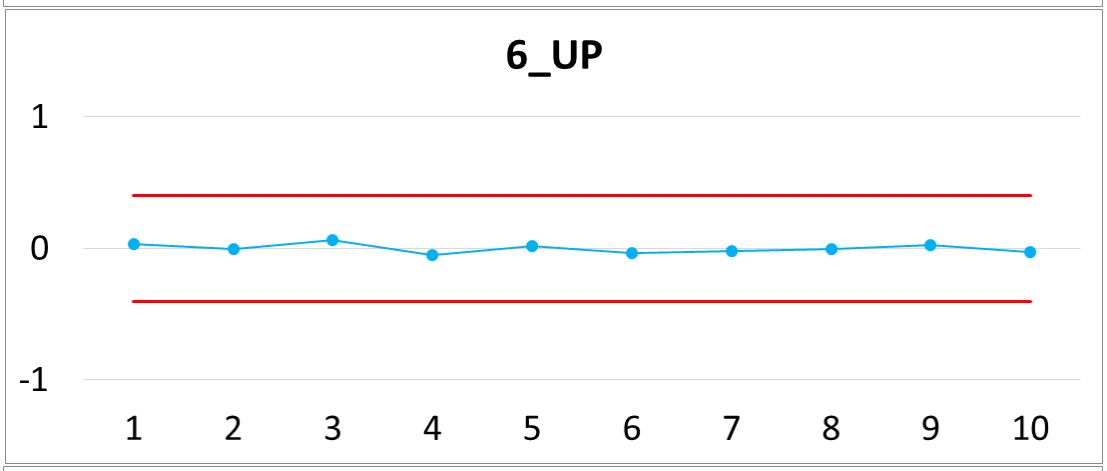









5_UP
1
0
-1
1 2 3 4 5 6 7 8 9 10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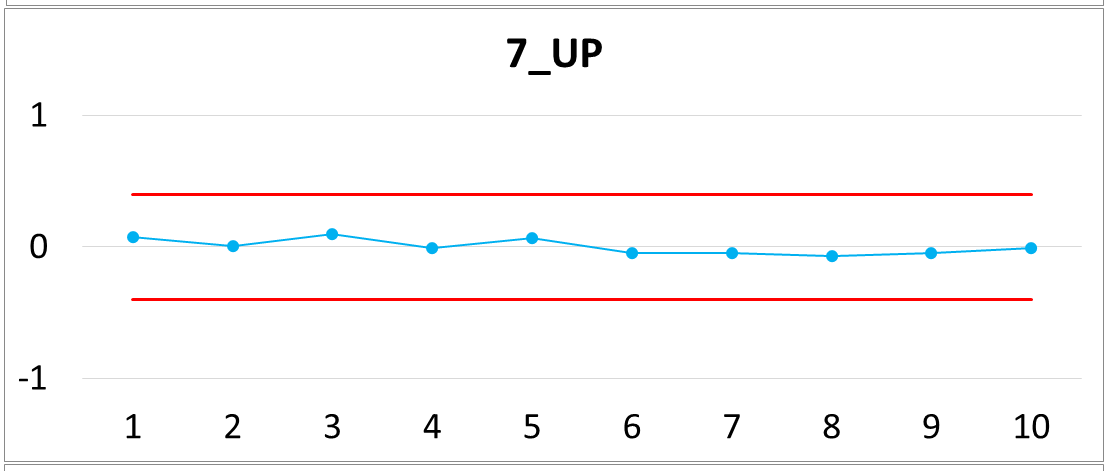
1 2 3 4 5 6 7 8 9 10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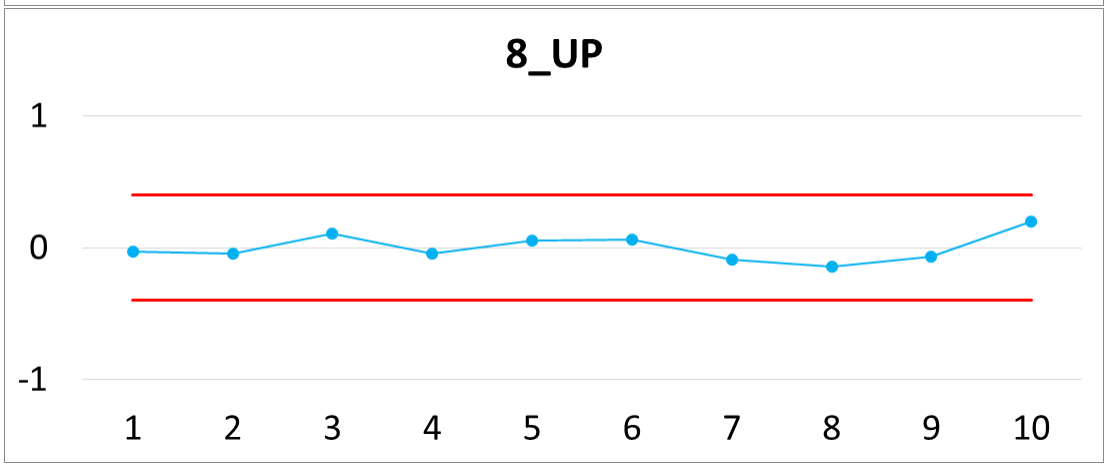
-1
1 2 3 4 5 6 7 8 9 10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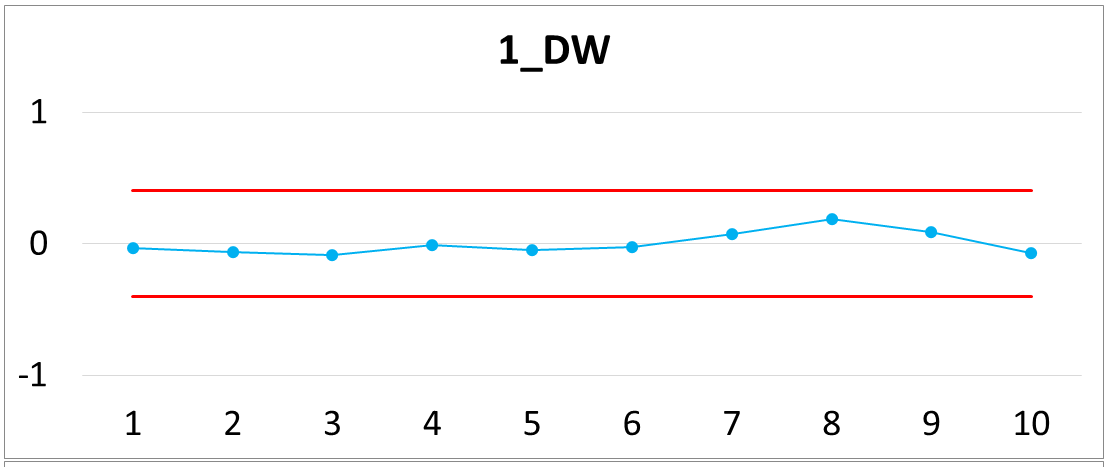
-1
1 2 3 4 5 6 7 8 9 10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-1
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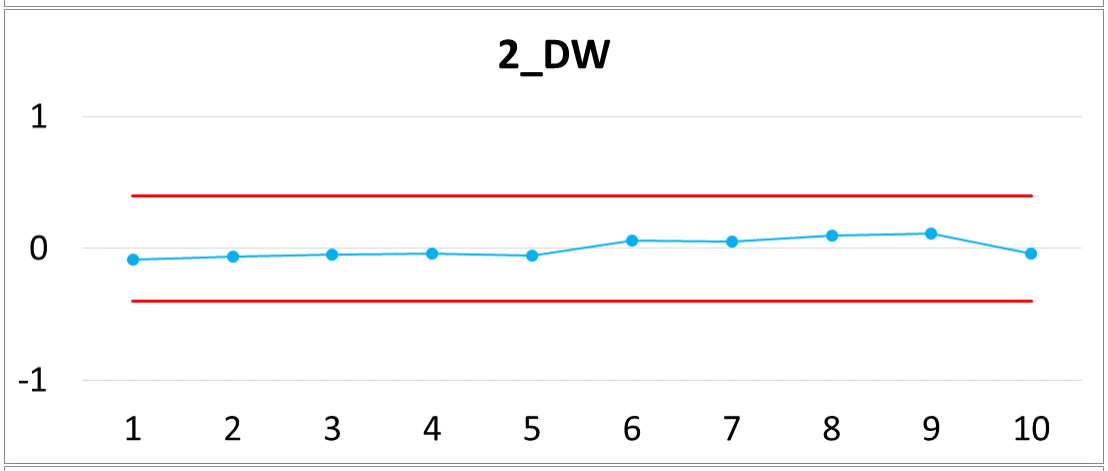
2_DW
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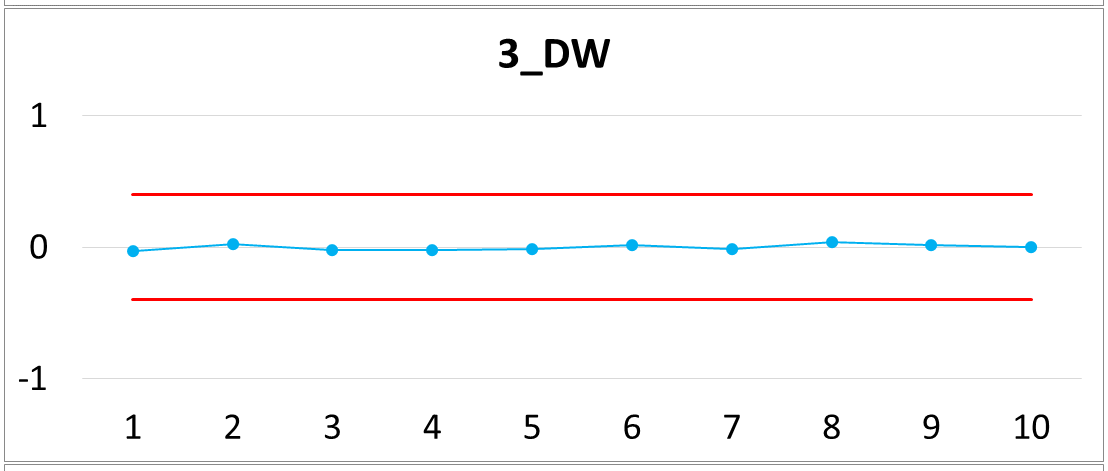
3_DW
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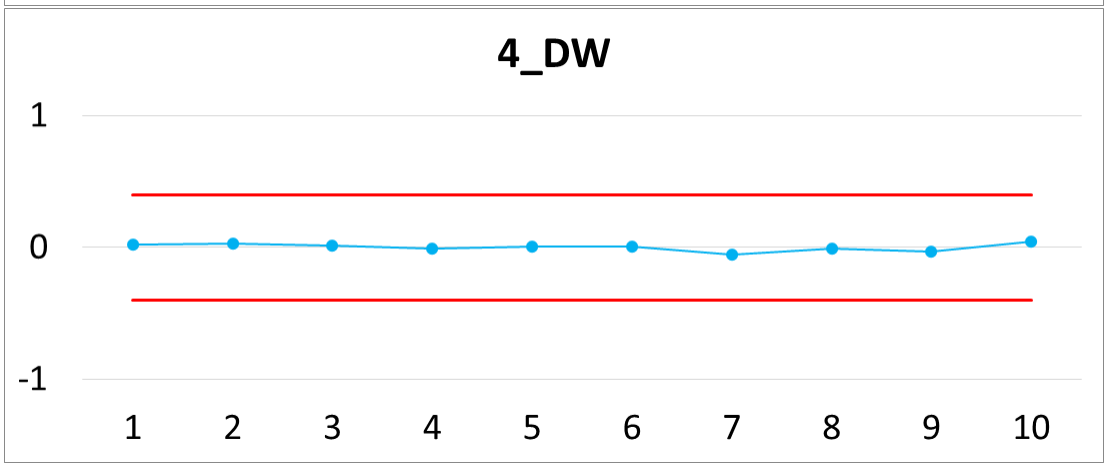
0
-1
1 2 3 4 5 6 7 8 9 10


4_DW
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0
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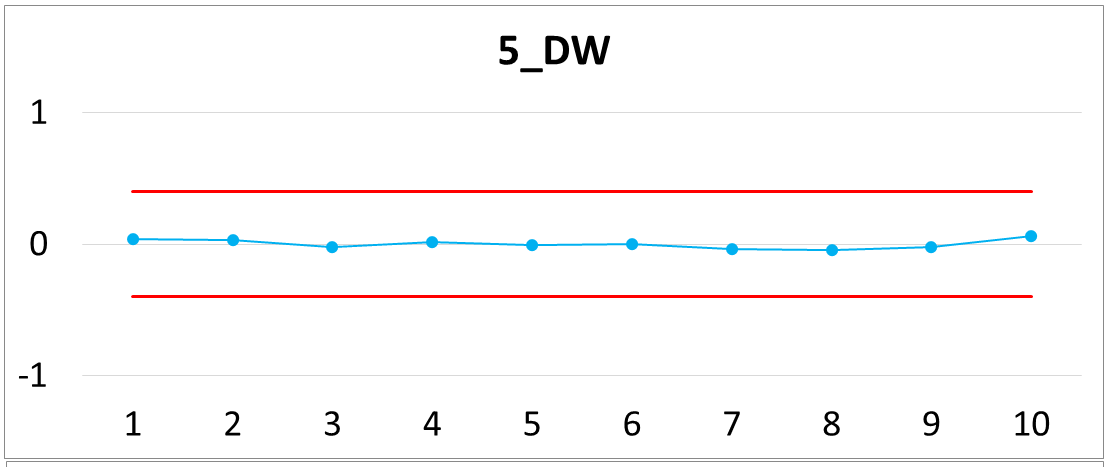
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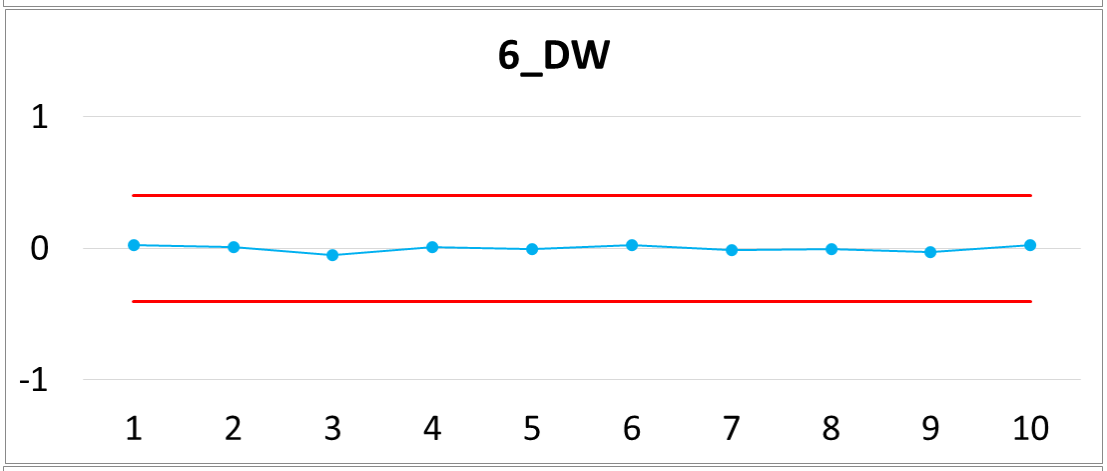
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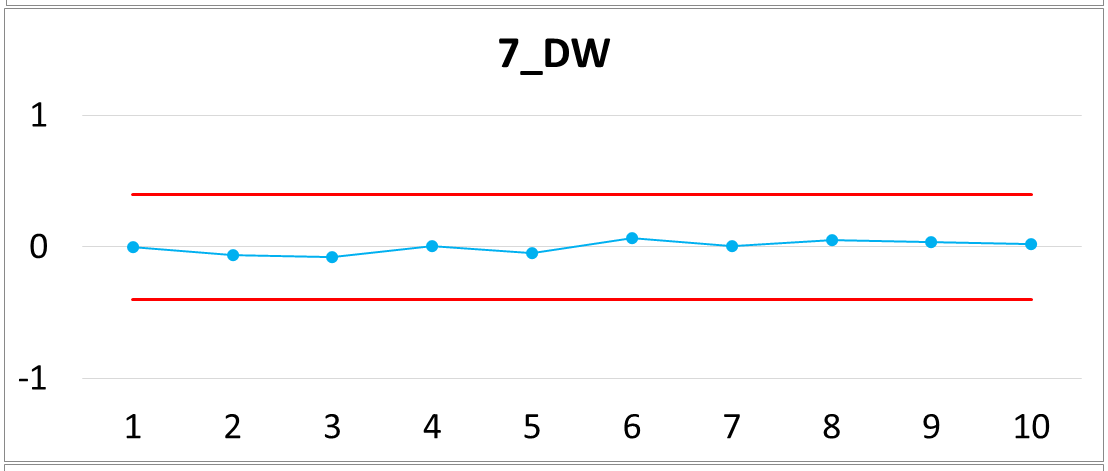
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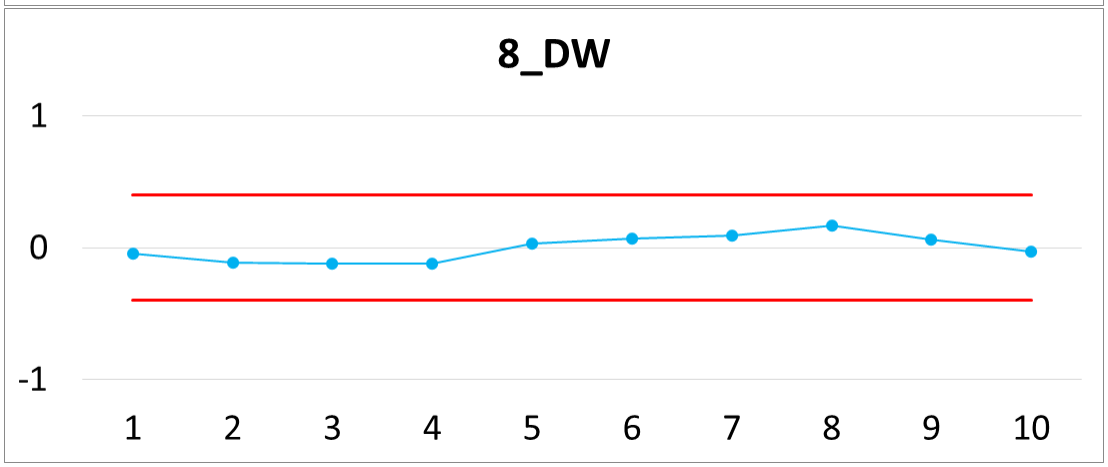
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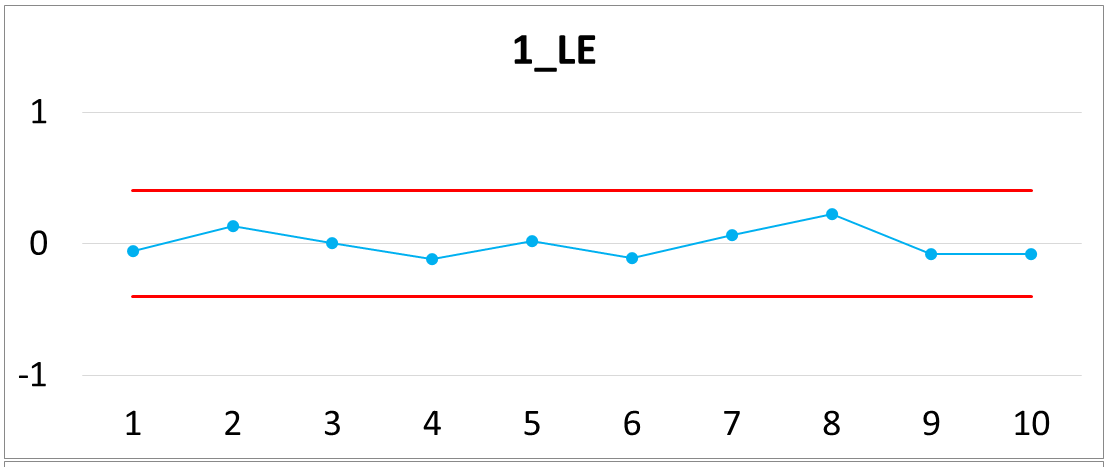
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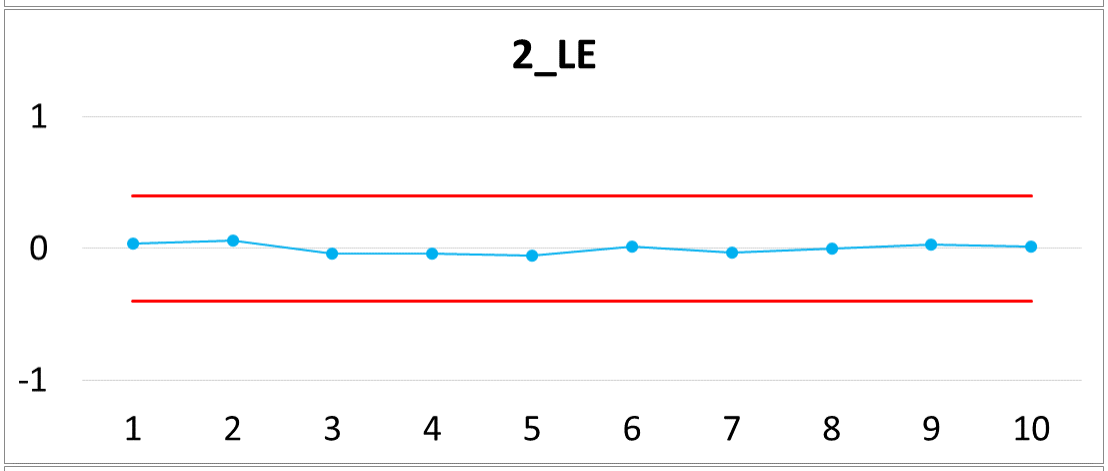
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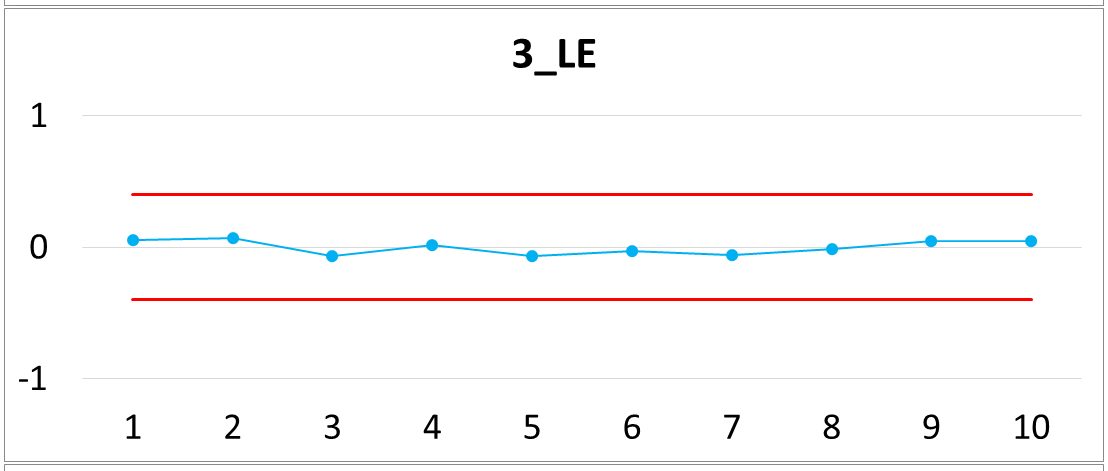
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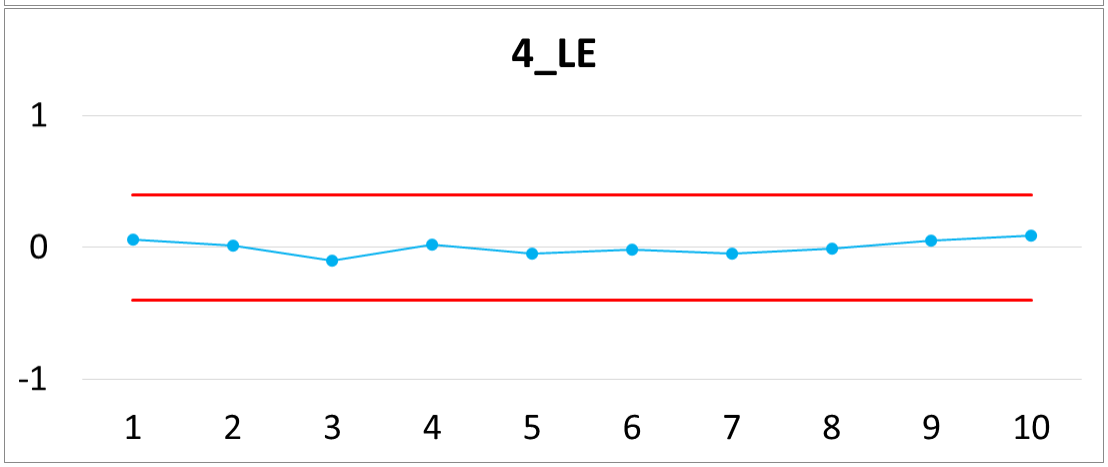
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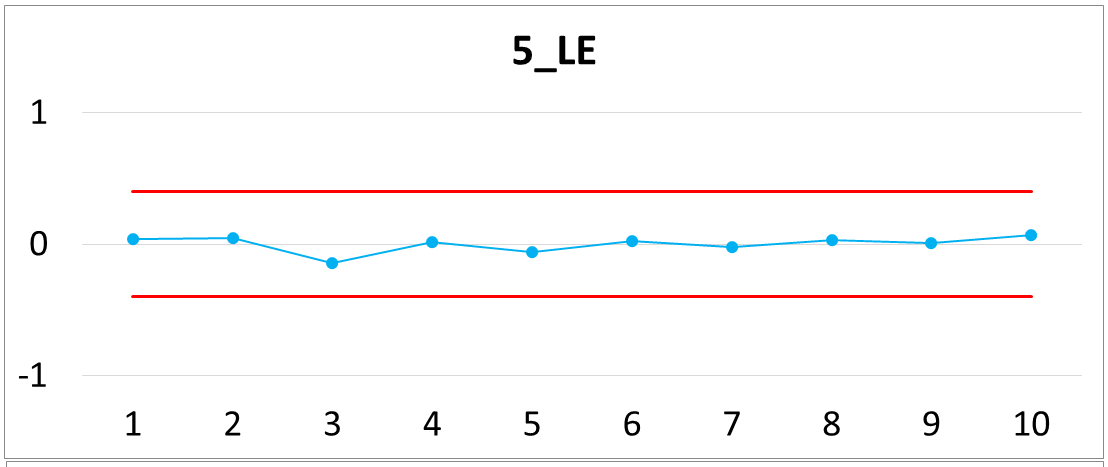
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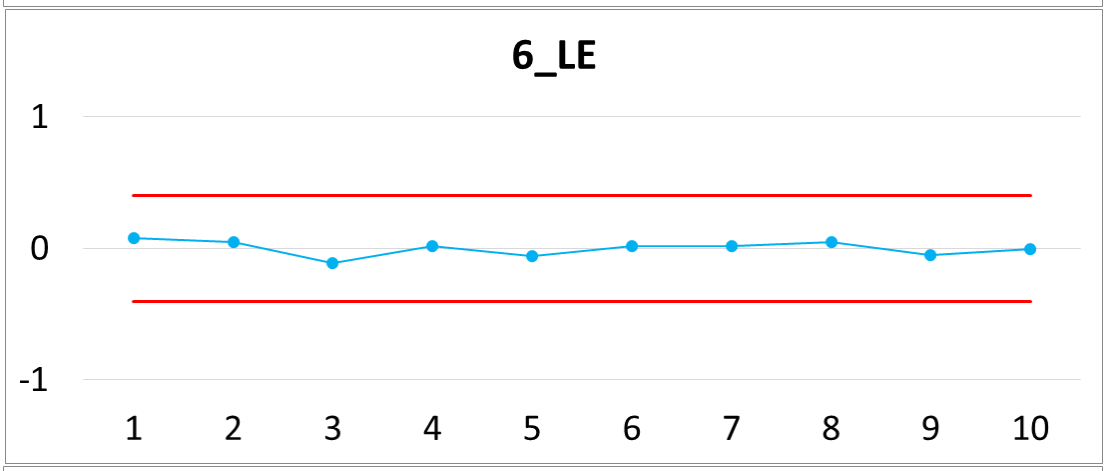
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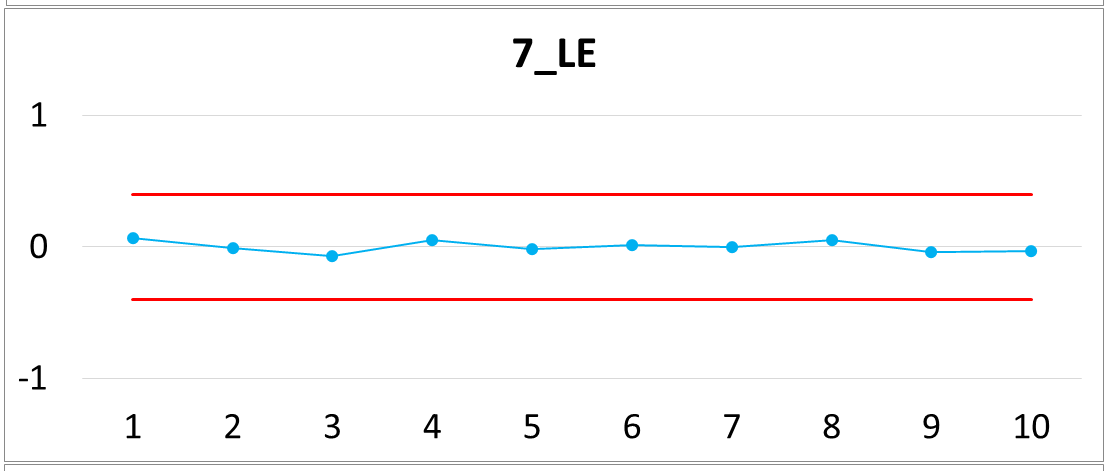
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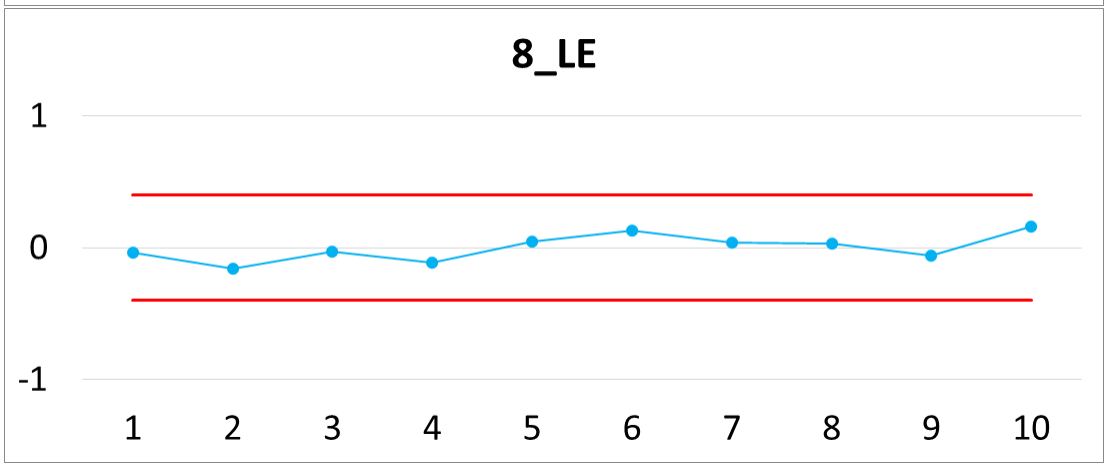
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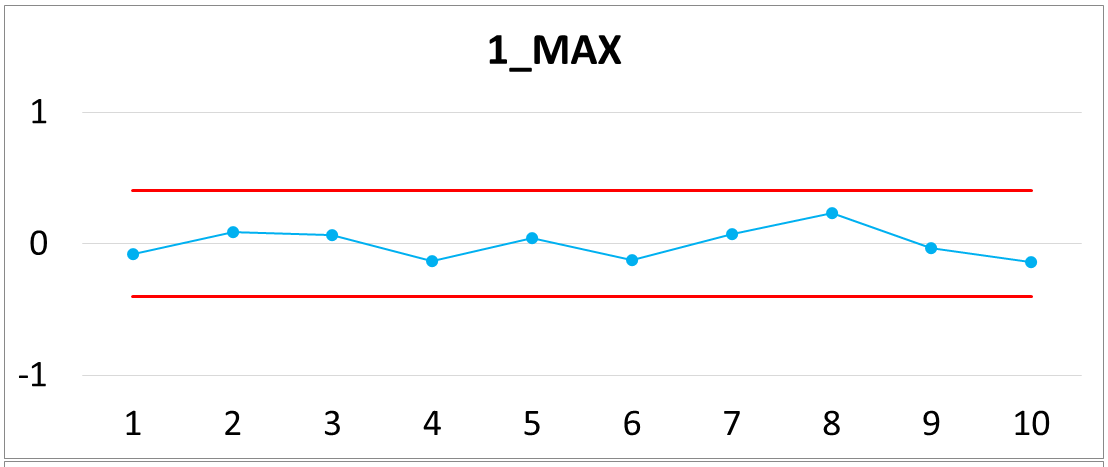
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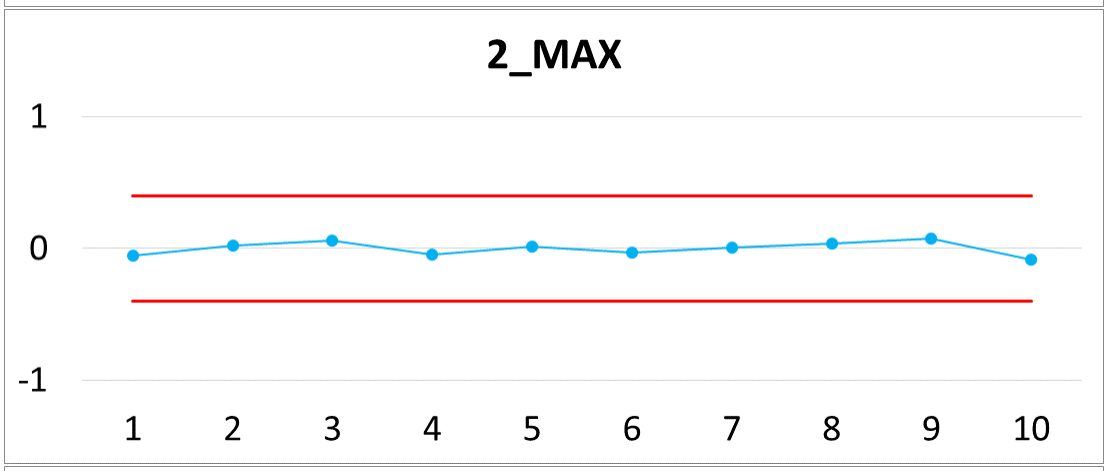
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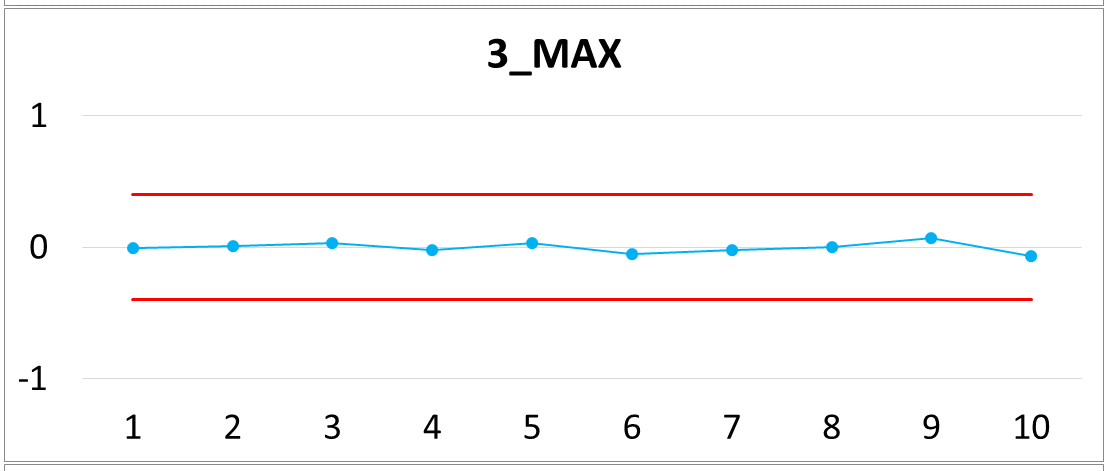
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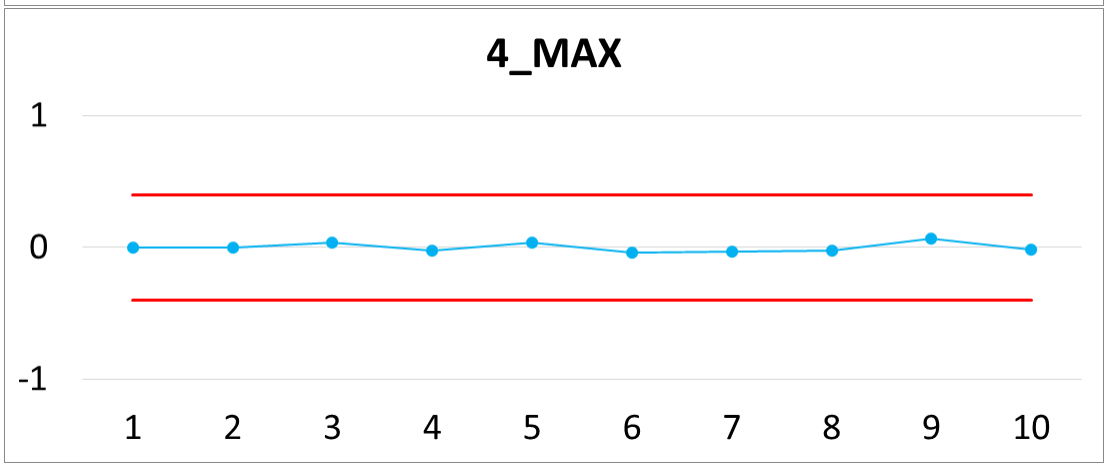
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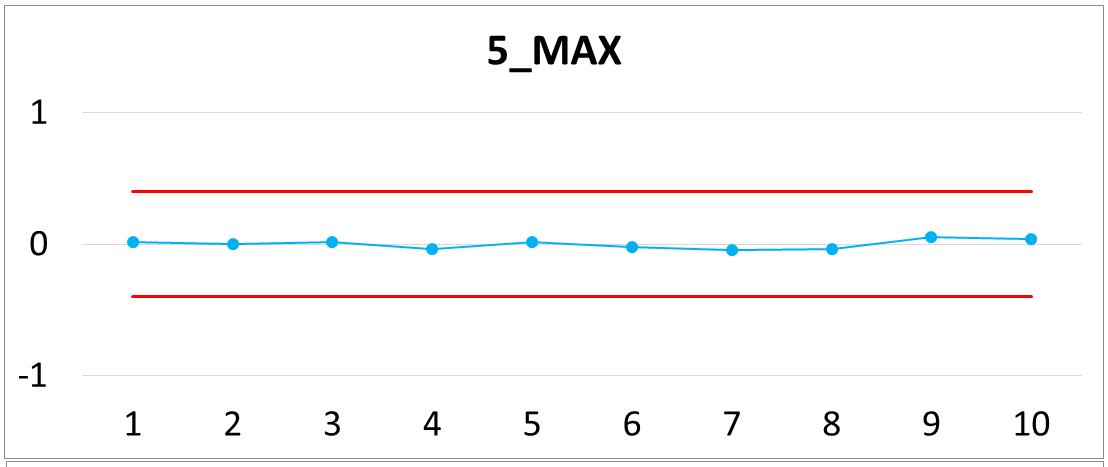
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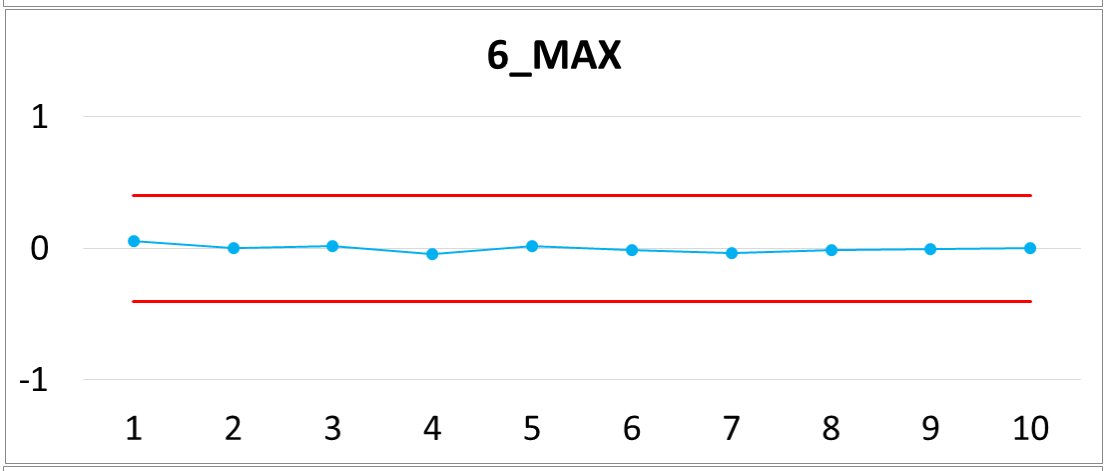
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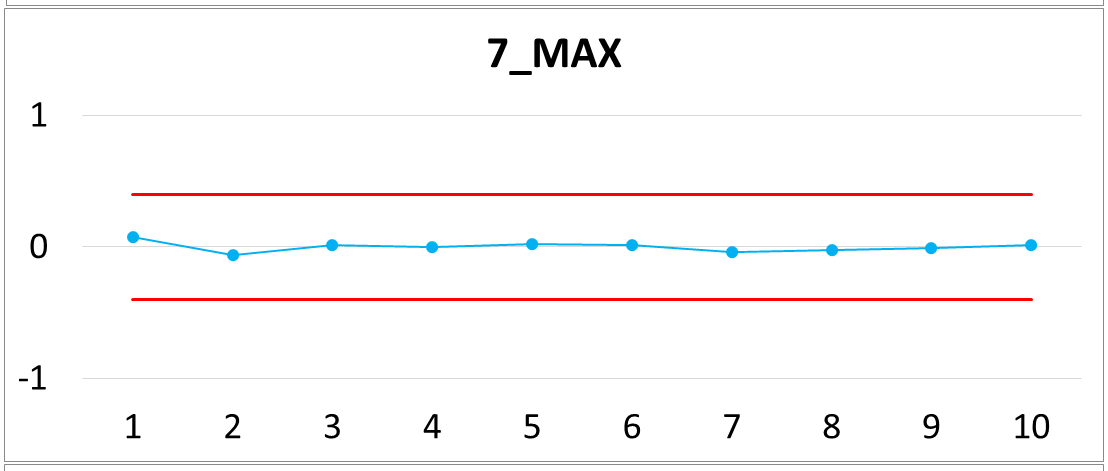
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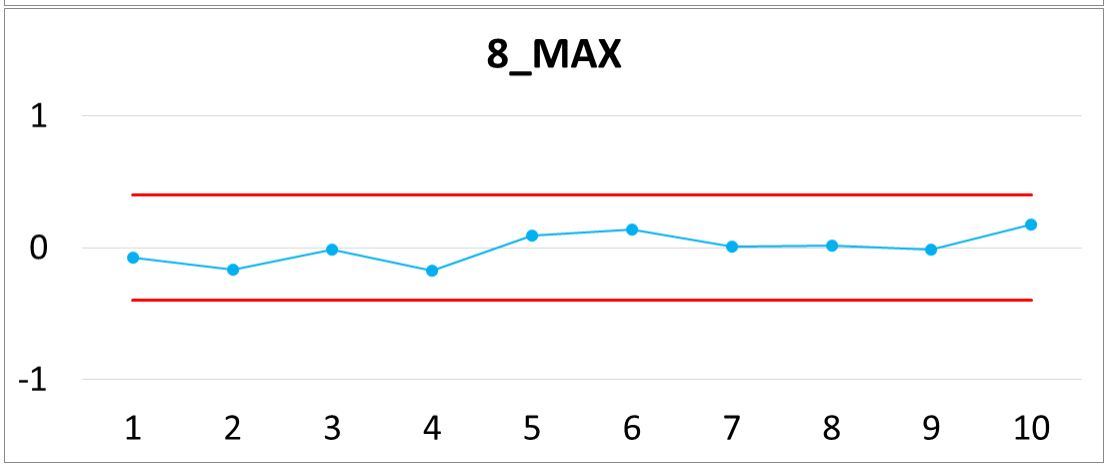
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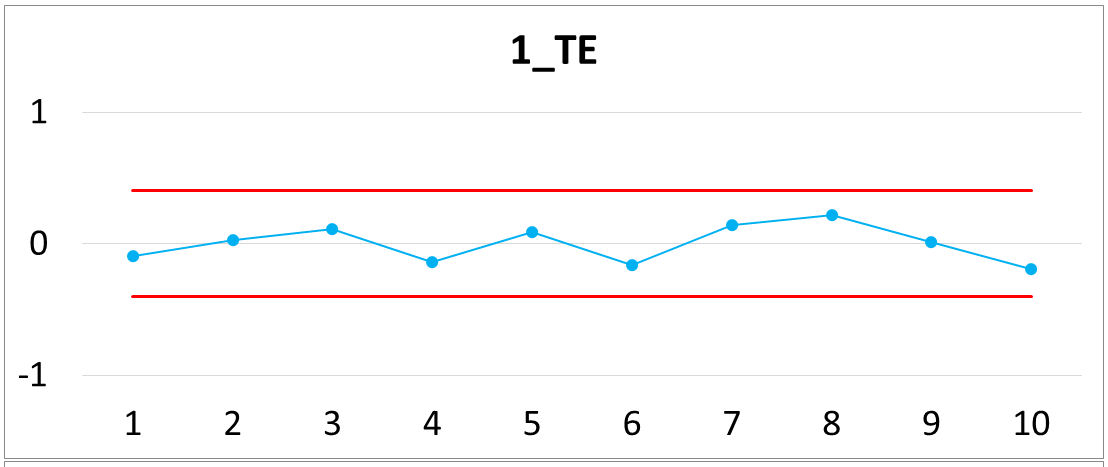
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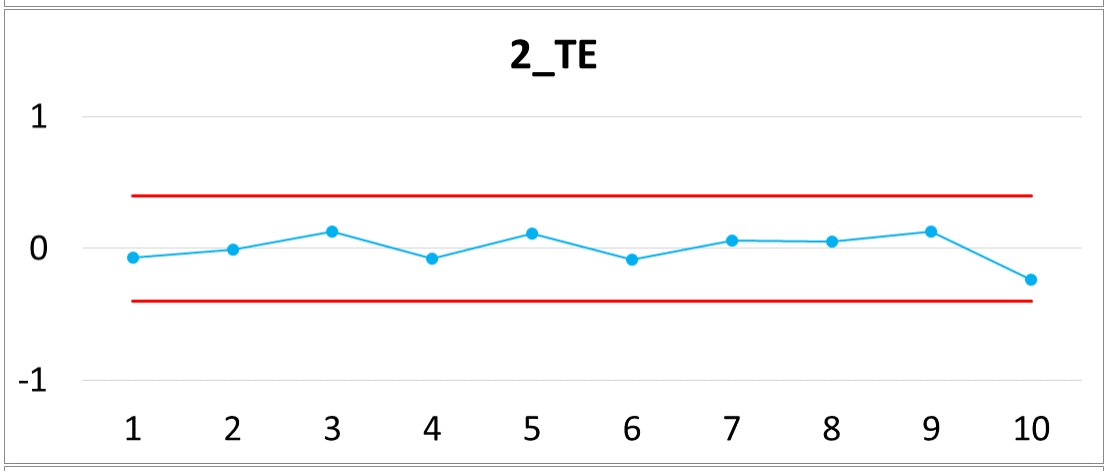
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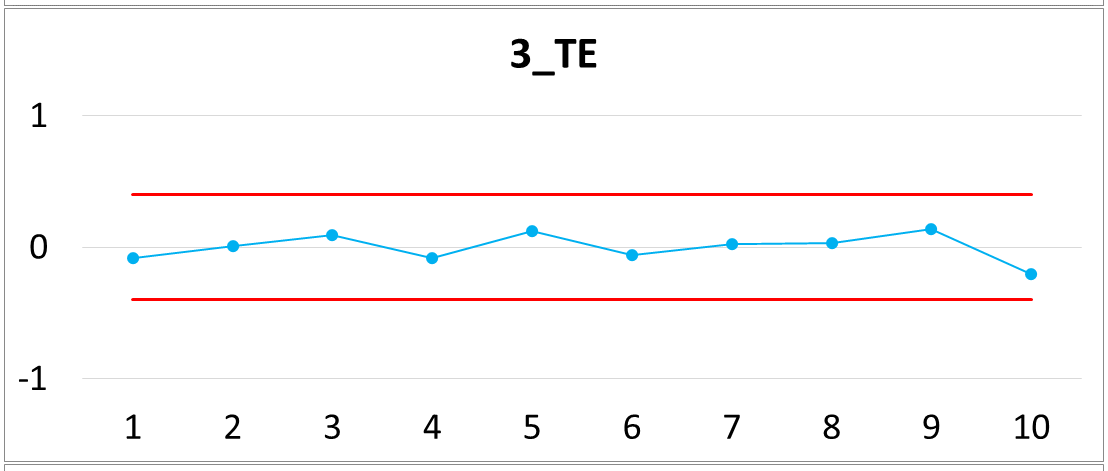
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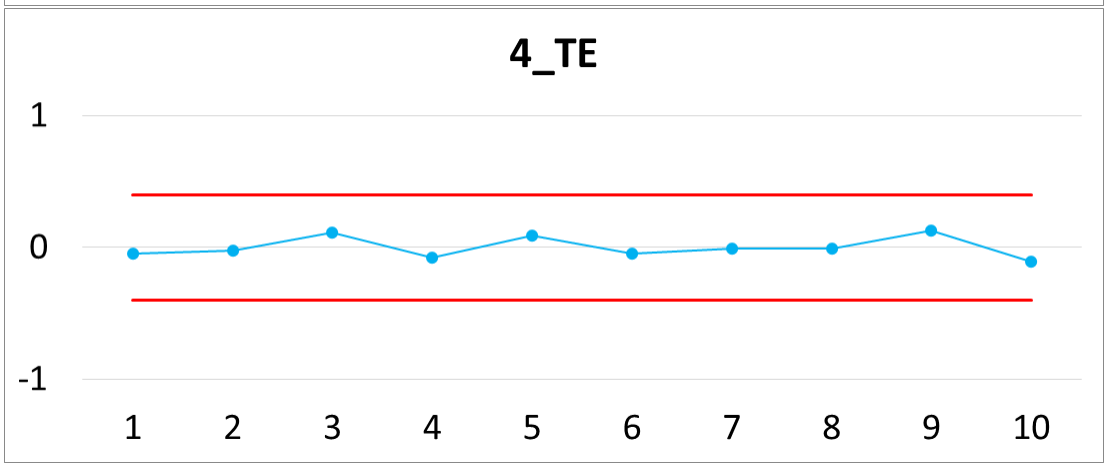
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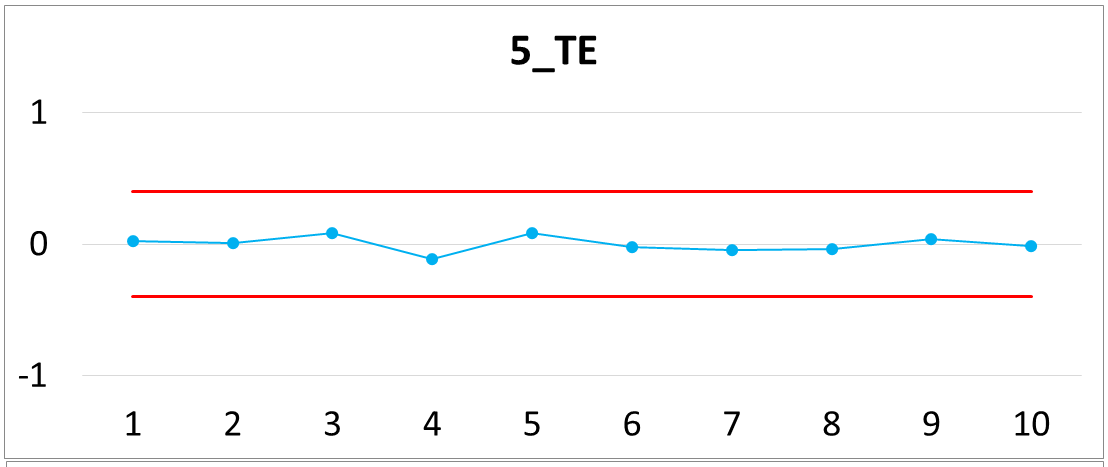
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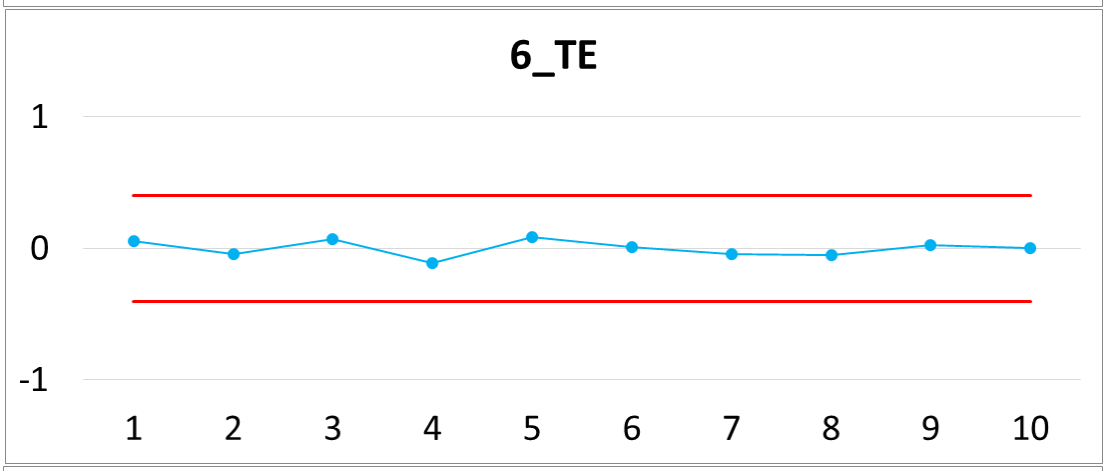
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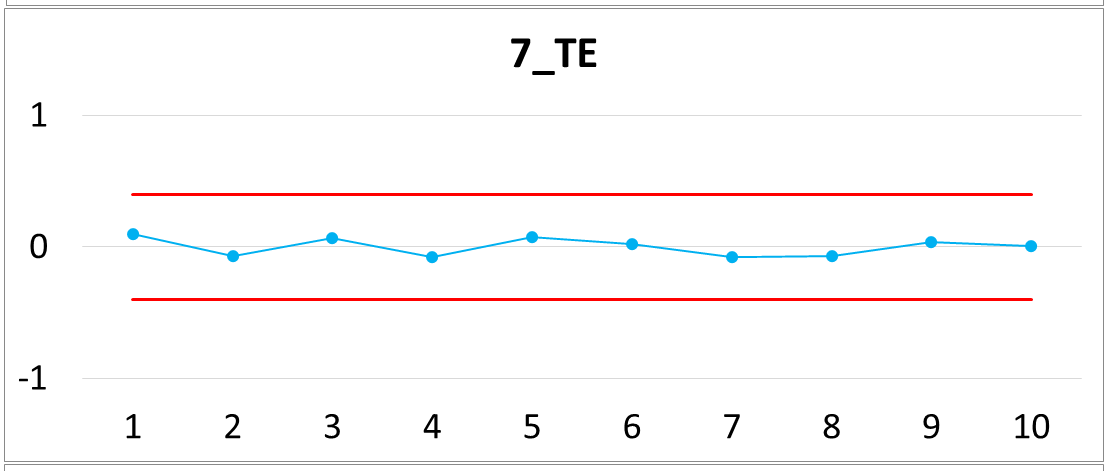
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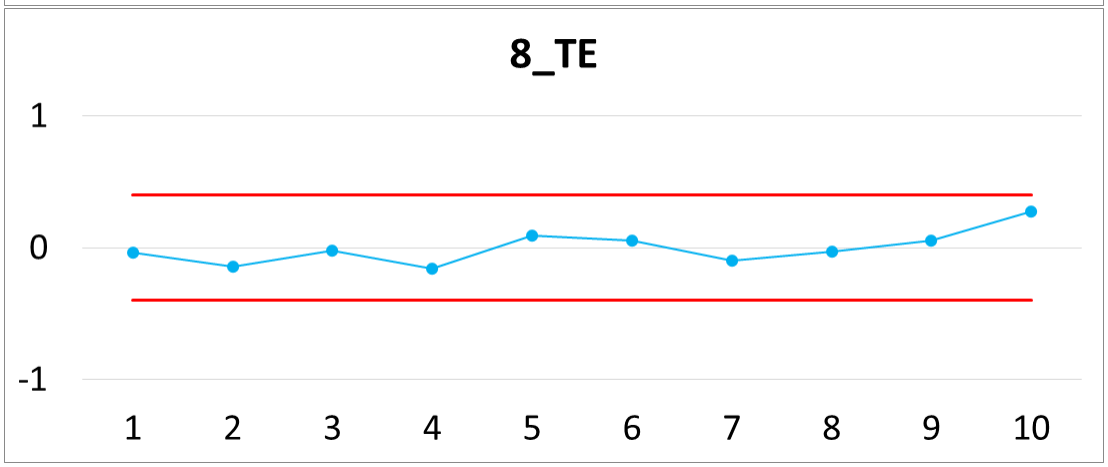
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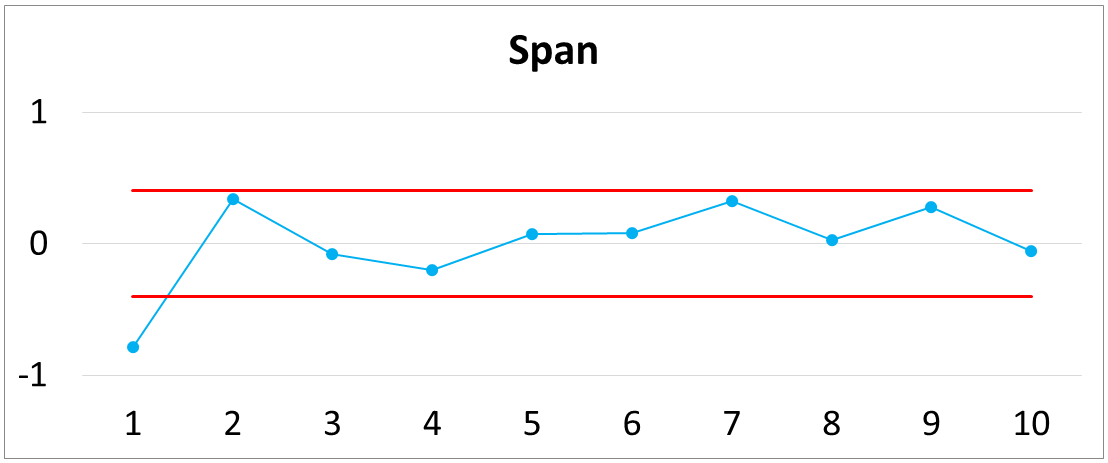
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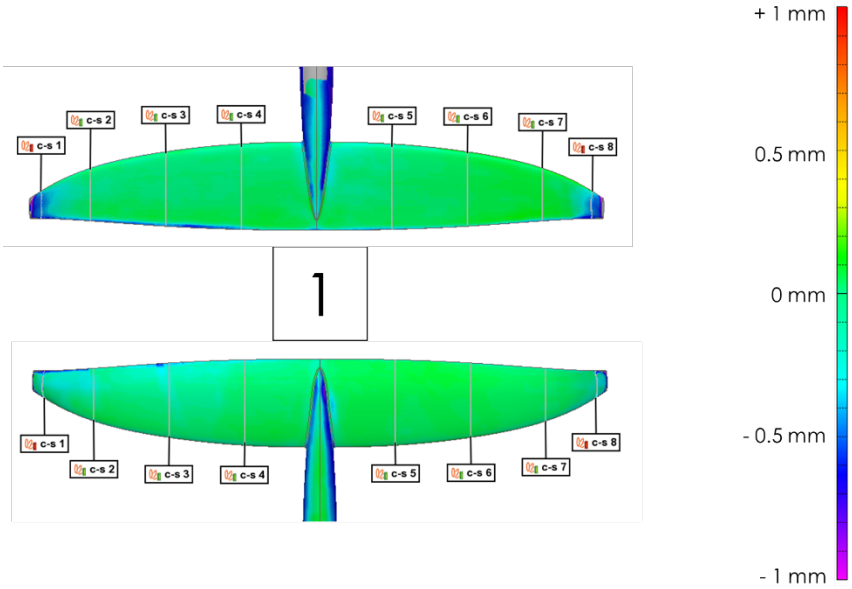
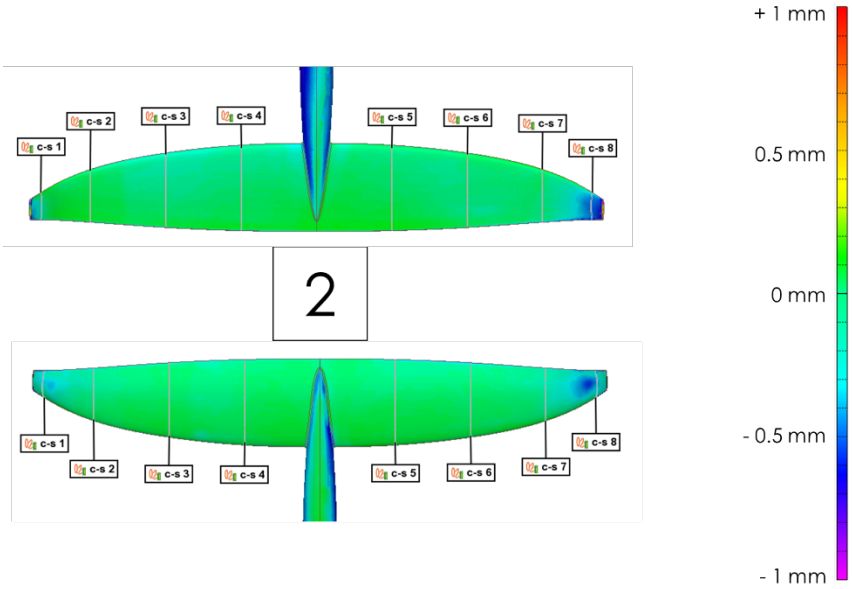
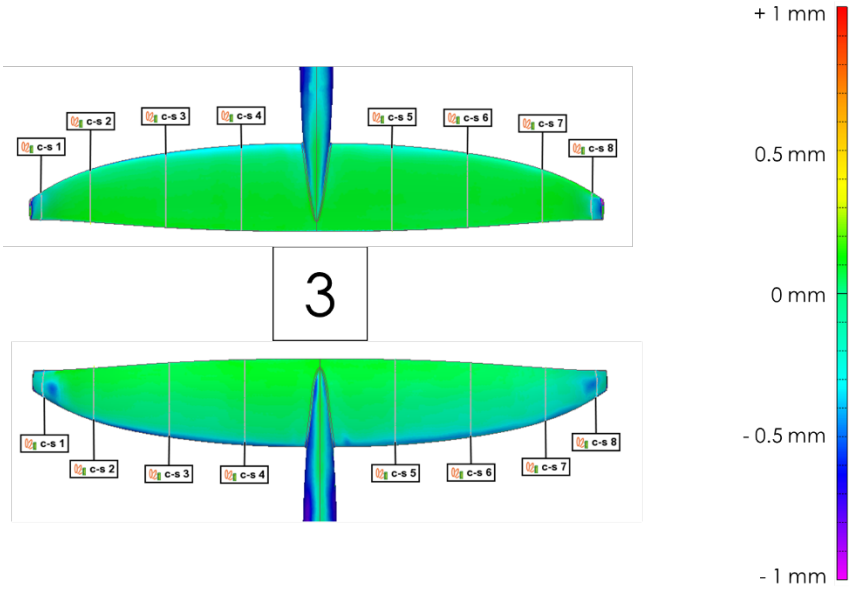
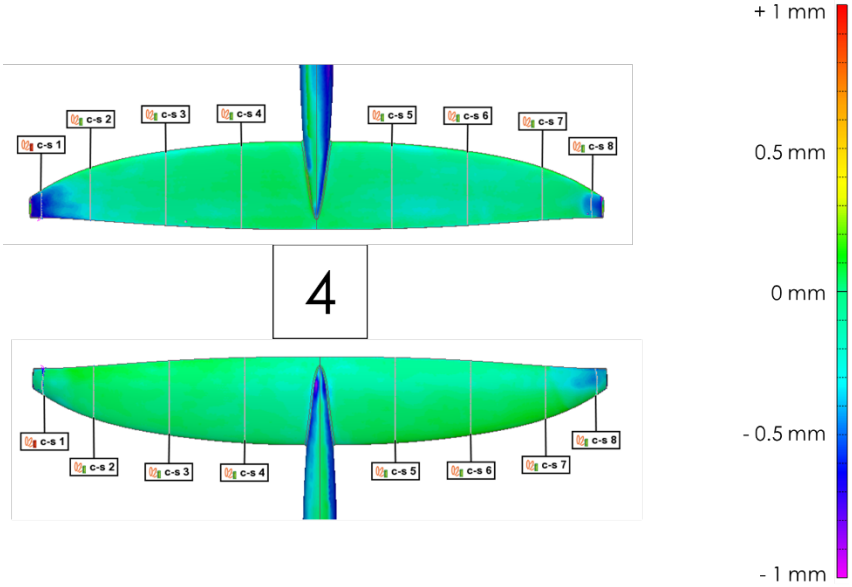
World Sailing Manufacturer Control System

Scanner Report: IKA Formula Kite – Chubanga Rearwing V4





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c-s 3
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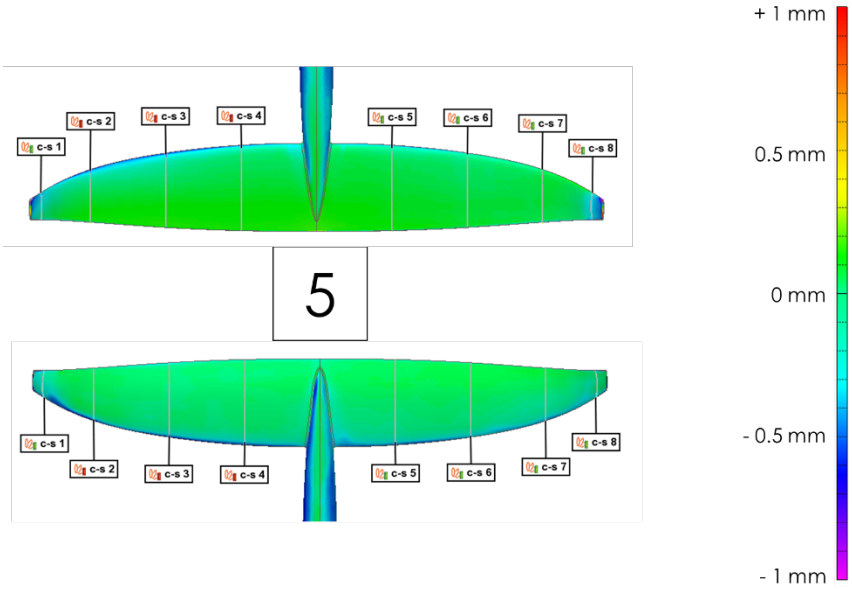
0 mm
- 0.5 mm
- 1 mm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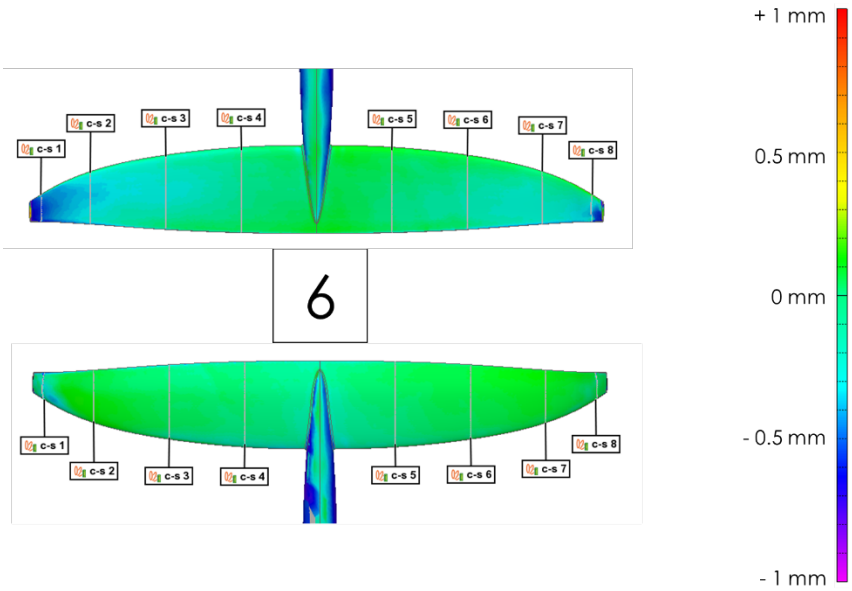
- 1 mm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c-s 2
c-s 3
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c-s 8
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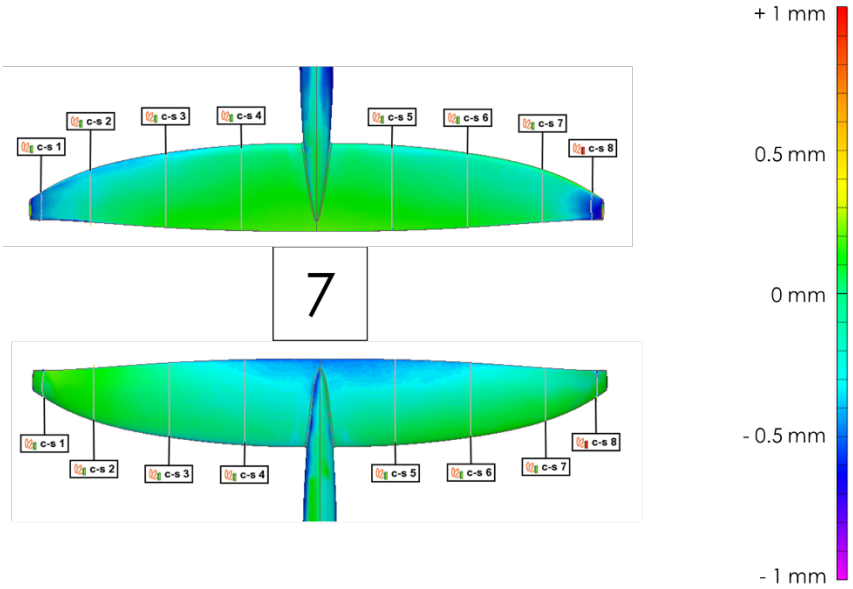
0 mm
- 0.5 mm
- 1 mm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c-s 2
c-s 3
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c-s 6
c-s 7
c-s 8
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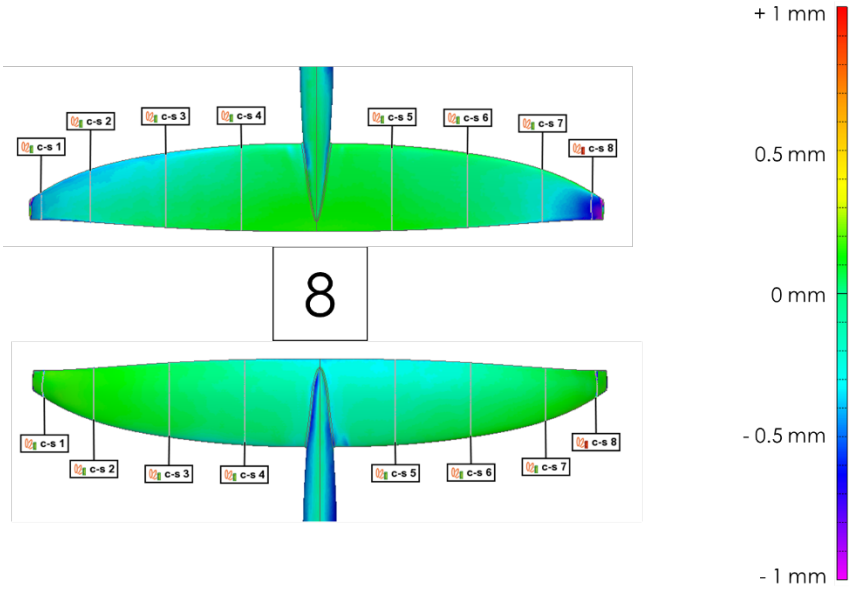
0.5 mm
0 mm
- 0.5 mm
- 1 mm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c-s 2
c-s 3
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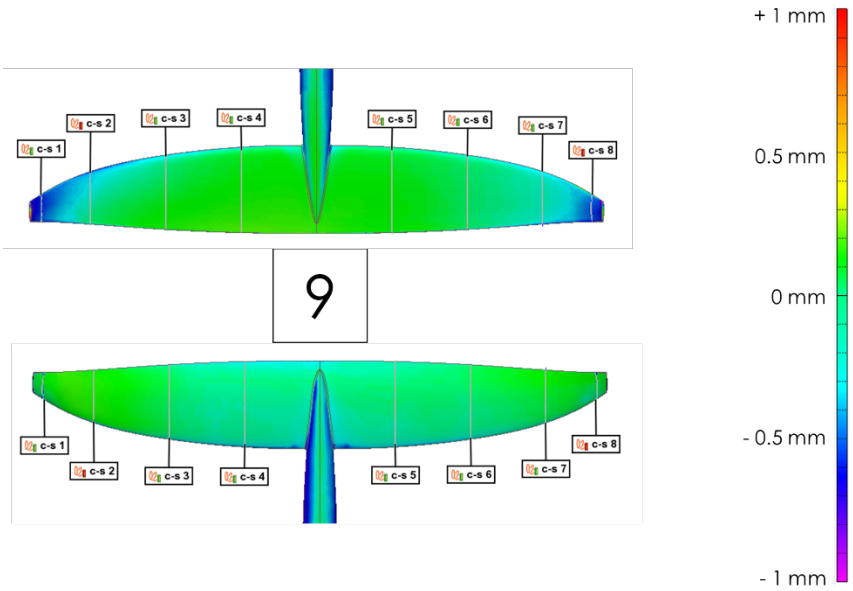
- 1 mm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c-s 3
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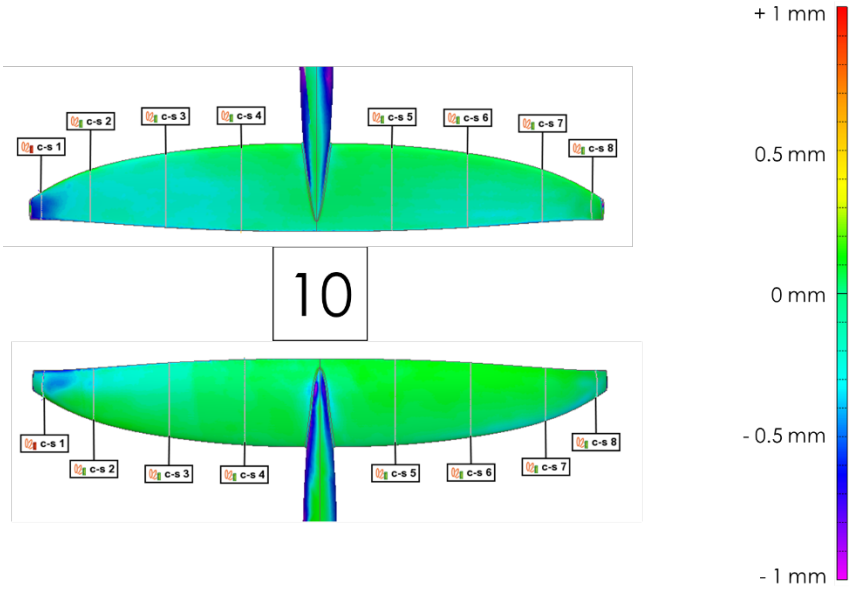
- 0.5 mm
- 1 mm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c-s 2
c-s 3
c-s 4
c-s 5
c-s 6
c-s 7
c-s 8
+ 1 mm
0.5 mm
0 mm
- 0.5 mm
- 1 mm