



## 1 Background

- 1.01 This document describes the measurement reports from the wheel profiles of ten wheel set assemblies (WSAs).
- 1.02 The ten WSAs were inspected as part of NTSB's investigation into the October 12, 2021 derailment of a WMATA 7000 series car, the derailment occurring between the Rosslyn and Arlington Cemetery Metro stops on Metro's Blue Line.
- 1.03 This report provides only data relative to the measurement of the wheel profiles. It does not contain any analysis with the exception of that noted in 1.04 through 1.07.
- 1.04 The wheel flanges of both wheels from the derailed wheel set showed extreme wear in comparison to the other wheels contained in this report.
- 1.05 They showed, also, extreme flange wear in comparison to the two wheels of the other wheel set in the derailed truck.
- 1.06 While Calipri measurements for the other two wheels were not taken, manual measurements using a standard AAR finger gage were taken. The derailed wheels showed flange wear in excess of 5/8" greater than the flange wear on the other two wheels from the derailed truck.
- 1.07 Note that the AAR finger gage does not measure flange thickness directly. Rather, it determines the amount of metal, in 1/16s of an inch, that must be removed from a wheel in order to restore the wheel to a full flange contour.

## 2 Measuring Device

- 2.01 We measured 20 wheel profiles using a NextSense Calipri TZ24 (C42) non-contact measuring device.



2.02 The Calipri has the following accuracy.

- 2.02.01 Absolute accuracy <  $\pm 200 \mu\text{m}$
- 2.02.02 Repeatability <  $\pm 100 \mu\text{m}$

2.03 The Calipri was last calibrated prior to the measurements reported herein on October 21, 2021.

2.04 A copy of that calibration is included in Appendix B.

### 3 Measured Wheel Set Assemblies

3.01 The table on the next page outlines the wheel measurements taken.

3.02 The location 'Greenbelt' refers to measurements taken by ORX personnel at WMATA's Greenbelt Rail Yard maintenance facility in College Park, Maryland.

3.03 The location 'ORX' refers to measurements taken by ORX personnel at its wheel shop in Tipton, Pennsylvania.

3.04 The first WSA in the table is the derailed wheel set assembly.

3.05 The WSA column shows ORX's wheel set assembly serial number.

3.06 The last two columns show the wheel serial numbers for the S-side and T-side wheels. The S-side wheel is the wheel on the gearbox side of the axle. The T-side wheel is its mate wheel.



### 3.07 Calipri Wheel Profile Measurements

| REF      | DATE              | LOCATION         | WSA         | S WHL SN    | T WHL SN    |
|----------|-------------------|------------------|-------------|-------------|-------------|
| <i>1</i> | <i>2021-10-27</i> | <i>Greenbelt</i> | <i>0879</i> | <i>2841</i> | <i>2833</i> |
| 2        | 2021-10-26        | Greenbelt        | 0903        | 2808        | 2864        |
| 3        | 2021-10-26        | Greenbelt        | 1567        | 3836        | 4024        |
| 4        | 2021-10-26        | Greenbelt        | 1878        | 3475        | 3579        |
| 5        | 2021-10-27        | ORX              | 0676        | 1456        | 1412        |
| 6        | 2021-10-27        | ORX              | 0694        | 1420        | 1451        |
| 7        | 2021-10-27        | ORX              | 1460        | 2079        | 2316        |
| 8        | 2021-10-27        | ORX              | 2063        | 4407        | 4379        |
| 9        | 2021-10-27        | ORX              | 2075        | 4251        | 4242        |
| 10       | 2021-10-27        | ORX              | 2935        | 6132        | 6315        |

## 4 Calipri Reports

4.01 The Calipri-generated reports for each wheel set are included in Appendix A.

4.02 Each Calipri report contains four pages.

4.03 The first page of each report is a title page.

4.04 The second page of the report shows a WSA view with the four measured values.

4.04.01 Fh = flange height

4.04.02 Fw = flange width

4.04.03 FAI = flange angle

4.04.04 W = flange width

4.05 The ORX wheel set assembly number is shown below the WSA graphic.



- 4.06 At the top of page 3, the wheel serial number, labeled 'Wheel Number', is shown, preceded by the side of the axle on which it was mounted, i.e., S or T.
- 4.07 This page shows graphically the new wheel profile (green) and the measured profile (blue). The red 'whiskers' along the new wheel profile have lengths proportional to the deviation of the measured profile from the new wheel profile.
- 4.08 Each whisker is shown at a 3X scale, i.e., three times its actual deviation from the new wheel profile.
- 4.09 Whiskers are not shown for deviations less than 0.010".
- 4.10 The two wheel profiles, new and worn (measured), are aligned at their tapping lines, 2.844" from the back face of the wheel.
- 4.11 The profile axes have units of inches.
- 4.12 Below the graphic is a summary of the measurements recorded. The "OK" range is the range established by the specification for the new wheel profile.
- 4.13 Measurements outside of the established "OK" range are red. Measurements within the "OK" range are green.
- 4.14 Page 4 is for the mate wheel of the wheel set assembly and follows the same structure as that described above for page 3.

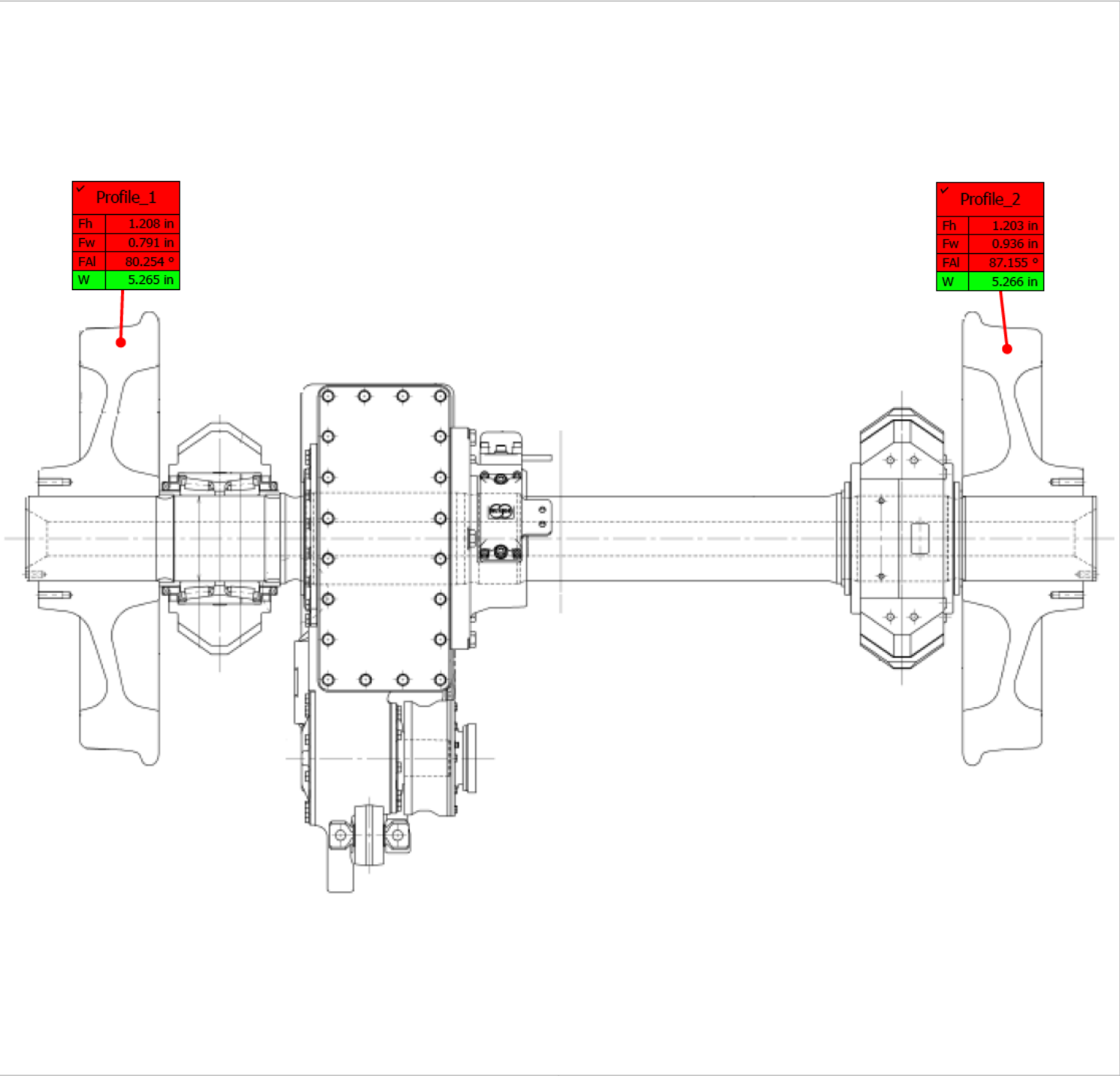


# APPENDIX A

## Calipri Wheel Profile Reports (40 pages)

# WMATA.7000

# WSA\_Measure

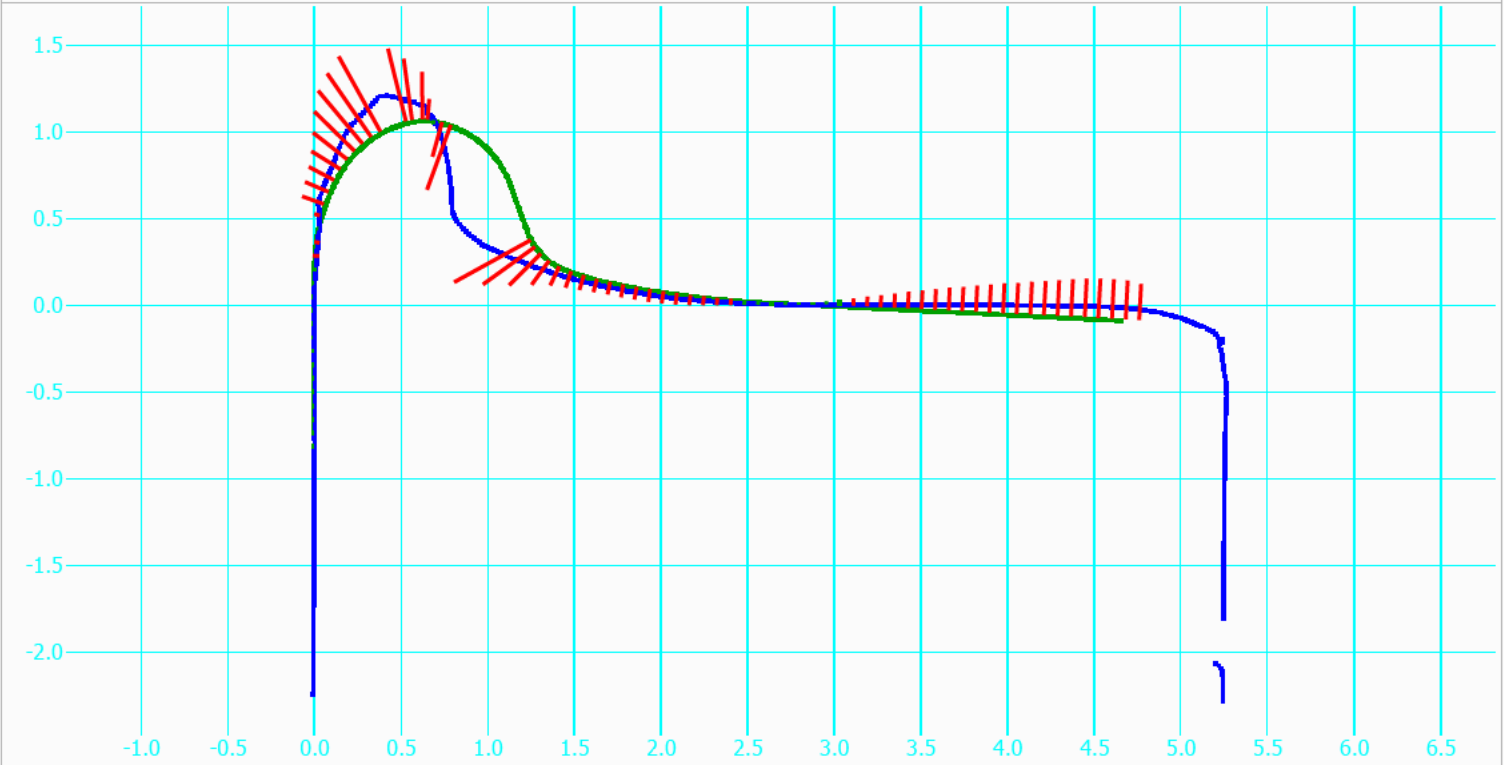


|            |      |
|------------|------|
| WSA Number | 0879 |
|------------|------|

Profile\_1

|              |        |
|--------------|--------|
| Wheel Number | T 2833 |
|--------------|--------|

Profile Compare DevPlot-Exaggeration: 3.0000 DevPlot-Tolerance: 0.0100



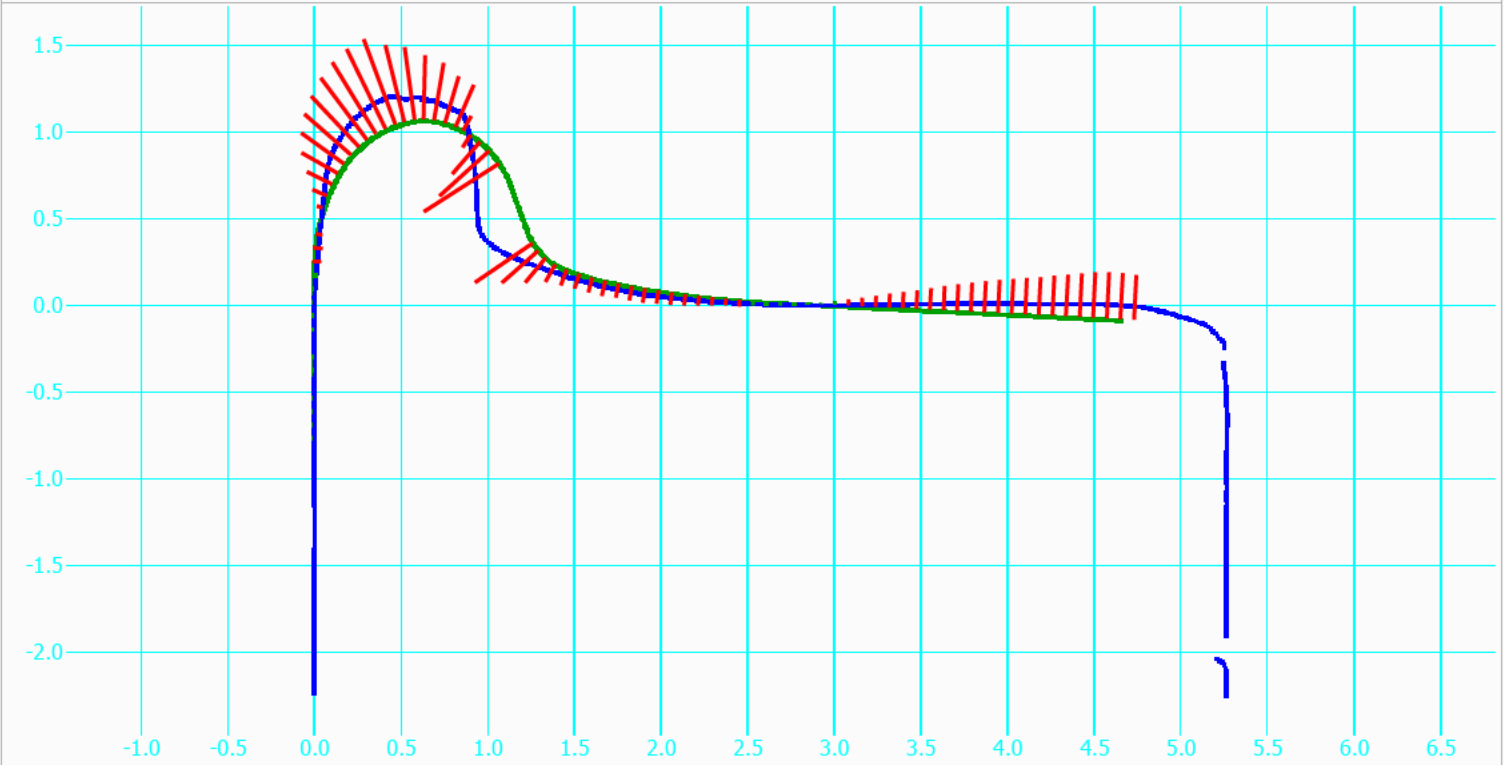
| Dimension     | Name | Measurement result (Rating) |
|---------------|------|-----------------------------|
|               |      | Tolerance class: min-max    |
| Flange height | Fh   | 1.208 in (Rejected)         |
|               |      | OK: 1.000 - 1.063           |
| Flange width  | Fw   | 0.791 in (Rejected)         |
|               |      | OK: 1.156 - 1.218           |
| Flange angle  | FAI  | 80.254 ° (Rejected)         |
|               |      | OK: 69.500 - 70.500         |
| Width         | W    | 5.265 in (OK)               |
|               |      | OK: 5.125 - 5.375           |



Profile\_2

|              |        |
|--------------|--------|
| Wheel Number | S 2841 |
|--------------|--------|

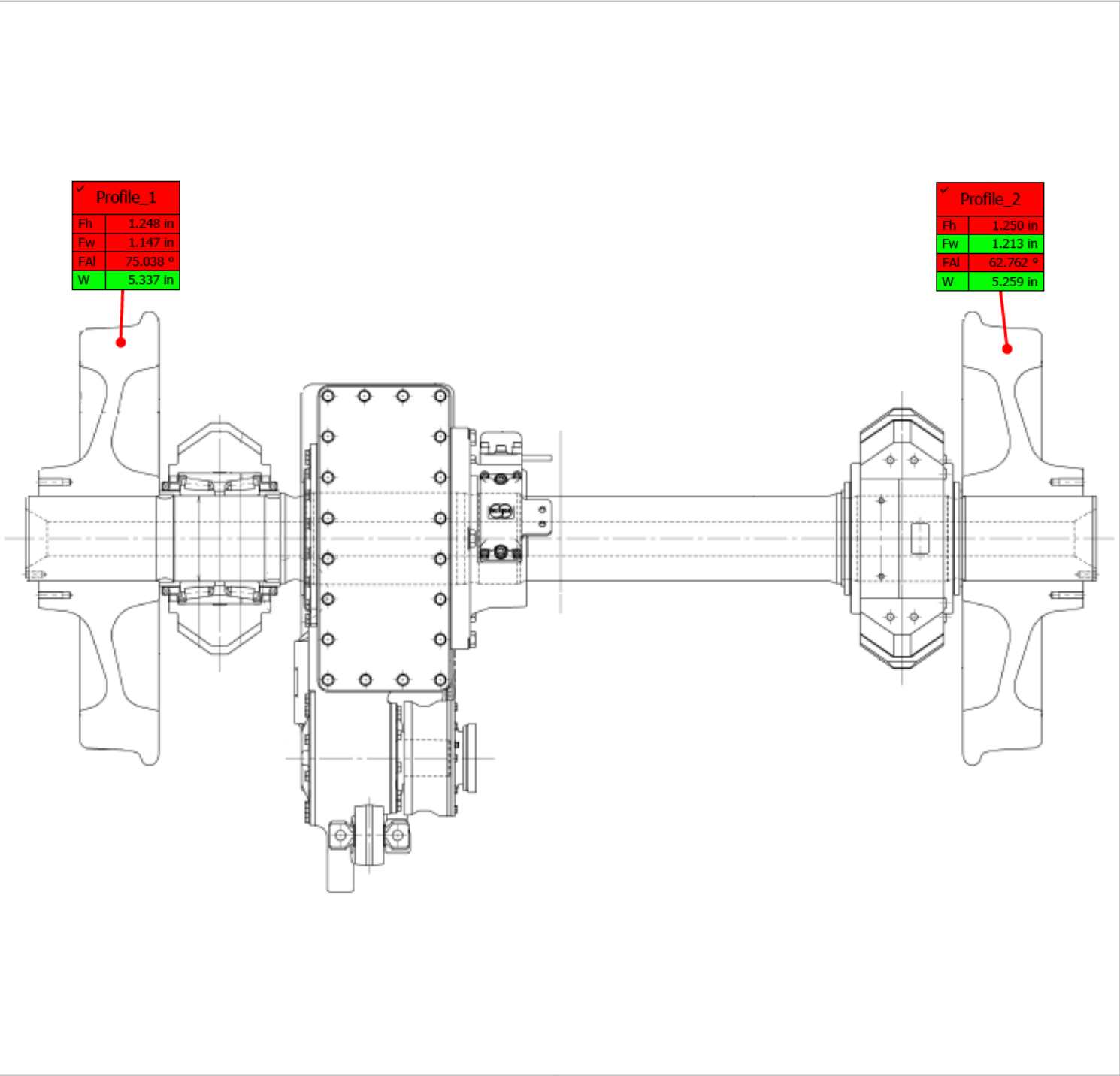
Profile Compare DevPlot-Exaggeration: 3.0000 DevPlot-Tolerance: 0.0100



| Dimension     | Name | Measurement result (Rating) |
|---------------|------|-----------------------------|
|               |      | Tolerance class: min-max    |
| Flange height | Fh   | 1.203 in (Rejected)         |
|               |      | OK: 1.000 - 1.063           |
| Flange width  | Fw   | 0.936 in (Rejected)         |
|               |      | OK: 1.156 - 1.218           |
| Flange angle  | FAI  | 87.155 ° (Rejected)         |
|               |      | OK: 69.500 - 70.500         |
| Width         | W    | 5.266 in (OK)               |
|               |      | OK: 5.125 - 5.375           |

# WMATA.7000

# WSA\_Measure



| Profile_1 |          |
|-----------|----------|
| Fh        | 1.248 in |
| Fw        | 1.147 in |
| FAI       | 75.038 ° |
| W         | 5.337 in |

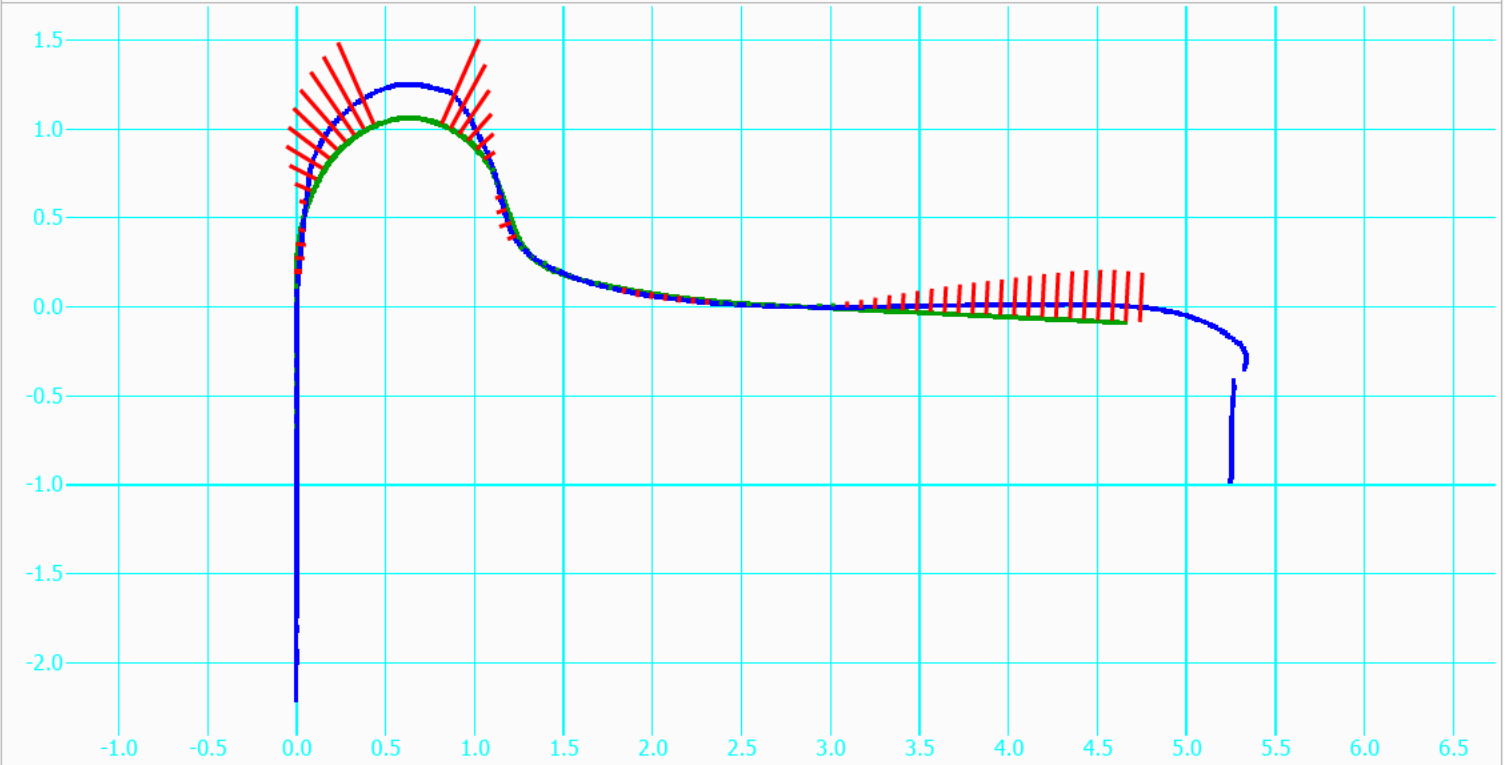
| Profile_2 |          |
|-----------|----------|
| Fh        | 1.250 in |
| Fw        | 1.213 in |
| FAI       | 62.762 ° |
| W         | 5.259 in |

|            |      |
|------------|------|
| WSA Number | 0903 |
|------------|------|

Profile\_1

|              |        |
|--------------|--------|
| Wheel Number | S 2808 |
|--------------|--------|

Profile Compare DevPlot-Exaggeration: 3.0000 DevPlot-Tolerance: 0.0100

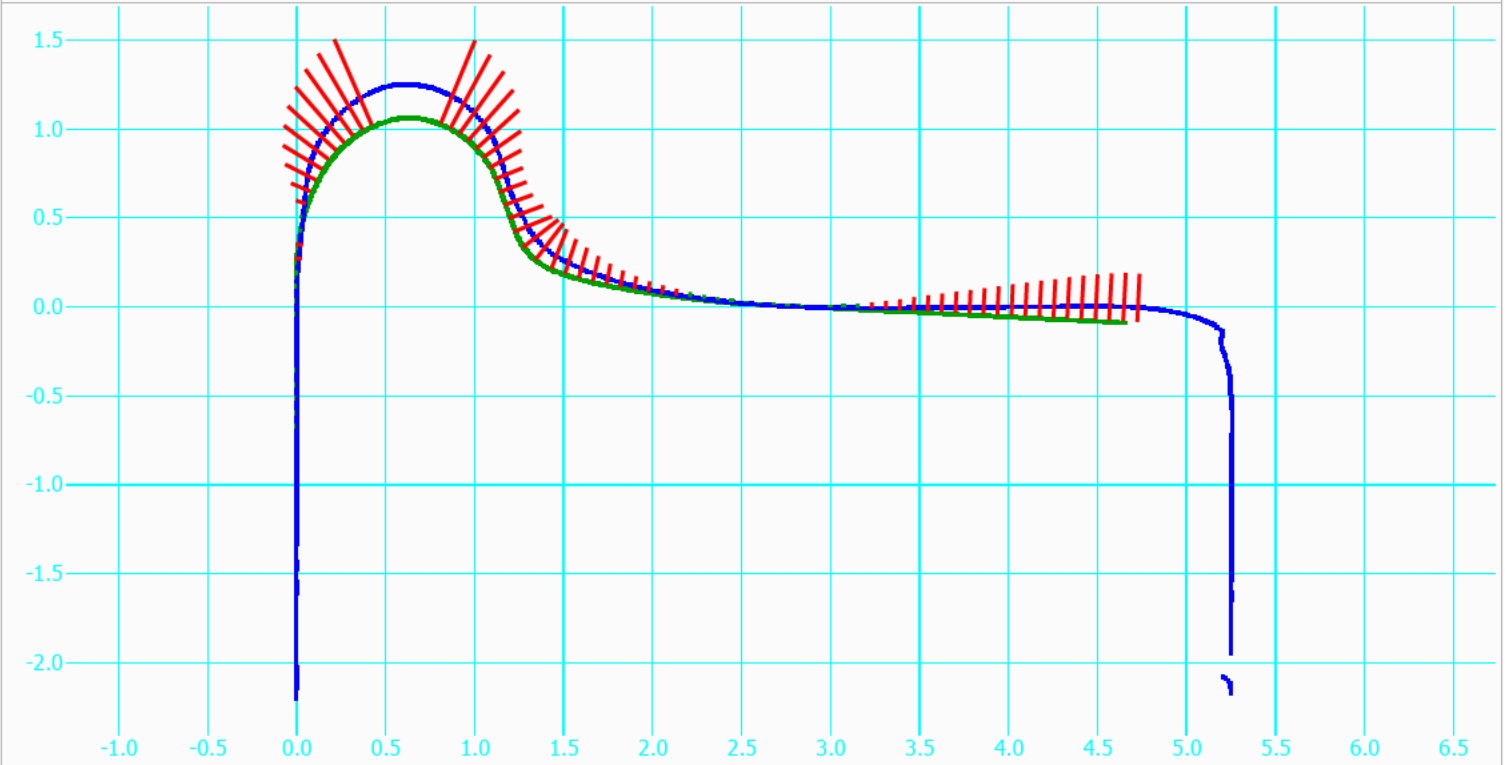


| Dimension     | Name | Measurement result (Rating) |
|---------------|------|-----------------------------|
|               |      | Tolerance class: min-max    |
| Flange height | Fh   | 1.248 in (Rejected)         |
|               |      | OK: 1.000 - 1.063           |
| Flange width  | Fw   | 1.147 in (Rejected)         |
|               |      | OK: 1.156 - 1.218           |
| Flange angle  | FAI  | 75.038 ° (Rejected)         |
|               |      | OK: 69.500 - 70.500         |
| Width         | W    | 5.337 in (OK)               |
|               |      | OK: 5.125 - 5.375           |

Profile\_2

|              |        |
|--------------|--------|
| Wheel Number | T 2864 |
|--------------|--------|

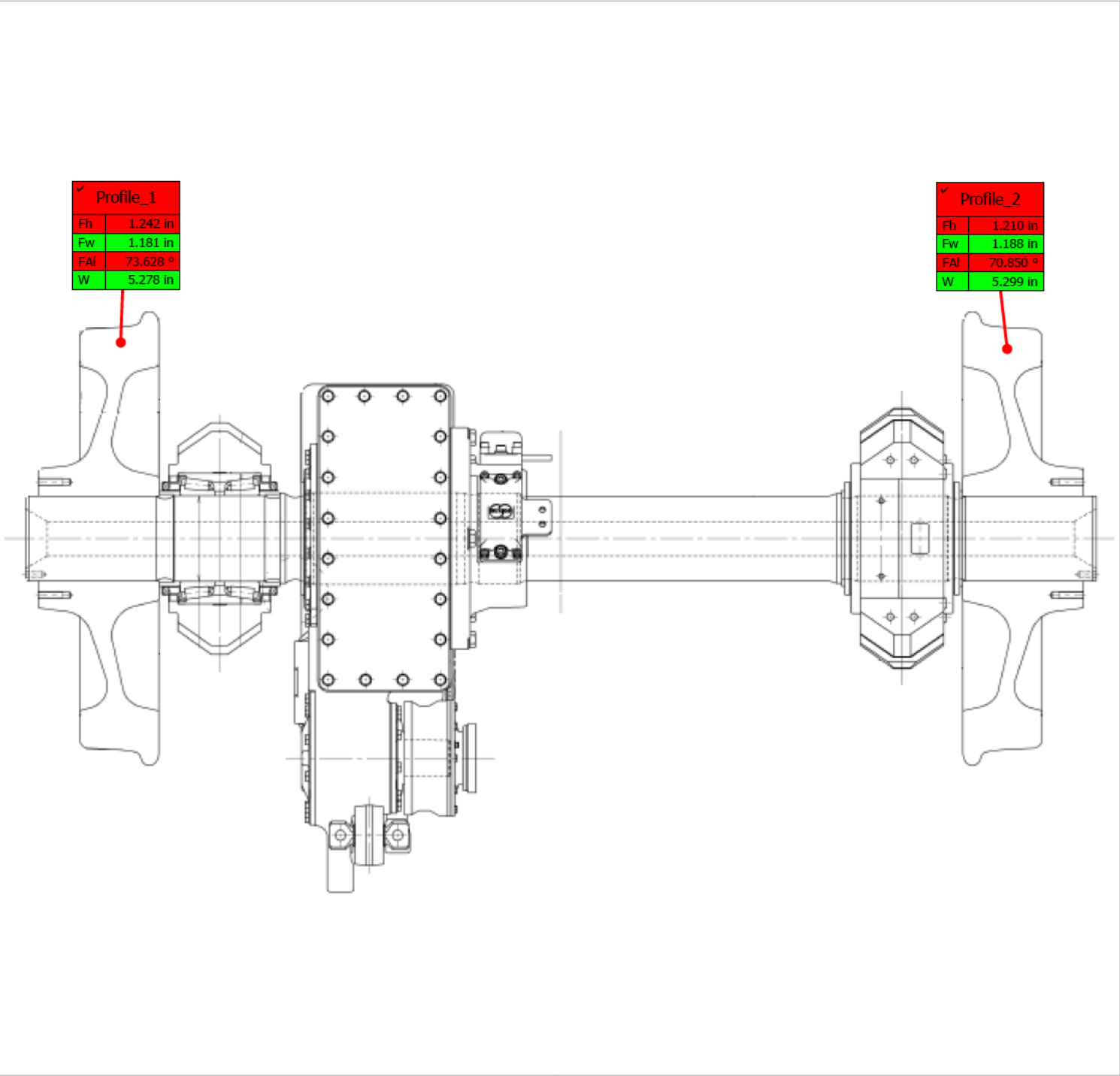
Profile Compare DevPlot-Exaggeration: 3.0000 DevPlot-Tolerance: 0.0100



| Dimension     | Name | Measurement result (Rating) |
|---------------|------|-----------------------------|
|               |      | Tolerance class: min-max    |
| Flange height | Fh   | 1.250 in (Rejected)         |
|               |      | OK: 1.000 - 1.063           |
| Flange width  | Fw   | 1.213 in (OK)               |
|               |      | OK: 1.156 - 1.218           |
| Flange angle  | FAI  | 62.762 ° (Rejected)         |
|               |      | OK: 69.500 - 70.500         |
| Width         | W    | 5.259 in (OK)               |
|               |      | OK: 5.125 - 5.375           |

# WMATA.7000

# WSA\_Measure



| Profile_1 |          |
|-----------|----------|
| Fh        | 1.242 in |
| Fw        | 1.181 in |
| FAI       | 73.628 ° |
| W         | 5.278 in |

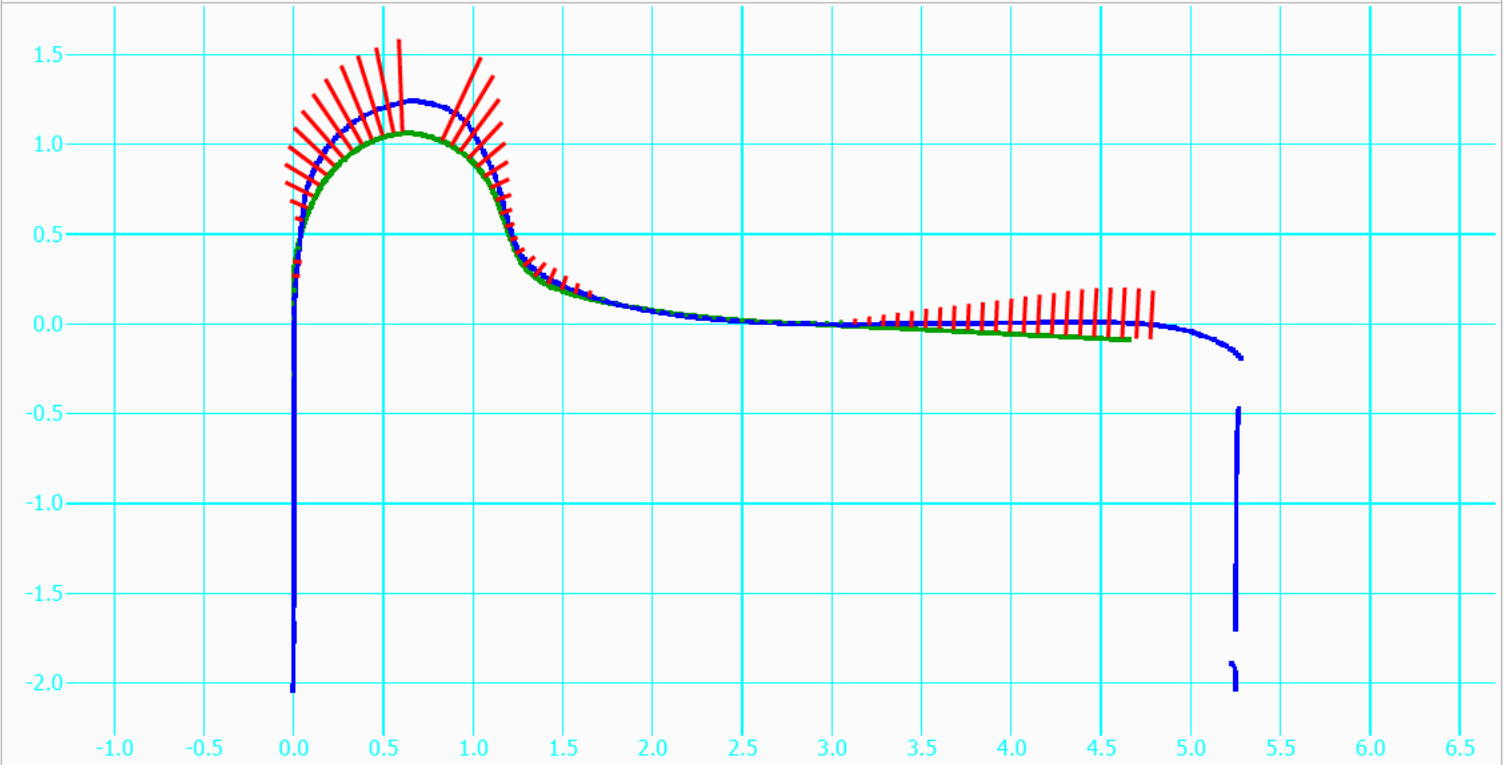
| Profile_2 |          |
|-----------|----------|
| Fh        | 1.210 in |
| Fw        | 1.188 in |
| FAI       | 70.850 ° |
| W         | 5.299 in |

|            |      |
|------------|------|
| WSA Number | 1567 |
|------------|------|

Profile\_1

|              |        |
|--------------|--------|
| Wheel Number | S 3836 |
|--------------|--------|

Profile Compare DevPlot-Exaggeration: 3.0000 DevPlot-Tolerance: 0.0100



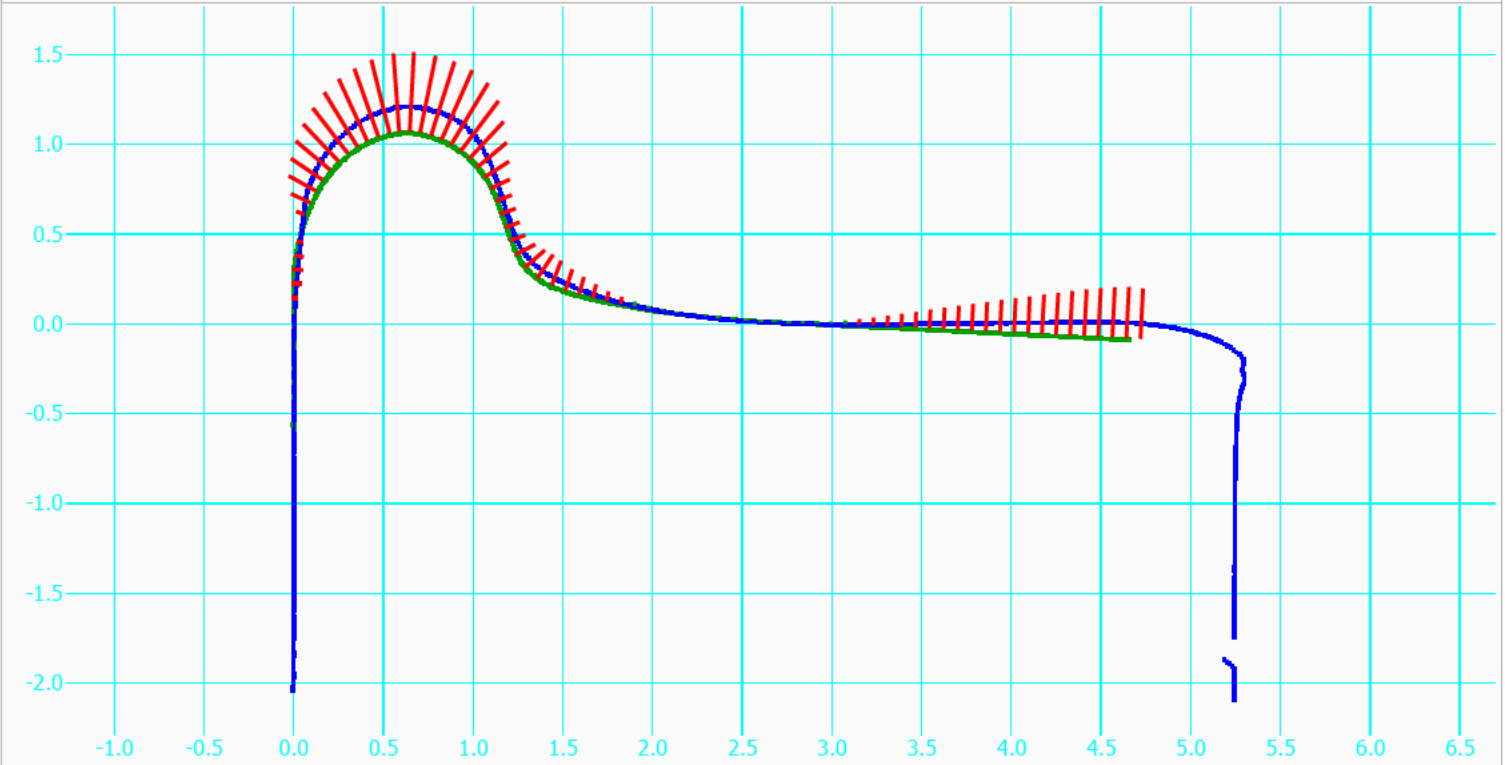
| Dimension     | Name | Measurement result (Rating) |
|---------------|------|-----------------------------|
|               |      | Tolerance class: min-max    |
| Flange height | Fh   | 1.242 in (Rejected)         |
|               |      | OK: 1.000 - 1.063           |
| Flange width  | Fw   | 1.181 in (OK)               |
|               |      | OK: 1.156 - 1.218           |
| Flange angle  | FAI  | 73.628 ° (Rejected)         |
|               |      | OK: 69.500 - 70.500         |
| Width         | W    | 5.278 in (OK)               |
|               |      | OK: 5.125 - 5.375           |



Profile\_2

|              |        |
|--------------|--------|
| Wheel Number | T 4024 |
|--------------|--------|

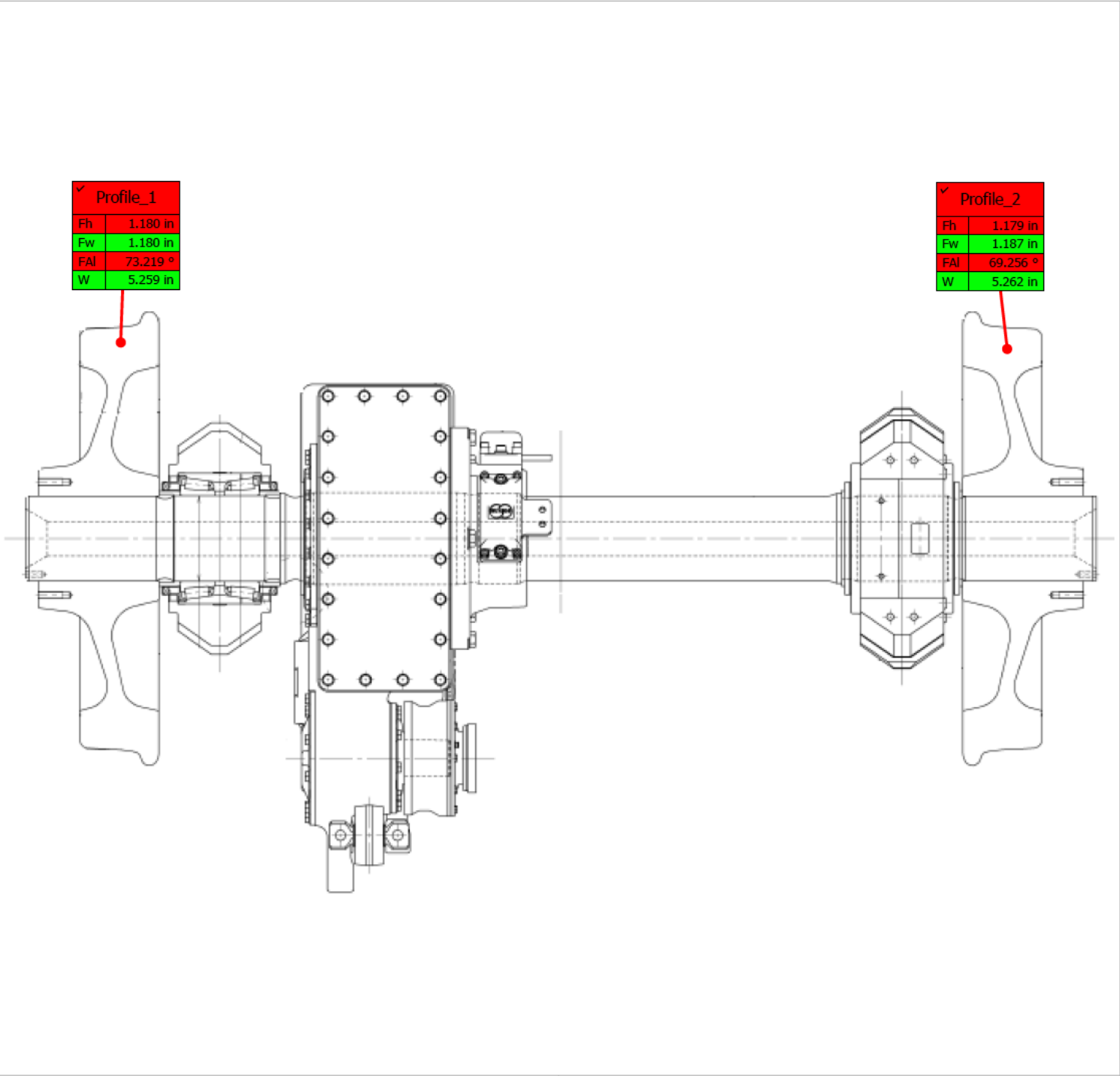
Profile Compare DevPlot-Exaggeration: 3.0000 DevPlot-Tolerance: 0.0100



| Dimension     | Name | Measurement result (Rating) |
|---------------|------|-----------------------------|
|               |      | Tolerance class: min-max    |
| Flange height | Fh   | 1.210 in (Rejected)         |
|               |      | OK: 1.000 - 1.063           |
| Flange width  | Fw   | 1.188 in (OK)               |
|               |      | OK: 1.156 - 1.218           |
| Flange angle  | FAI  | 70.850 ° (Rejected)         |
|               |      | OK: 69.500 - 70.500         |
| Width         | W    | 5.299 in (OK)               |
|               |      | OK: 5.125 - 5.375           |

# WMATA.7000

# WSA\_Measure

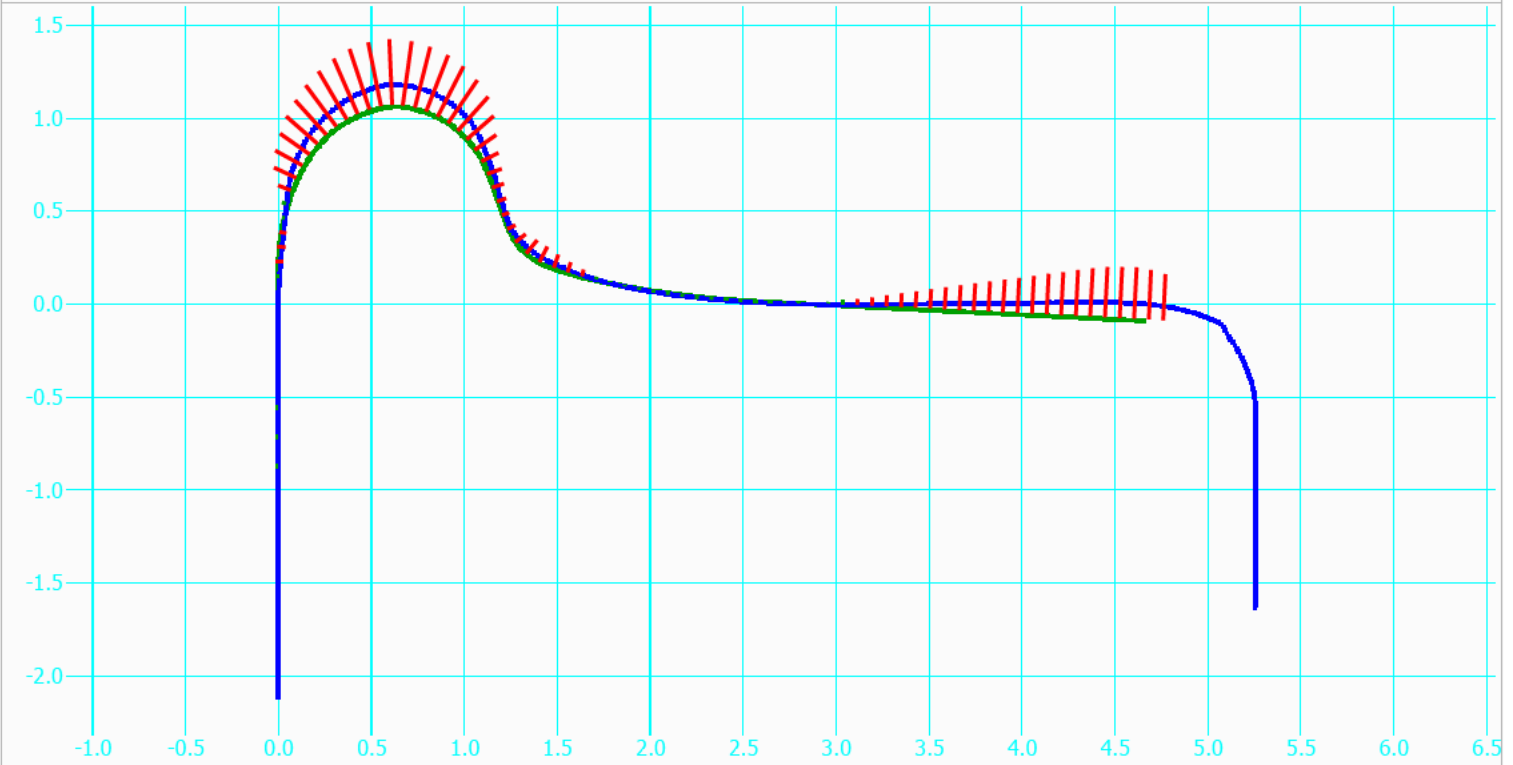


|            |      |
|------------|------|
| WSA Number | 1878 |
|------------|------|

Profile\_1

|              |        |
|--------------|--------|
| Wheel Number | S 3475 |
|--------------|--------|

Profile Compare DevPlot-Exaggeration: 3.0000 DevPlot-Tolerance: 0.0100

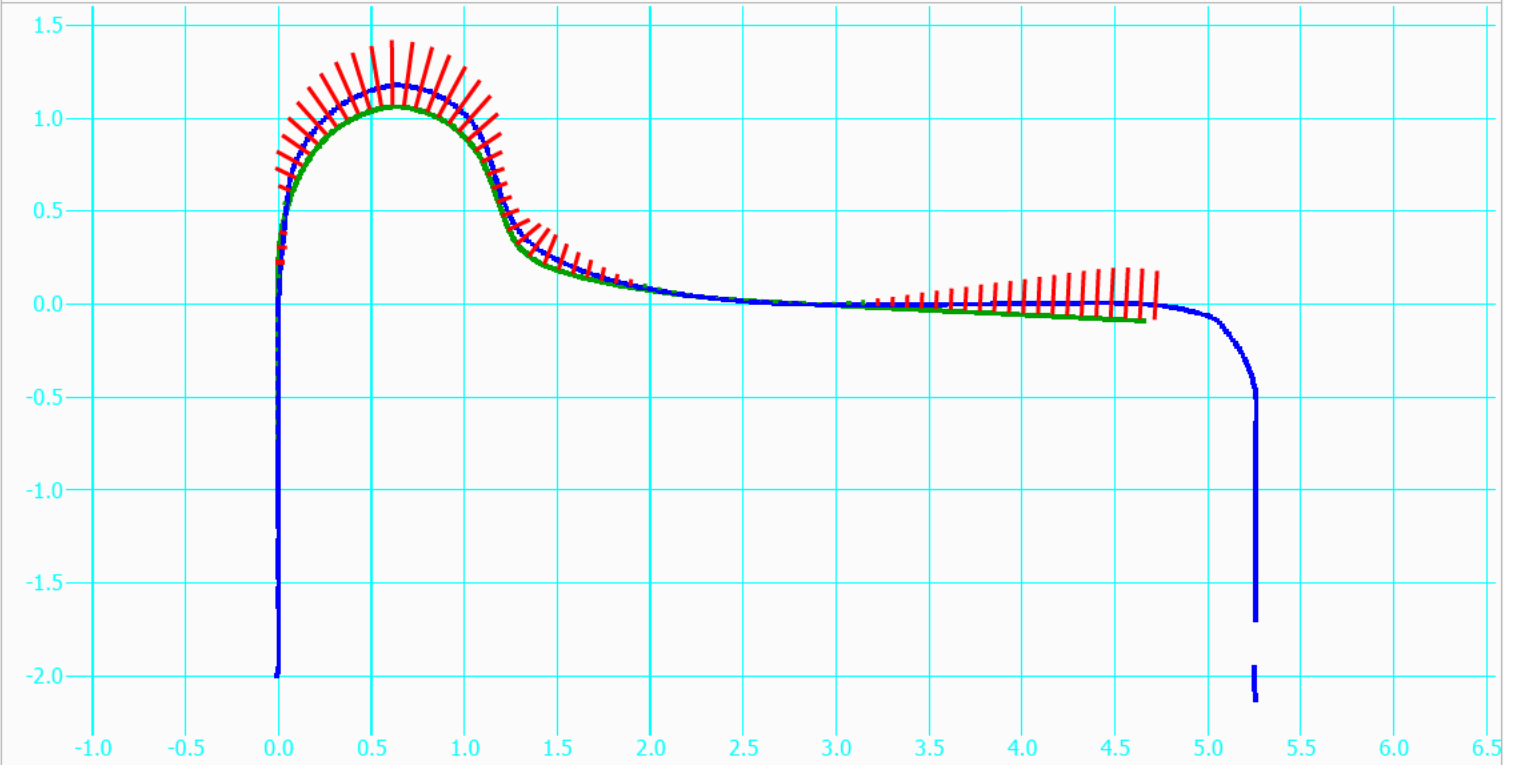


| Dimension     | Name | Measurement result (Rating) |
|---------------|------|-----------------------------|
|               |      | Tolerance class: min-max    |
| Flange height | Fh   | 1.180 in (Rejected)         |
|               |      | OK: 1.000 - 1.063           |
| Flange width  | Fw   | 1.180 in (OK)               |
|               |      | OK: 1.156 - 1.218           |
| Flange angle  | FAI  | 73.219 ° (Rejected)         |
|               |      | OK: 69.500 - 70.500         |
| Width         | W    | 5.259 in (OK)               |
|               |      | OK: 5.125 - 5.375           |

Profile\_2

|              |        |
|--------------|--------|
| Wheel Number | T 3579 |
|--------------|--------|

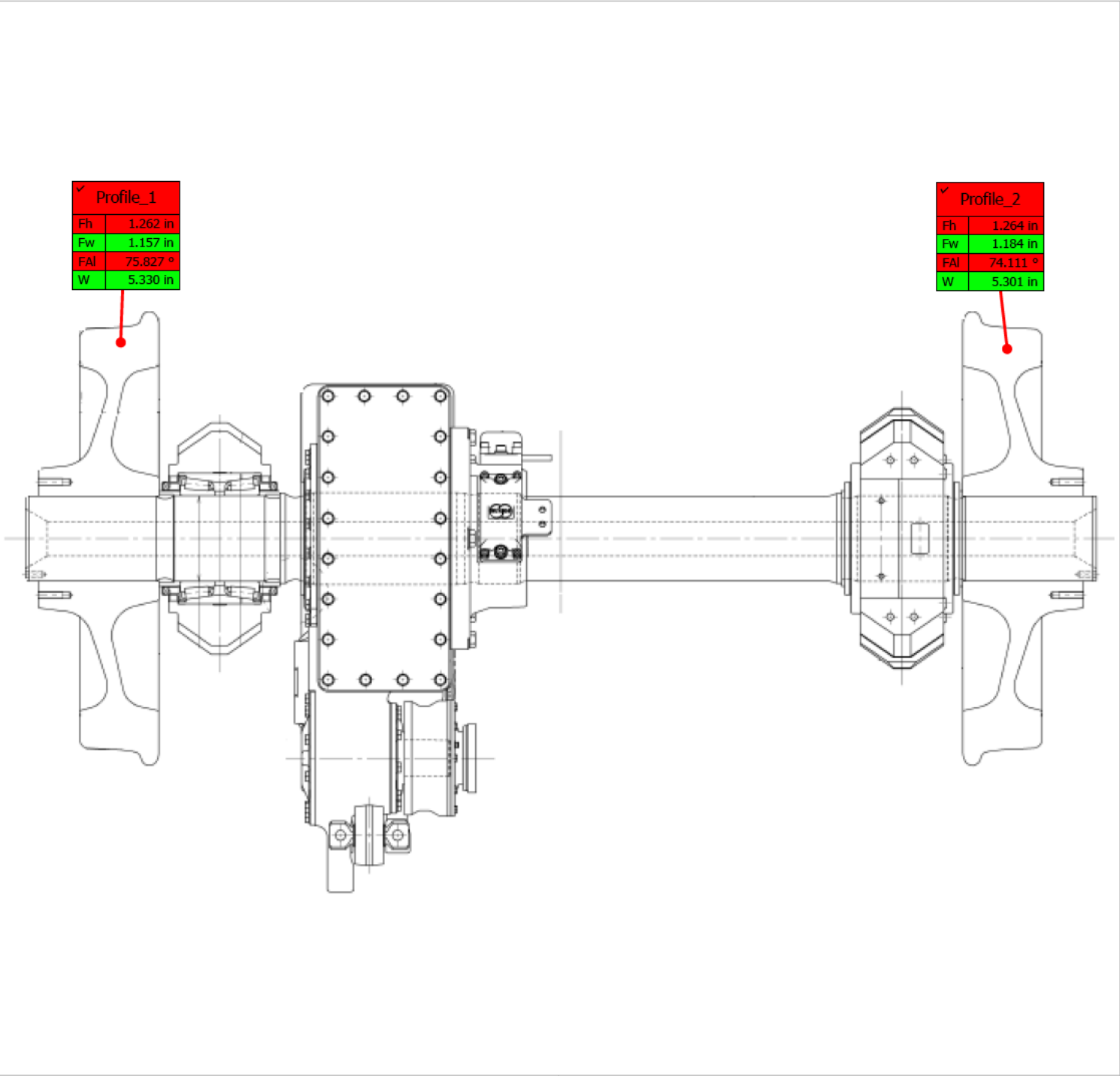
Profile Compare DevPlot-Exaggeration: 3.0000 DevPlot-Tolerance: 0.0100



| Dimension     | Name | Measurement result (Rating) |
|---------------|------|-----------------------------|
|               |      | Tolerance class: min-max    |
| Flange height | Fh   | 1.179 in (Rejected)         |
|               |      | OK: 1.000 - 1.063           |
| Flange width  | Fw   | 1.187 in (OK)               |
|               |      | OK: 1.156 - 1.218           |
| Flange angle  | FAI  | 69.256 ° (Rejected)         |
|               |      | OK: 69.500 - 70.500         |
| Width         | W    | 5.262 in (OK)               |
|               |      | OK: 5.125 - 5.375           |

# WMATA.7000

# WSA\_Measure

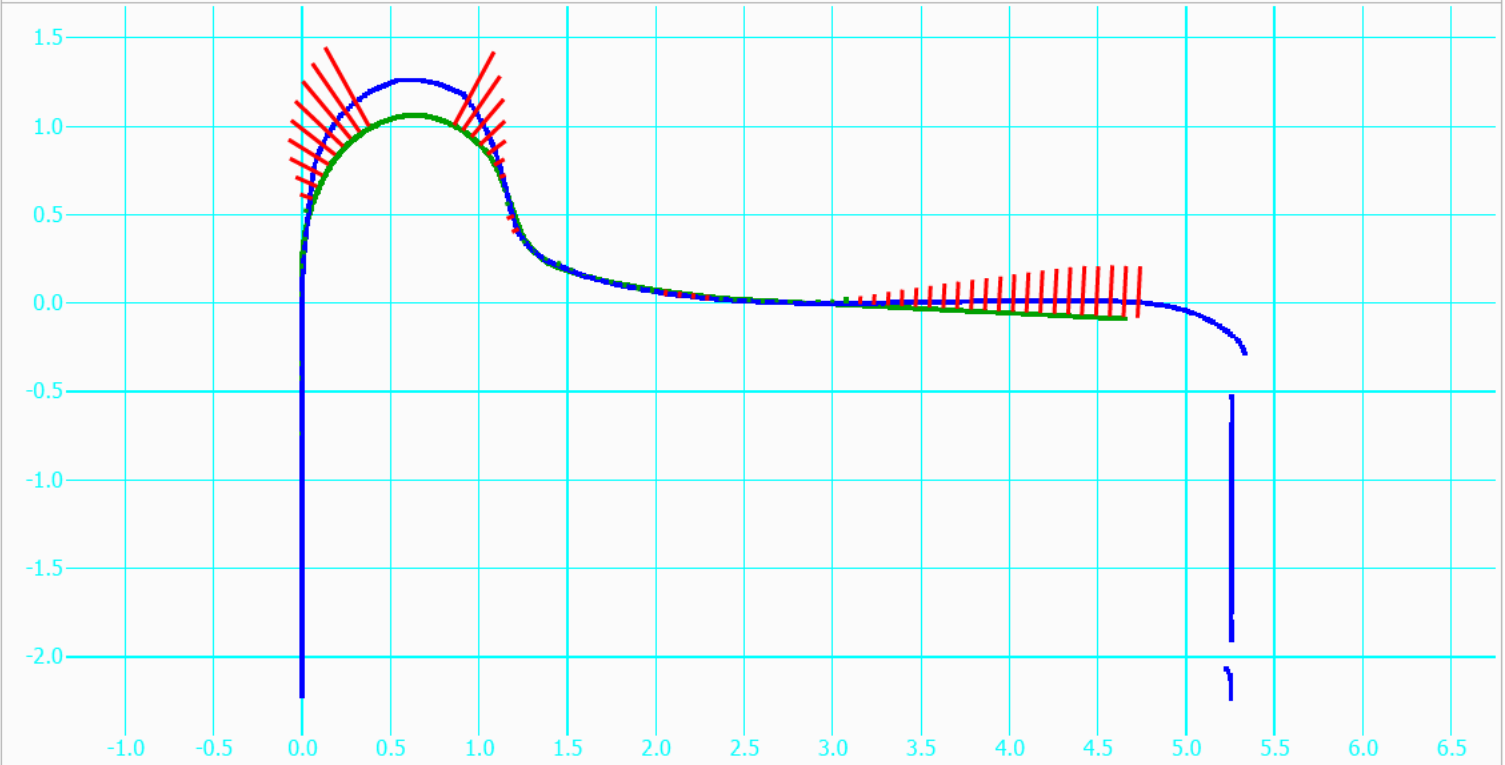


|            |      |
|------------|------|
| WSA Number | 0676 |
|------------|------|

Profile\_1

|              |        |
|--------------|--------|
| Wheel Number | S 1456 |
|--------------|--------|

Profile Compare DevPlot-Exaggeration: 3.0000 DevPlot-Tolerance: 0.0100



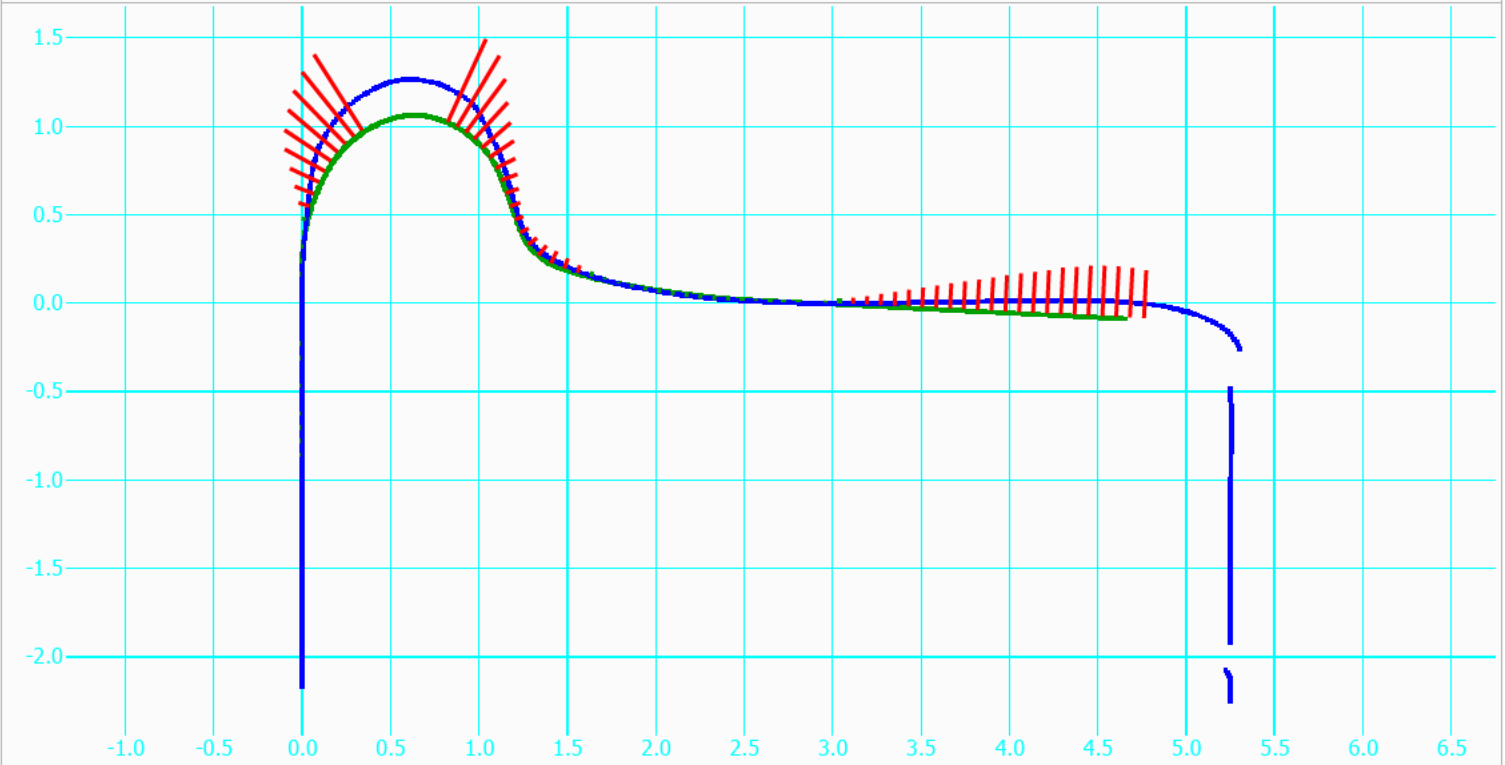
| Dimension     | Name | Measurement result (Rating) |
|---------------|------|-----------------------------|
|               |      | Tolerance class: min-max    |
| Flange height | Fh   | 1.262 in (Rejected)         |
|               |      | OK: 1.000 - 1.063           |
| Flange width  | Fw   | 1.157 in (OK)               |
|               |      | OK: 1.156 - 1.218           |
| Flange angle  | FAI  | 75.827 ° (Rejected)         |
|               |      | OK: 69.500 - 70.500         |
| Width         | W    | 5.330 in (OK)               |
|               |      | OK: 5.125 - 5.375           |



Profile\_2

|              |        |
|--------------|--------|
| Wheel Number | T 1412 |
|--------------|--------|

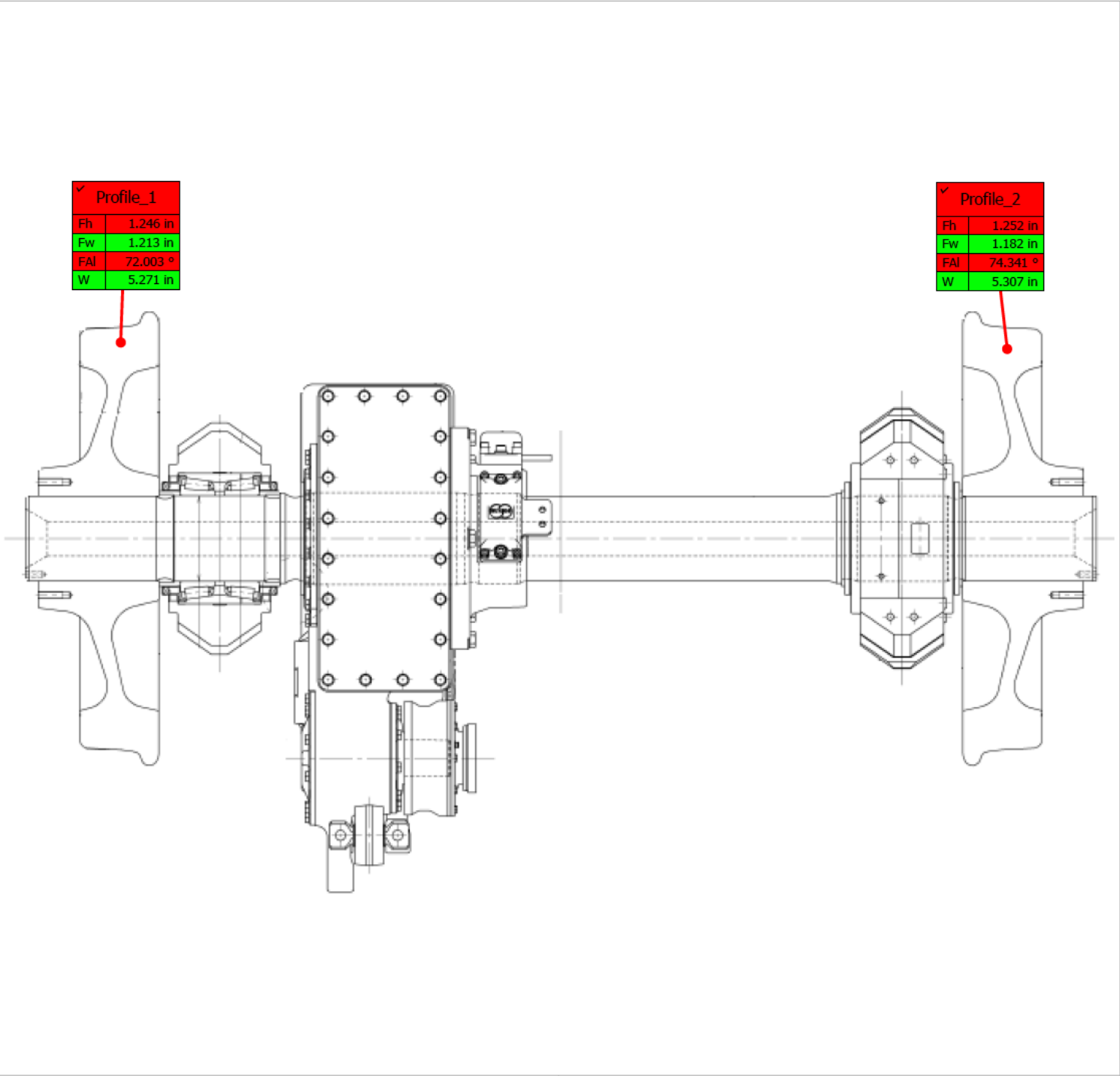
Profile Compare DevPlot-Exaggeration: 3.0000 DevPlot-Tolerance: 0.0100



| Dimension     | Name | Measurement result (Rating) |
|---------------|------|-----------------------------|
|               |      | Tolerance class: min-max    |
| Flange height | Fh   | 1.264 in (Rejected)         |
|               |      | OK: 1.000 - 1.063           |
| Flange width  | Fw   | 1.184 in (OK)               |
|               |      | OK: 1.156 - 1.218           |
| Flange angle  | FAI  | 74.111 ° (Rejected)         |
|               |      | OK: 69.500 - 70.500         |
| Width         | W    | 5.301 in (OK)               |
|               |      | OK: 5.125 - 5.375           |

# WMATA.7000

# WSA\_Measure



| Profile_1 |          |
|-----------|----------|
| Fh        | 1.246 in |
| Fw        | 1.213 in |
| FAI       | 72.003 ° |
| W         | 5.271 in |

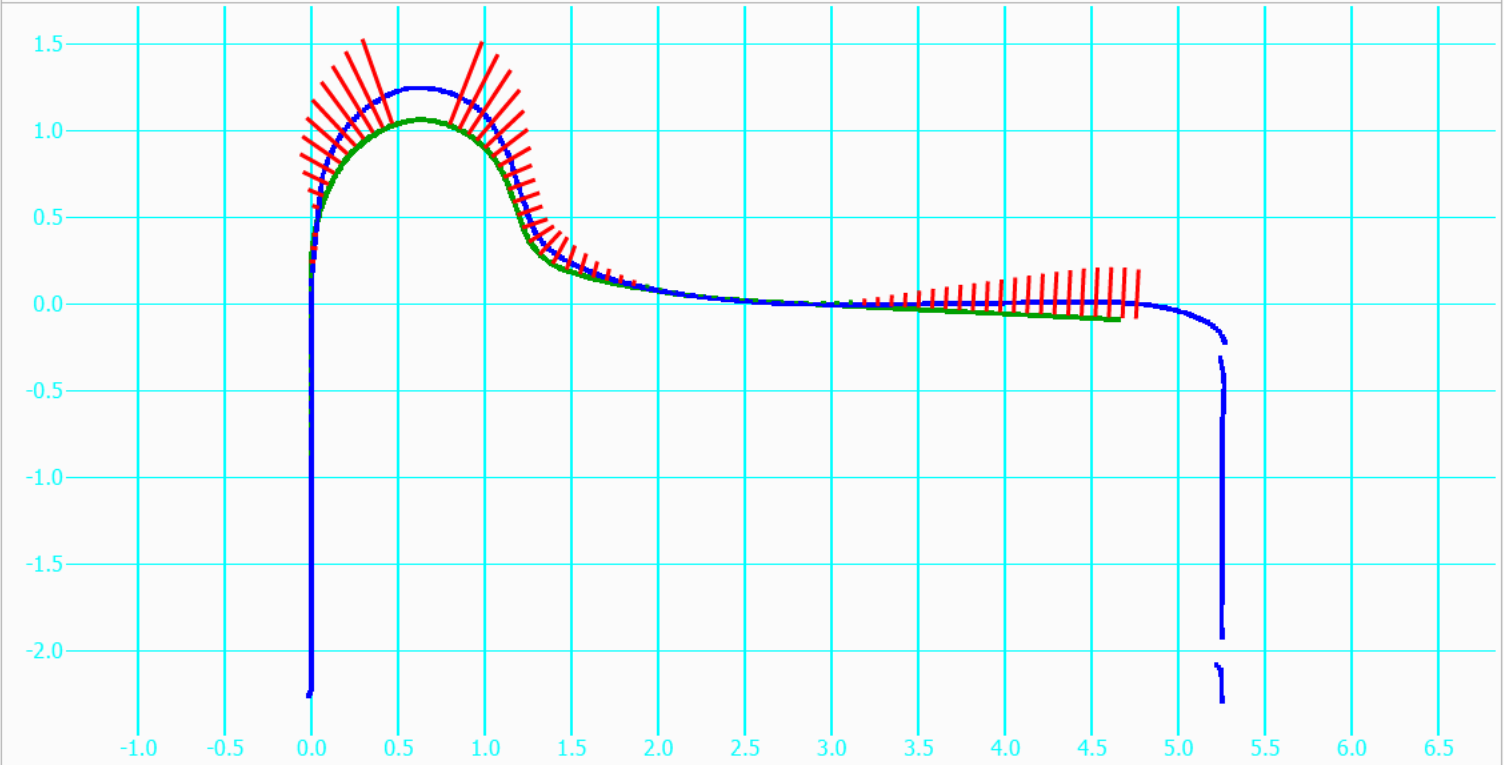
| Profile_2 |          |
|-----------|----------|
| Fh        | 1.252 in |
| Fw        | 1.182 in |
| FAI       | 74.341 ° |
| W         | 5.307 in |

|            |      |
|------------|------|
| WSA Number | 0694 |
|------------|------|

Profile\_1

|              |        |
|--------------|--------|
| Wheel Number | S 1420 |
|--------------|--------|

Profile Compare DevPlot-Exaggeration: 3.0000 DevPlot-Tolerance: 0.0100

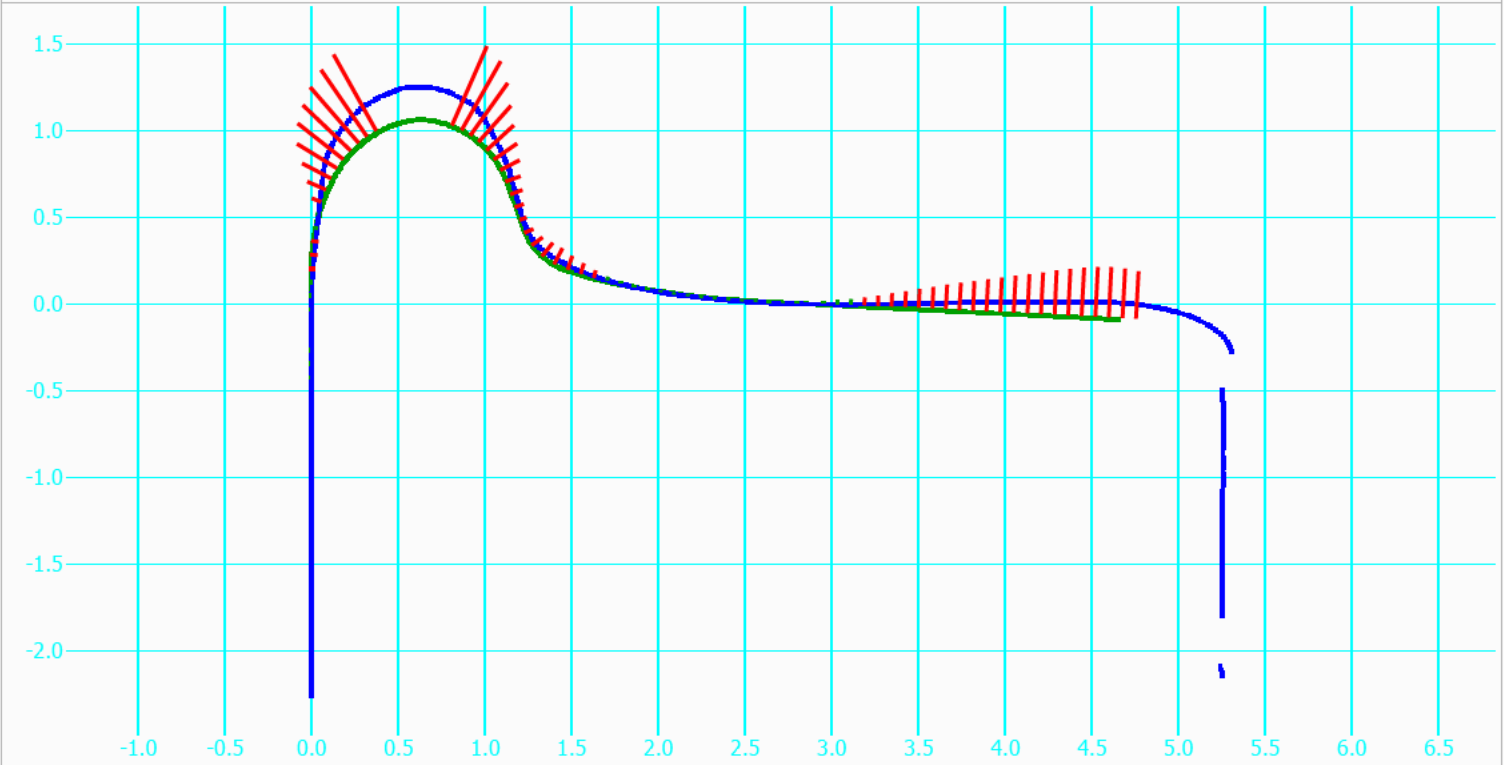


| Dimension     | Name | Measurement result (Rating) |
|---------------|------|-----------------------------|
|               |      | Tolerance class: min-max    |
| Flange height | Fh   | 1.246 in (Rejected)         |
|               |      | OK: 1.000 - 1.063           |
| Flange width  | Fw   | 1.213 in (OK)               |
|               |      | OK: 1.156 - 1.218           |
| Flange angle  | FAI  | 72.003 ° (Rejected)         |
|               |      | OK: 69.500 - 70.500         |
| Width         | W    | 5.271 in (OK)               |
|               |      | OK: 5.125 - 5.375           |

Profile\_2

|              |        |
|--------------|--------|
| Wheel Number | T 1451 |
|--------------|--------|

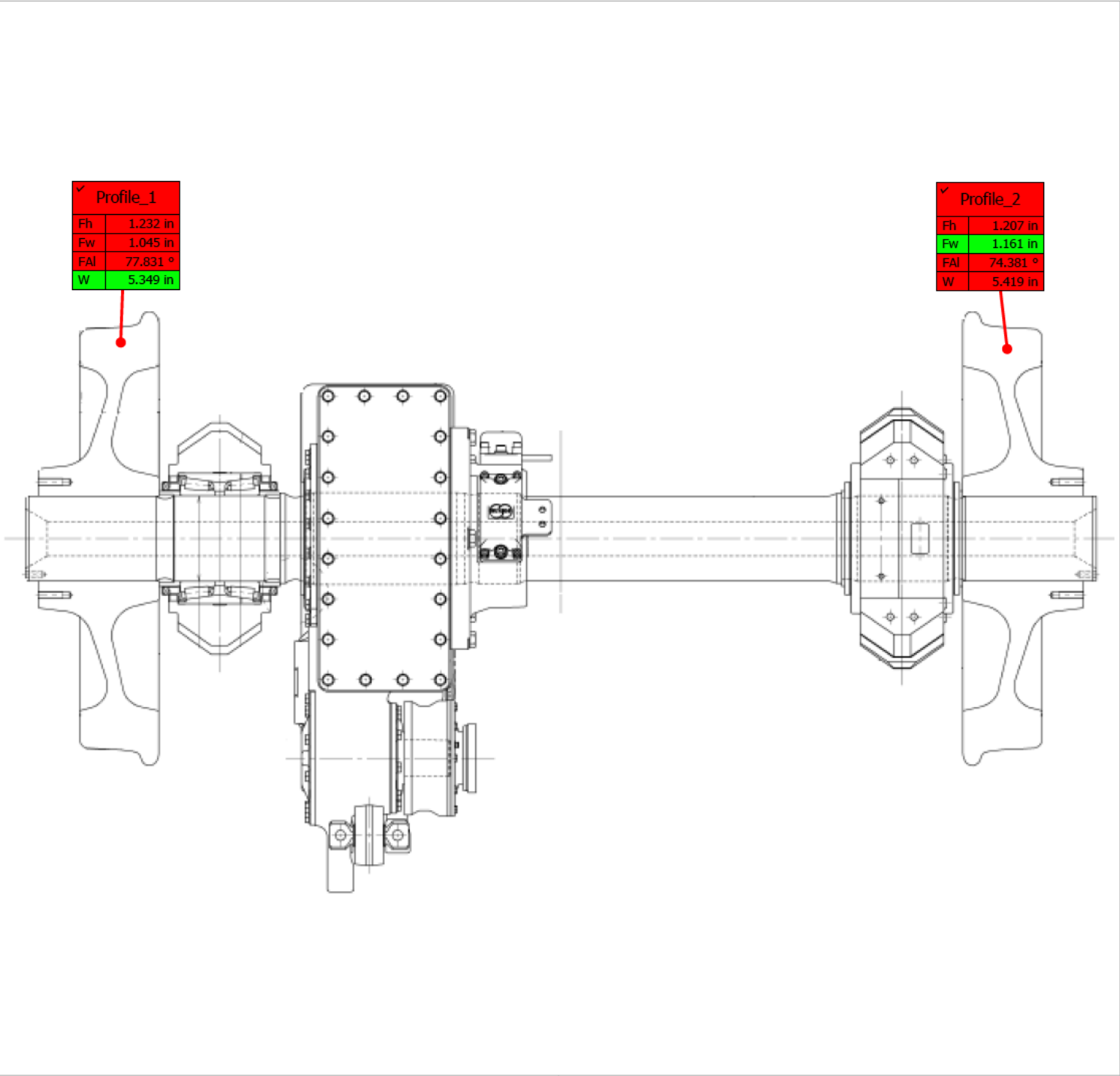
Profile Compare DevPlot-Exaggeration: 3.0000 DevPlot-Tolerance: 0.0100



| Dimension     | Name | Measurement result (Rating) |
|---------------|------|-----------------------------|
|               |      | Tolerance class: min-max    |
| Flange height | Fh   | 1.252 in (Rejected)         |
|               |      | OK: 1.000 - 1.063           |
| Flange width  | Fw   | 1.182 in (OK)               |
|               |      | OK: 1.156 - 1.218           |
| Flange angle  | FAI  | 74.341 ° (Rejected)         |
|               |      | OK: 69.500 - 70.500         |
| Width         | W    | 5.307 in (OK)               |
|               |      | OK: 5.125 - 5.375           |

# WMATA.7000

# WSA\_Measure



| Profile_1 |          |
|-----------|----------|
| Fh        | 1.232 in |
| Fw        | 1.045 in |
| FAI       | 77.831 ° |
| W         | 5.349 in |

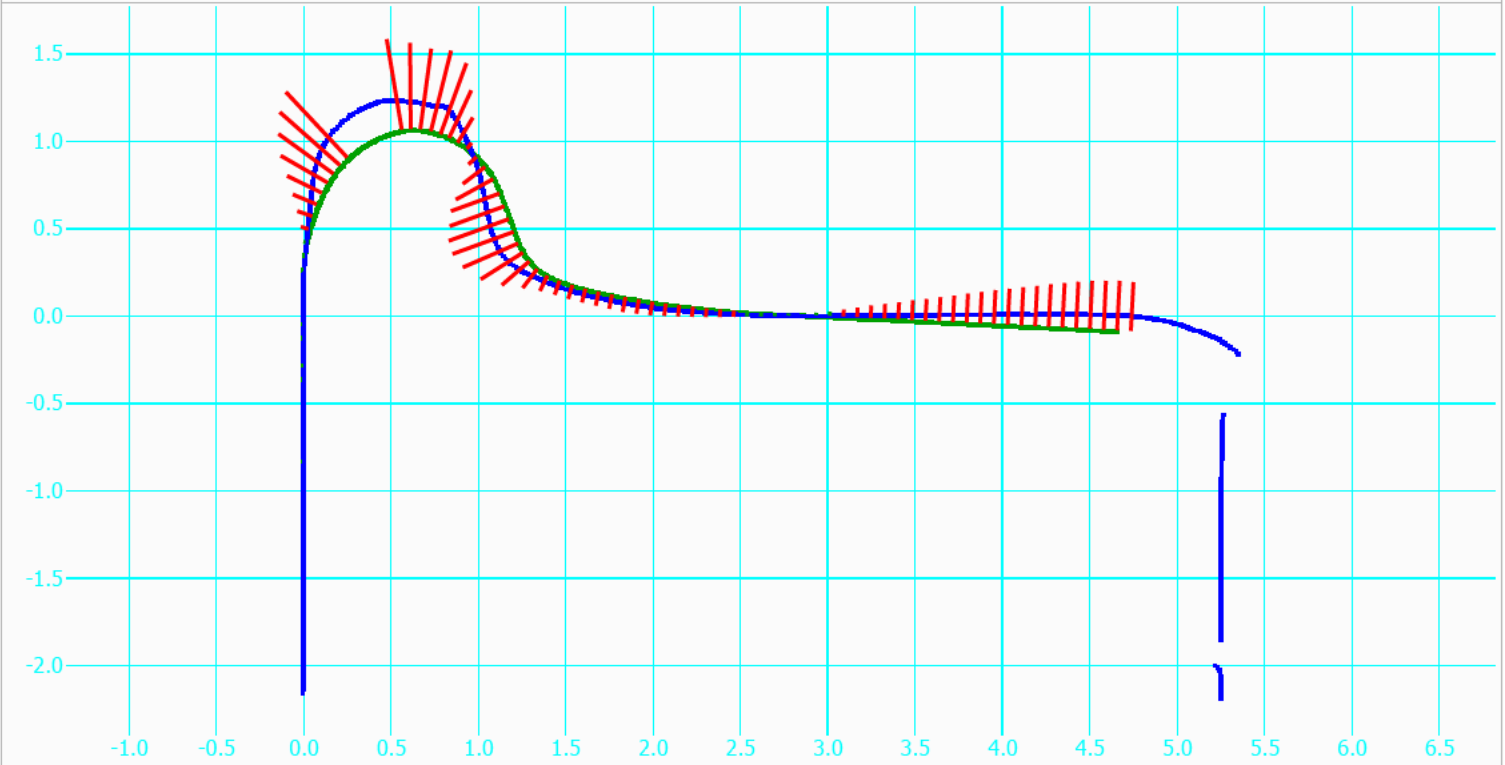
| Profile_2 |          |
|-----------|----------|
| Fh        | 1.207 in |
| Fw        | 1.161 in |
| FAI       | 74.381 ° |
| W         | 5.419 in |

|            |      |
|------------|------|
| WSA Number | 1460 |
|------------|------|

Profile\_1

|              |        |
|--------------|--------|
| Wheel Number | S 2079 |
|--------------|--------|

Profile Compare DevPlot-Exaggeration: 3.0000 DevPlot-Tolerance: 0.0100



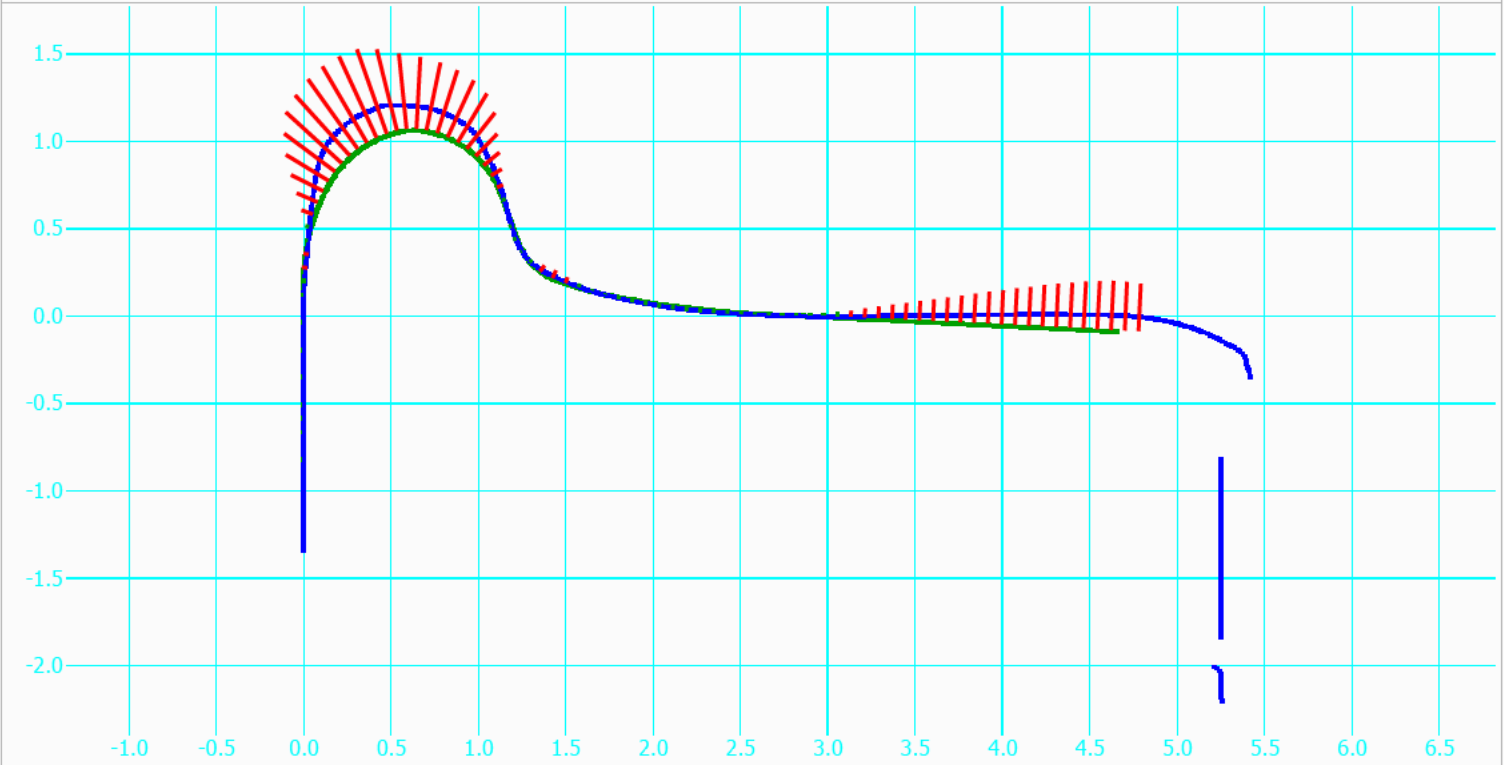
| Dimension     | Name | Measurement result (Rating) |
|---------------|------|-----------------------------|
|               |      | Tolerance class: min-max    |
| Flange height | Fh   | 1.232 in (Rejected)         |
|               |      | OK: 1.000 - 1.063           |
| Flange width  | Fw   | 1.045 in (Rejected)         |
|               |      | OK: 1.156 - 1.218           |
| Flange angle  | FAI  | 77.831 ° (Rejected)         |
|               |      | OK: 69.500 - 70.500         |
| Width         | W    | 5.349 in (OK)               |
|               |      | OK: 5.125 - 5.375           |



Profile\_2

|              |        |
|--------------|--------|
| Wheel Number | T 2316 |
|--------------|--------|

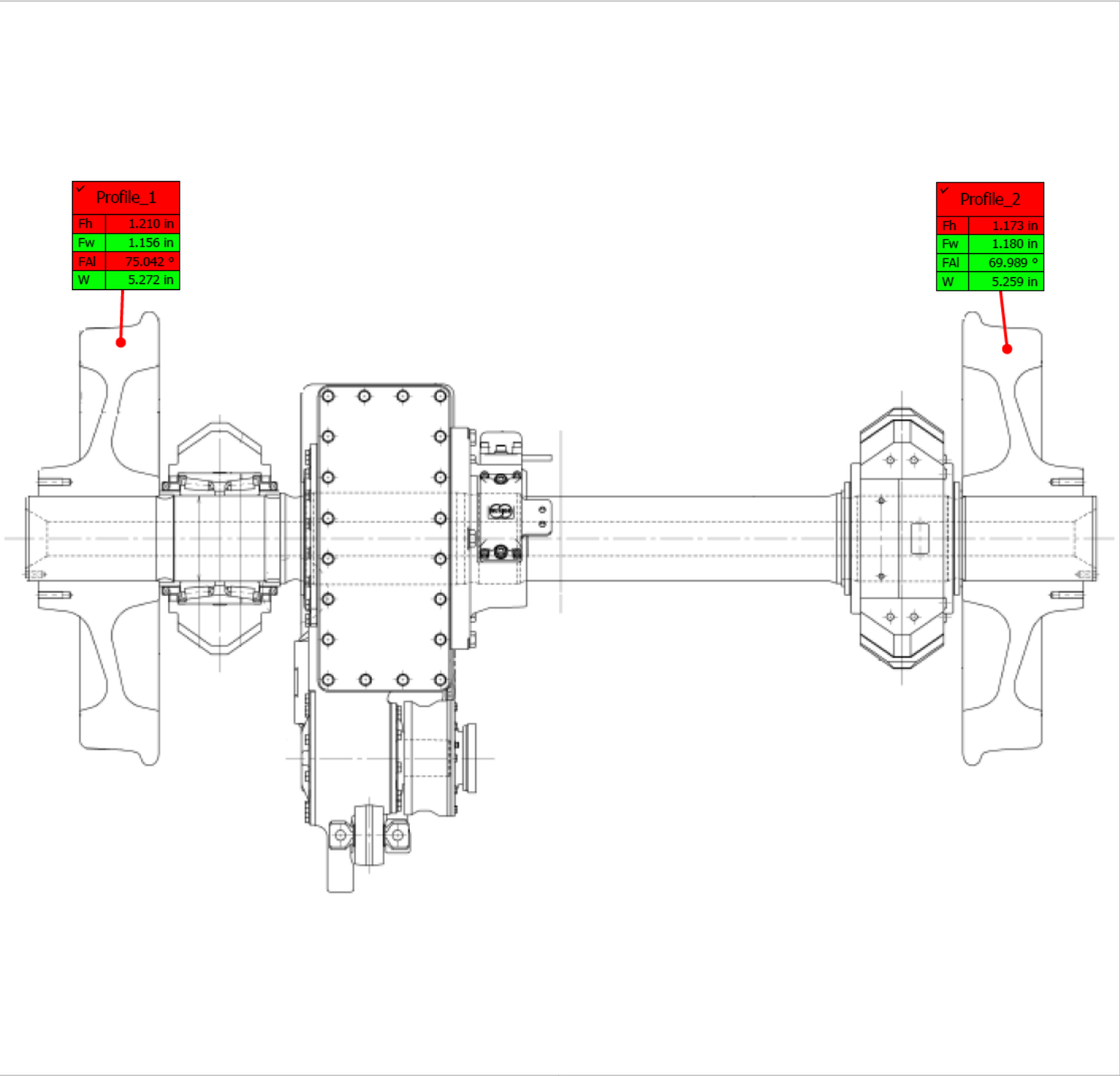
Profile Compare DevPlot-Exaggeration: 3.0000 DevPlot-Tolerance: 0.0100



| Dimension     | Name | Measurement result (Rating) |
|---------------|------|-----------------------------|
|               |      | Tolerance class: min-max    |
| Flange height | Fh   | 1.207 in (Rejected)         |
|               |      | OK: 1.000 - 1.063           |
| Flange width  | Fw   | 1.161 in (OK)               |
|               |      | OK: 1.156 - 1.218           |
| Flange angle  | FAI  | 74.381 ° (Rejected)         |
|               |      | OK: 69.500 - 70.500         |
| Width         | W    | 5.419 in (Rejected)         |
|               |      | OK: 5.125 - 5.375           |

# WMATA.7000

# WSA\_Measure

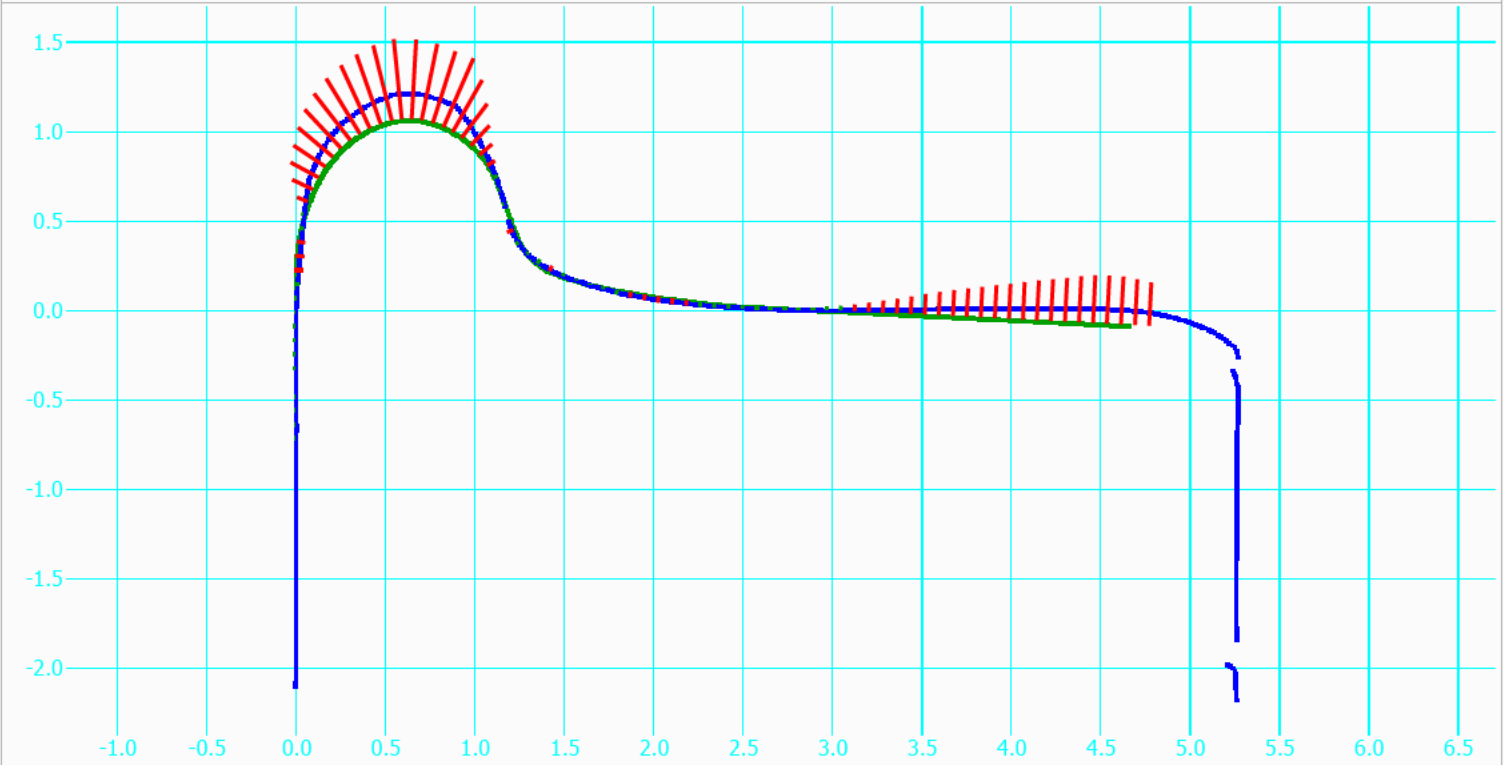


|            |      |
|------------|------|
| WSA Number | 2063 |
|------------|------|

Profile\_1

|              |        |
|--------------|--------|
| Wheel Number | S 4407 |
|--------------|--------|

Profile Compare DevPlot-Exaggeration: 3.0000 DevPlot-Tolerance: 0.0100

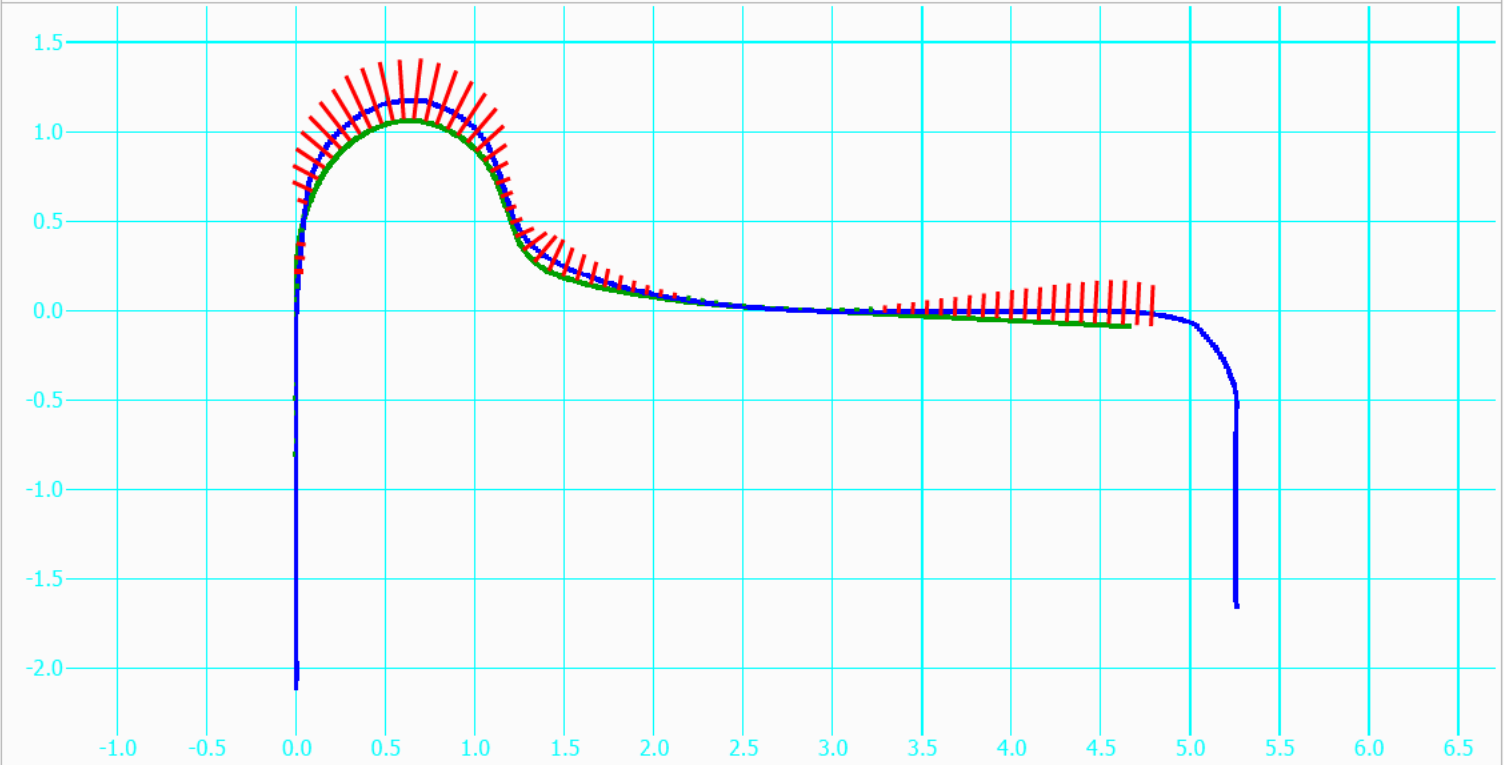


| Dimension     | Name | Measurement result (Rating) |
|---------------|------|-----------------------------|
|               |      | Tolerance class: min-max    |
| Flange height | Fh   | 1.210 in (Rejected)         |
|               |      | OK: 1.000 - 1.063           |
| Flange width  | Fw   | 1.156 in (OK)               |
|               |      | OK: 1.156 - 1.218           |
| Flange angle  | FAI  | 75.042 ° (Rejected)         |
|               |      | OK: 69.500 - 70.500         |
| Width         | W    | 5.272 in (OK)               |
|               |      | OK: 5.125 - 5.375           |

Profile\_2

|              |        |
|--------------|--------|
| Wheel Number | T 4379 |
|--------------|--------|

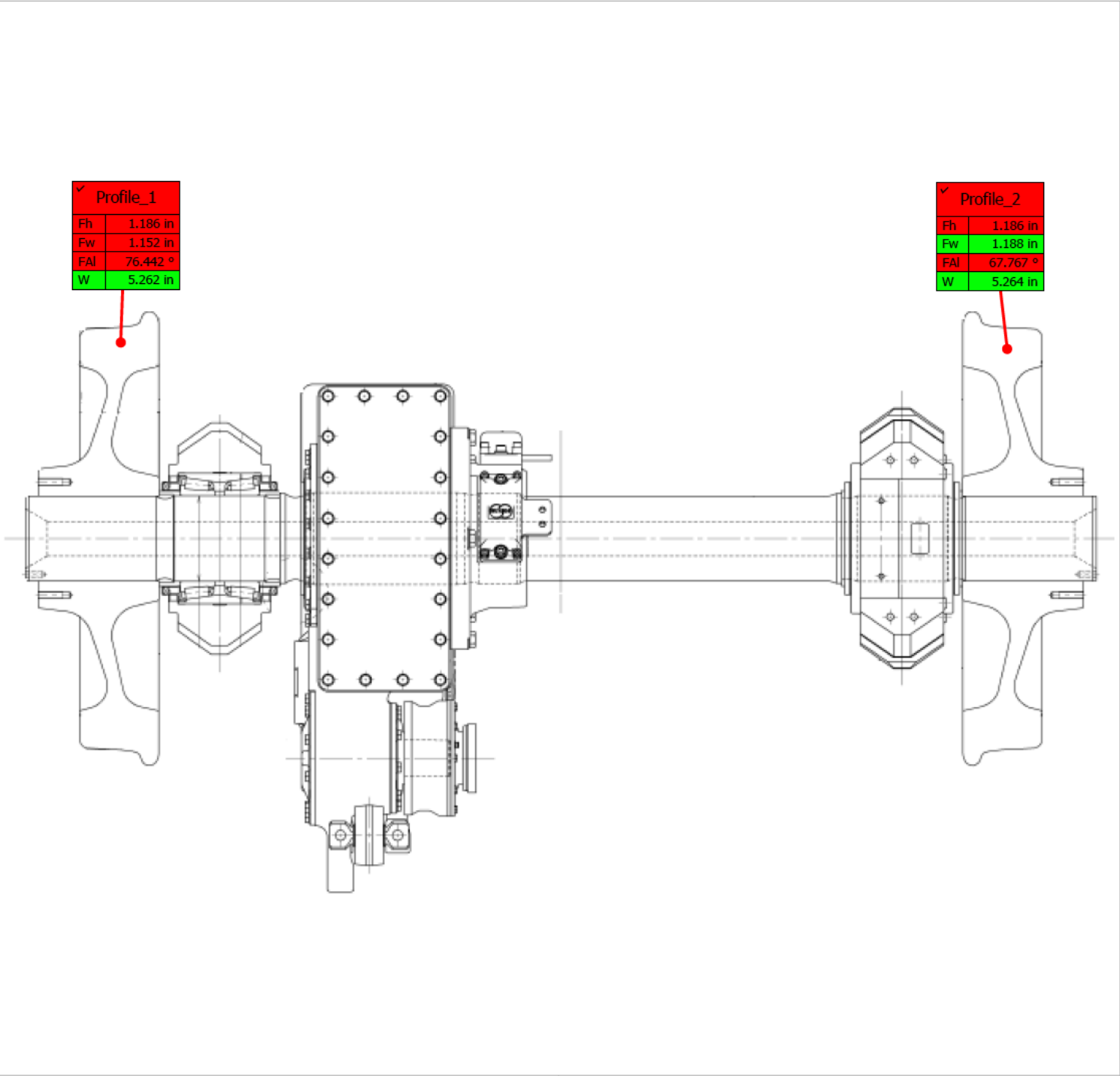
Profile Compare DevPlot-Exaggeration: 3.0000 DevPlot-Tolerance: 0.0100



| Dimension     | Name | Measurement result (Rating) |
|---------------|------|-----------------------------|
|               |      | Tolerance class: min-max    |
| Flange height | Fh   | 1.173 in (Rejected)         |
|               |      | OK: 1.000 - 1.063           |
| Flange width  | Fw   | 1.180 in (OK)               |
|               |      | OK: 1.156 - 1.218           |
| Flange angle  | FAI  | 69.989 ° (OK)               |
|               |      | OK: 69.500 - 70.500         |
| Width         | W    | 5.259 in (OK)               |
|               |      | OK: 5.125 - 5.375           |

# WMATA.7000

# WSA\_Measure

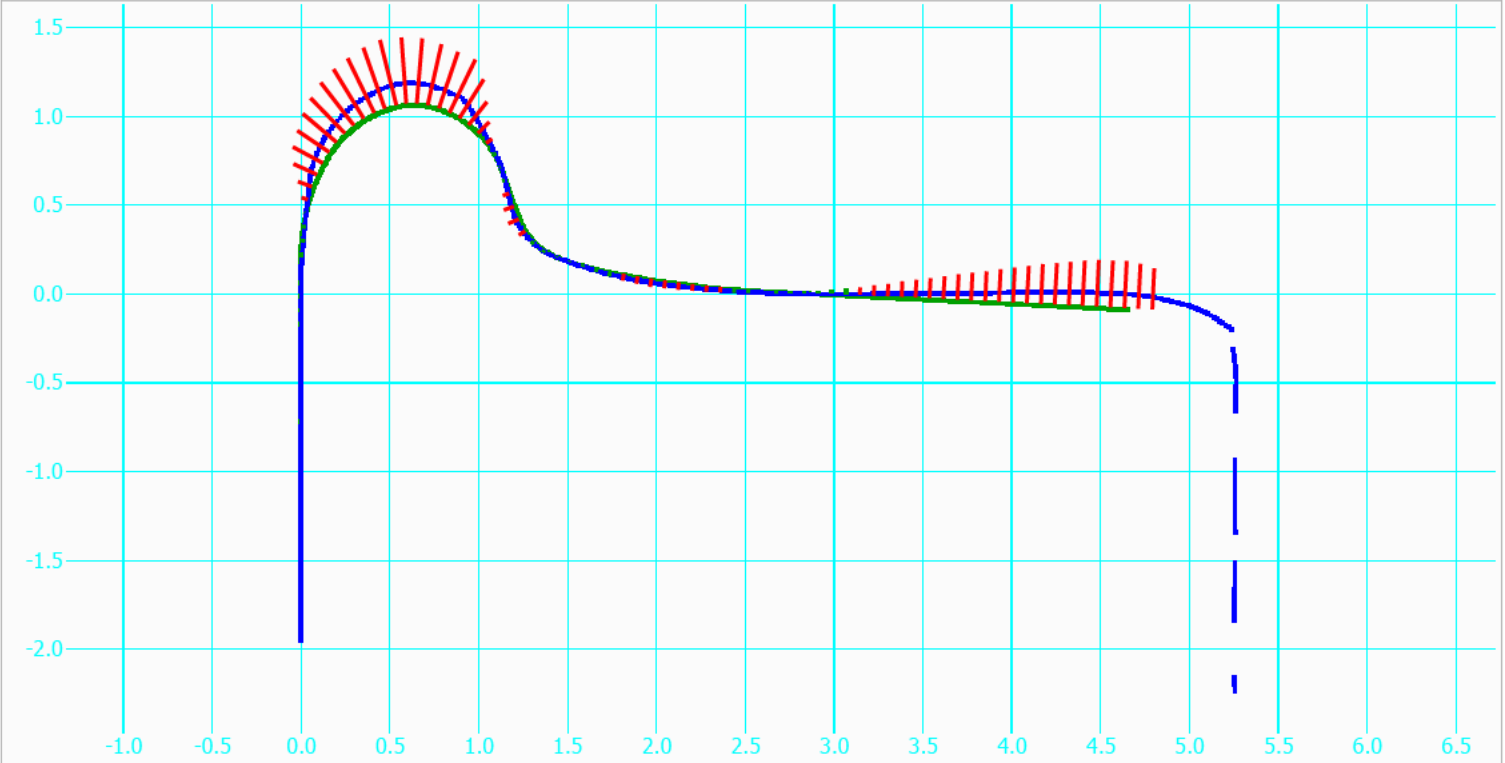


|            |      |
|------------|------|
| WSA Number | 2075 |
|------------|------|

Profile\_1

|              |        |
|--------------|--------|
| Wheel Number | S 4251 |
|--------------|--------|

Profile Compare DevPlot-Exaggeration: 3.0000 DevPlot-Tolerance: 0.0100



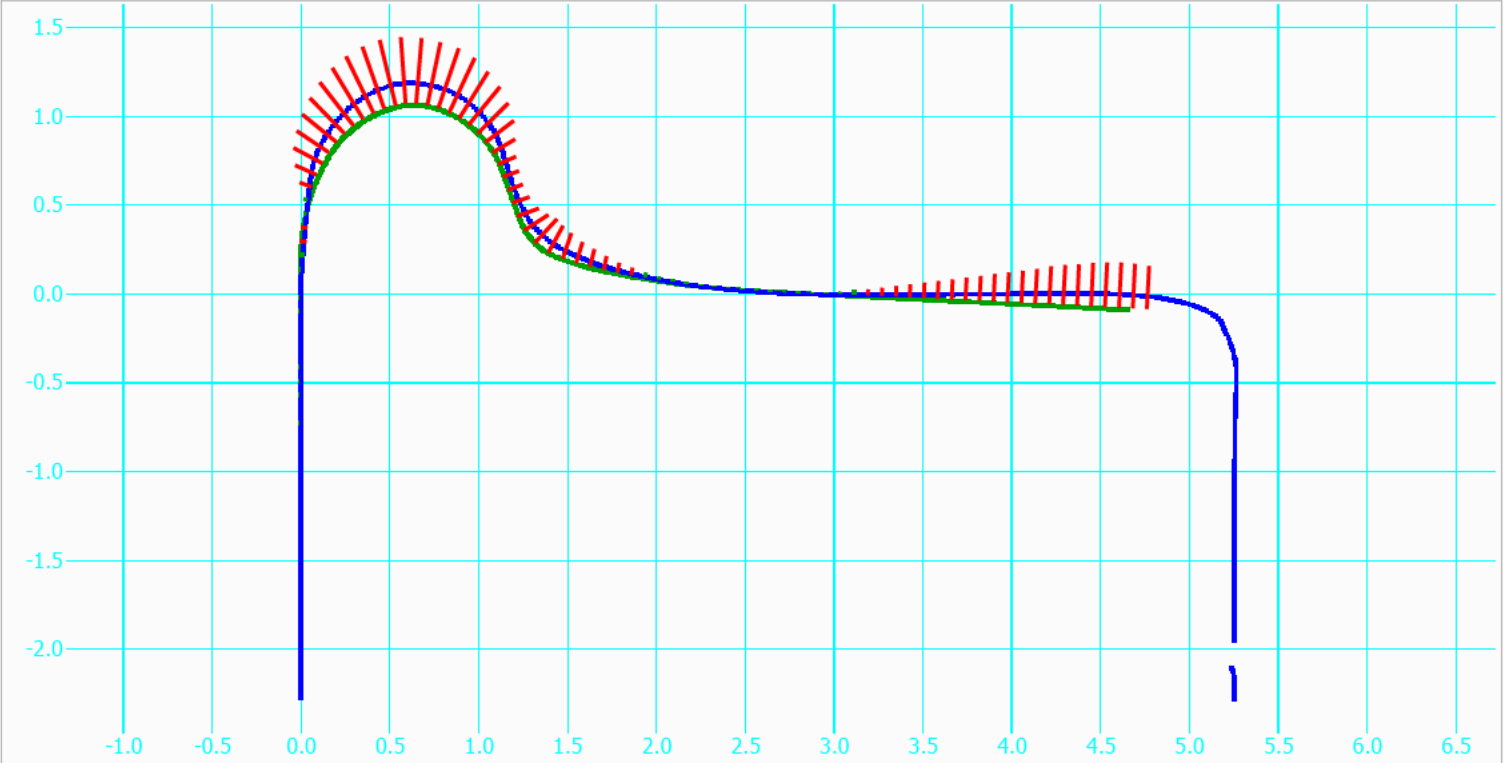
| Dimension     | Name | Measurement result (Rating) |
|---------------|------|-----------------------------|
|               |      | Tolerance class: min-max    |
| Flange height | Fh   | 1.186 in (Rejected)         |
|               |      | OK: 1.000 - 1.063           |
| Flange width  | Fw   | 1.152 in (Rejected)         |
|               |      | OK: 1.156 - 1.218           |
| Flange angle  | FAI  | 76.442 ° (Rejected)         |
|               |      | OK: 69.500 - 70.500         |
| Width         | W    | 5.262 in (OK)               |
|               |      | OK: 5.125 - 5.375           |



Profile\_2

|              |        |
|--------------|--------|
| Wheel Number | T 4242 |
|--------------|--------|

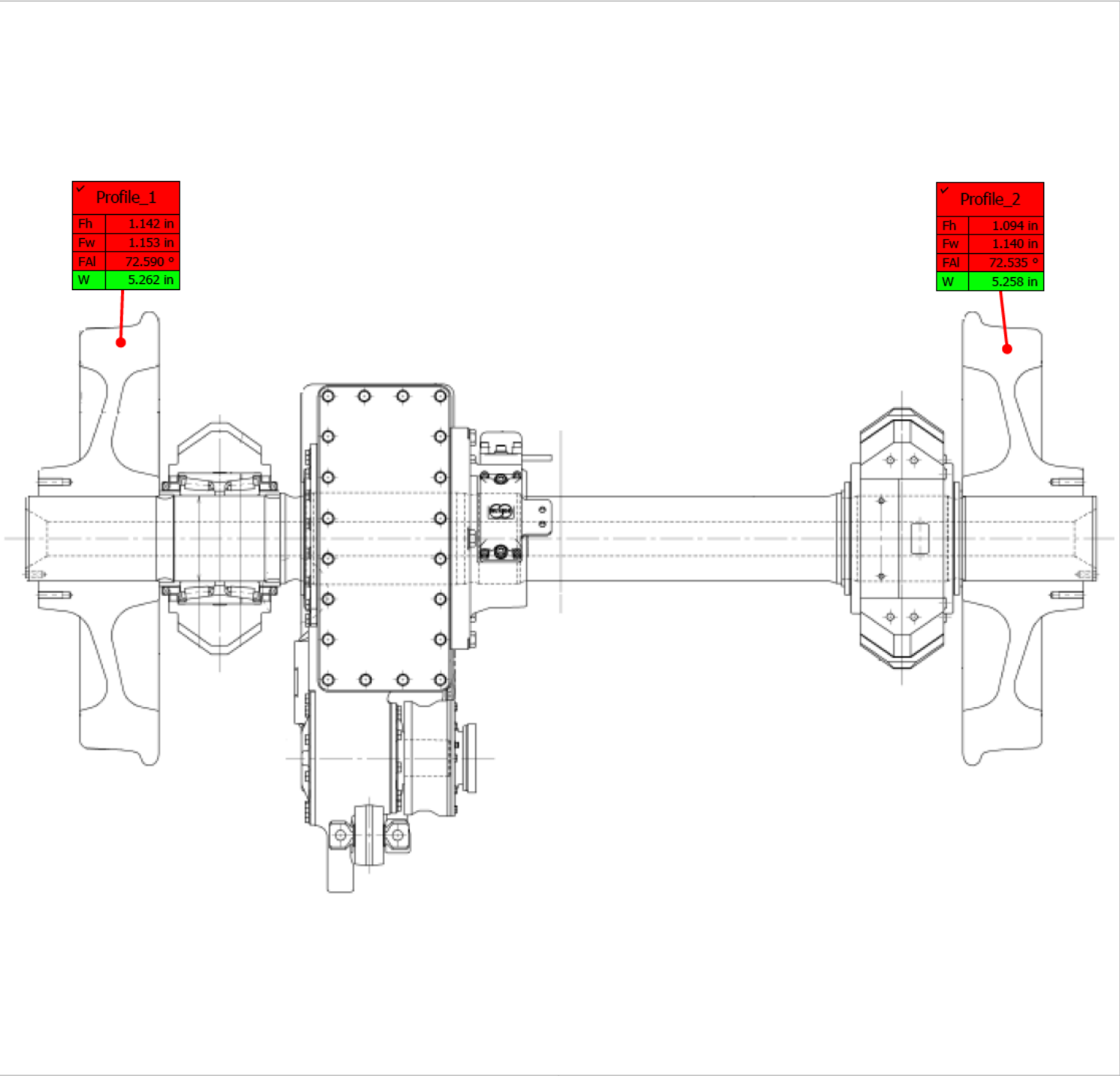
Profile Compare DevPlot-Exaggeration: 3.0000 DevPlot-Tolerance: 0.0100



| Dimension     | Name | Measurement result (Rating) |
|---------------|------|-----------------------------|
|               |      | Tolerance class: min-max    |
| Flange height | Fh   | 1.186 in (Rejected)         |
|               |      | OK: 1.000 - 1.063           |
| Flange width  | Fw   | 1.188 in (OK)               |
|               |      | OK: 1.156 - 1.218           |
| Flange angle  | FAI  | 67.767 ° (Rejected)         |
|               |      | OK: 69.500 - 70.500         |
| Width         | W    | 5.264 in (OK)               |
|               |      | OK: 5.125 - 5.375           |

# WMATA.7000

# WSA\_Measure



| Profile_1 |          |
|-----------|----------|
| Fh        | 1.142 in |
| Fw        | 1.153 in |
| FAI       | 72.590 ° |
| W         | 5.262 in |

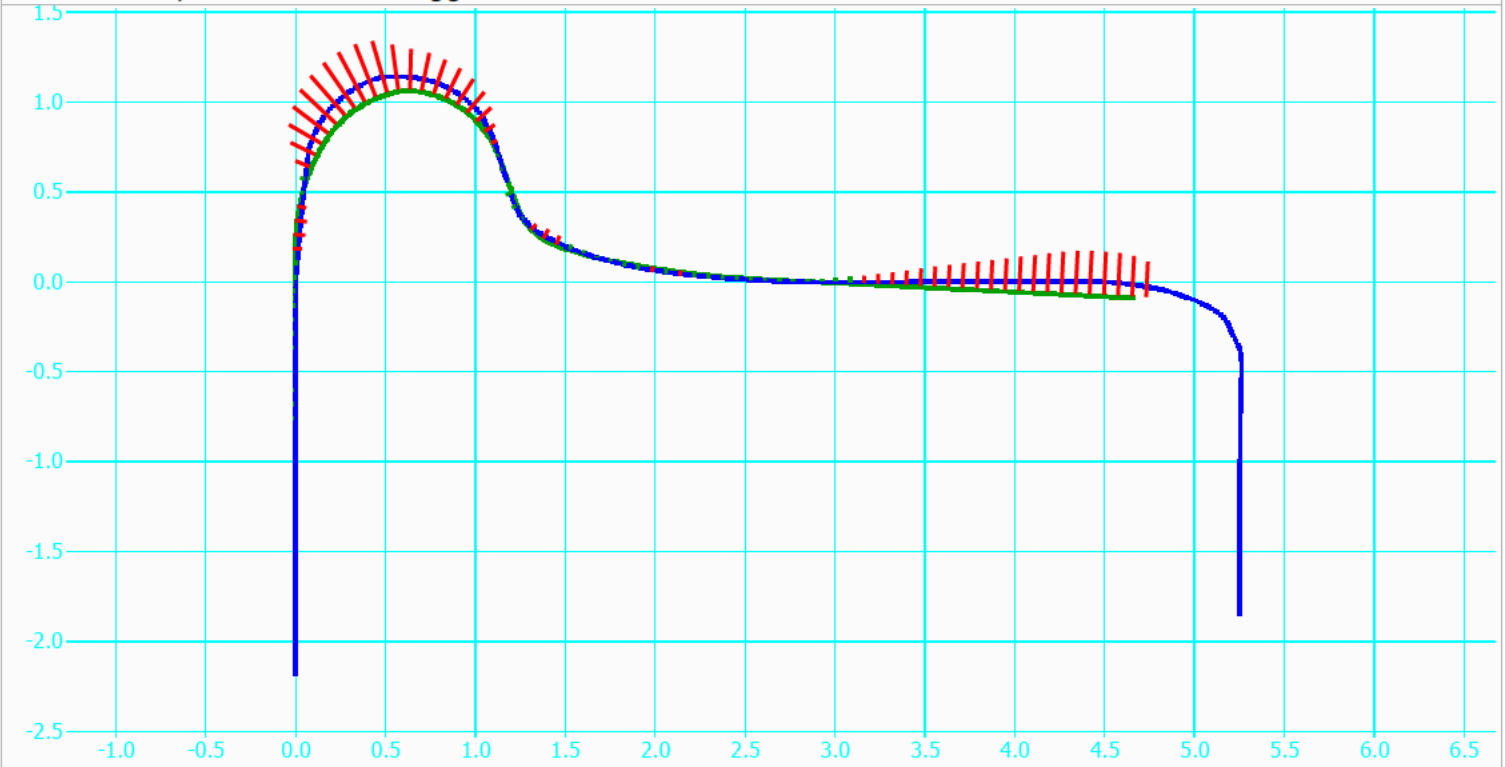
| Profile_2 |          |
|-----------|----------|
| Fh        | 1.094 in |
| Fw        | 1.140 in |
| FAI       | 72.535 ° |
| W         | 5.258 in |

|            |      |
|------------|------|
| WSA Number | 2935 |
|------------|------|

Profile\_1

|              |        |
|--------------|--------|
| Wheel Number | S 6132 |
|--------------|--------|

Profile Compare DevPlot-Exaggeration: 3.0000 DevPlot-Tolerance: 0.0100

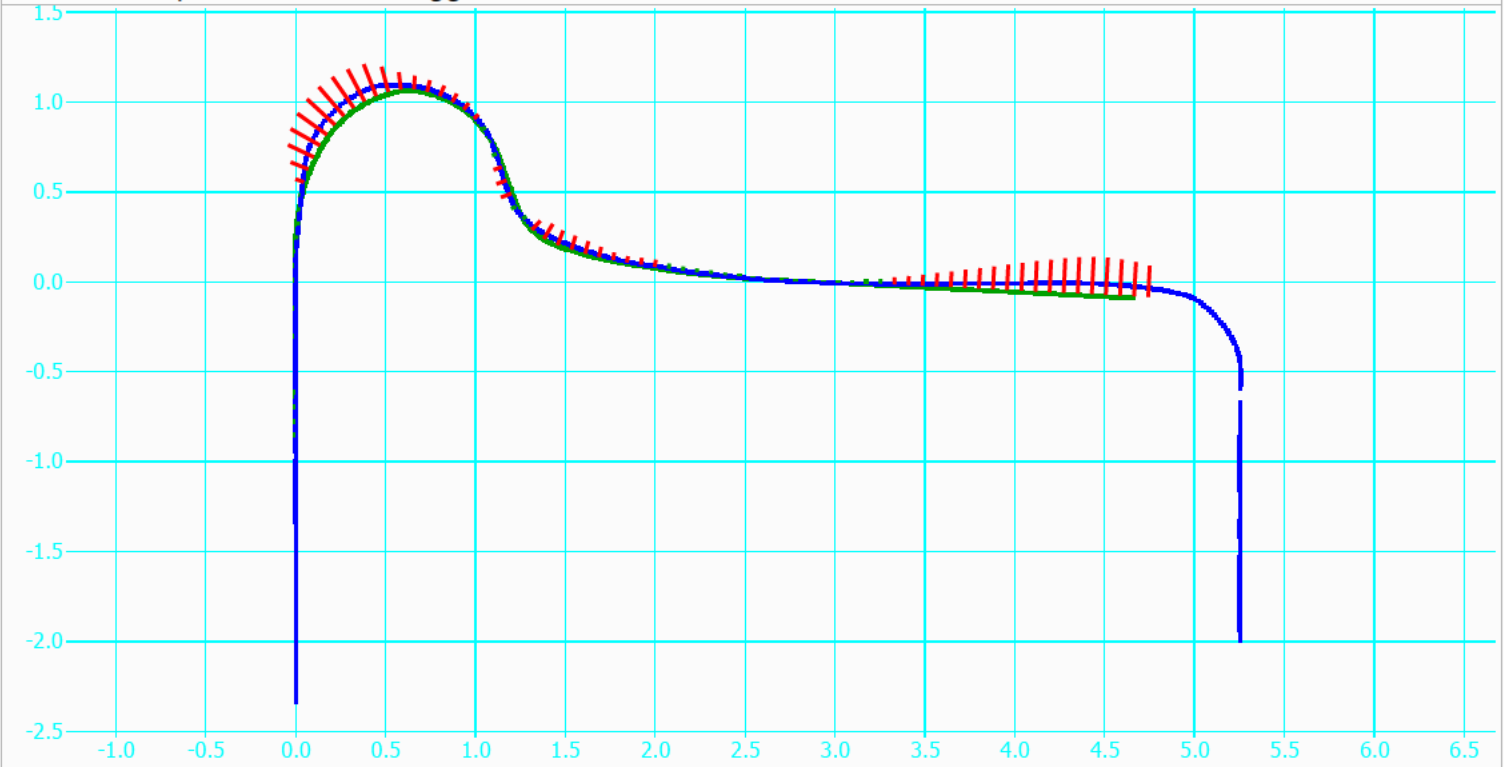


| Dimension     | Name | Measurement result (Rating) |
|---------------|------|-----------------------------|
|               |      | Tolerance class: min-max    |
| Flange height | Fh   | 1.142 in (Rejected)         |
|               |      | OK: 1.000 - 1.063           |
| Flange width  | Fw   | 1.153 in (Rejected)         |
|               |      | OK: 1.156 - 1.218           |
| Flange angle  | FAI  | 72.590 ° (Rejected)         |
|               |      | OK: 69.500 - 70.500         |
| Width         | W    | 5.262 in (OK)               |
|               |      | OK: 5.125 - 5.375           |

Profile\_2

|              |        |
|--------------|--------|
| Wheel Number | T 6315 |
|--------------|--------|

Profile Compare DevPlot-Exaggeration: 3.0000 DevPlot-Tolerance: 0.0100



| Dimension     | Name | Measurement result (Rating) |
|---------------|------|-----------------------------|
|               |      | Tolerance class: min-max    |
| Flange height | Fh   | 1.094 in (Rejected)         |
|               |      | OK: 1.000 - 1.063           |
| Flange width  | Fw   | 1.140 in (Rejected)         |
|               |      | OK: 1.156 - 1.218           |
| Flange angle  | FAI  | 72.535 ° (Rejected)         |
|               |      | OK: 69.500 - 70.500         |
| Width         | W    | 5.258 in (OK)               |
|               |      | OK: 5.125 - 5.375           |



# APPENDIX B

## Calipri Calibration Certification

(1 page)

CERT# [REDACTED] 3

Certificate #: 32 [REDACTED] 018 Rev. 3 **Certificate of Calibration** Report Date: 10/21/2021

**Customer Information**

ORX Railway Corporation - Tipton  
3350 RIVERWOOD PARKWAY  
Atlanta, GA 30339

Sales Order #: [REDACTED]  
Purchase Order #: [REDACTED]

**Equipment Information**

Gage ID : ORX 03121 Serial Number : [REDACTED]  
 Manufacturer : Nextsense Model Number : TZ24  
 Department :  
 Description : Target Base Sensor

**Certification Information**

Date of Calibration : 10/21/2021 As Found : In Tolerance  
 Date Due Calibration : 10/21/2022 As Left : In Tolerance  
 Customer Cal. Interval : 12 Month(s)  
 Temp./RH : 68.5F/38%  
 Calibration Location : In Lab  
 Certification Done and Authorized By: Morgan, Sean (e-signed (1/24/2022 19:56:40 UTC))

**Calibration Notes**

Uncertainty is ± (0.24 + 0.000 69L) μm

**Standards Used To Calibrate Equipment**

| ID Number        | Description                       | NIST Traceability Number | Last Cal. | Due Date  |
|------------------|-----------------------------------|--------------------------|-----------|-----------|
| VCDIM [REDACTED] | Temperature & Humidity Datalogger | [REDACTED]               | 7/20/2021 | 7/31/2023 |
| VCINS [REDACTED] | O-Inspect With Touch Probe        | [REDACTED]               | 9/7/2021  | 9/30/2022 |

**Calibration Procedures**

| Procedure Name              | Rev Num | Rev Date |
|-----------------------------|---------|----------|
| MANUFACTURES SPECIFICATIONS |         |          |

The MSI-Viking Gage, LLC calibration laboratories operate under the requirements of ISO/IEC 17025 and ANS /NCSL Z540-1 (1994). All calibrations are traceable to SI Units (NIST). The results indicated on the certificate relate only to the item(s) calibrated. The reported measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2. Any statement of compliance is based solely on the tolerance listed without taking the uncertainty of the measurement into consideration. This certificate of calibration is neither a contract nor a contractual representation. MSI-Viking Gage, LLC is responsible for the calibration process results during the time of the calibration process. Any number of factors may cause the unit under test's readings to drift out of specification before the calibration interval has expired. It shall be the customer's responsibility to ensure that the TI's remain within calibration for the duration of the assigned calibration interval. Any test denoted with double exclamation points (!!) was performed in accordance with R205 – Specific Requirements: Calibration Laboratory Accreditation Program and is deemed equivalent with a calibration. This certificate of calibration may not be copied except in full and only with the written consent of MSI-Viking Gage, LLC.