

**BS EN 13848-4:2011**  
**EN 13848-4:2011 (E)**

**Parameters measured by track geometry measuring trolleys (TGMTs) and manually operated devices (MODs)**

## **INTRODUCTION:**

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Owing to the design of TGMTs and MODs, the EN 13848-1:2003+A1:2008 requirements have to be modified. Therefore, this annex lists in tabular form the minimum requirements for each track geometry parameter which can be measured by TGMTs and MODs. Requirements differing from EN 13848-1:2003+A1:2008 are highlighted in bold. The requirements of EN 13848-1:2003+A1:2008 are shown only for comparison purposes.

# 1 TRACK GAUGE

**Table 1: Track Gauge - Comparison with the requirements of EN 13848-1:2003+A1:2008**

| Characteristics           | Requirements for TGMT   | LRAIL  | Requirements for MOD  | Requirements of EN 13848-1:2003+A1:2008   | Comments |
|---------------------------|---|--|---|---|----------|
| <b>Measurement method</b> | Track gauge is the smallest distance between lines perpendicular to the running surface intersecting each rail head profile at point P in a range from 0 to Zp below the running surface. Zp is always 14 mm. | Inertially-corrected 3D laser triangulation. Track gauge is the smallest distance between lines perpendicular to the running surface intersecting each rail head profile at point P in a range from 0 to Zp below the running surface. Zp is always 14 mm. | Track gauge is the smallest distance between lines perpendicular to the running surface intersecting each rail head profile at point P in a range from 0 to Zp below the running surface. Zp is always 14 mm. | Track gauge is the smallest distance between lines perpendicular to the running surface intersecting each rail head profile at point P in a range from 0 to Zp below the running surface. Zp is always 14 mm. |          |
| <b>Wavelength range</b>   | N/A   | There is no effective limit for absolute value measurement.  | N/A   | N/A   |          |
| Resolution                | ≤ 0,5 mm  | ≤ 0,5 mm   | ≤ 0,5 mm  | ≤ 0,5 mm  |          |
| Uncertainty               | ± 1 mm  | ± 0.5 mm   | ± 1 mm  | ± 1 mm  |          |
| Analysis method           | No real time numerical analysis or additional processing required.  | 3D range analysis can be performed either in near-real-time or post-processed.   | No real time numerical analysis or additional processing required.  | Nominal value to peak value   |          |
| Output requirements       | Set of readings recorded in digital form.   | Set of readings recorded in digital form which can be presented in   | Digital or analogue output.   | Set of readings recorded preferably in digital form and shall also be   |          |



|                     |  |   |  |  |  |
|---------------------|--|---|--|--|--|
|                     |  | XML, CSV or SHP file formats.   |  | presented graphically.   |  |
| Output presentation | Track gauge or the difference between measured and nominal gauge | Absolute Track gauge measurement value or the difference between measured and nominal gauge | Track gauge or the difference between measured and nominal gauge | <ul style="list-style-type: none"> <li>• Individual defects</li> <li>• Track gauge</li> <li>• Difference between measured and nominal gauge</li> <li>• Mean track gauge over a specified distance</li> <li>• Variation of track gauge over a specified distance</li> </ul> |  |

## 2 LONGITUDINAL LEVEL

*Table 2: Longitudinal level - Comparison with the requirements of EN 13848-1:2003+A1:2008*

| Characteristics    | Requirements for TGMT  | LRAIL   | Requirements for MOD | Requirements of EN 13848-1:2003+A1:2008  | Comments   |
|--------------------|--|---|----------------------|--|--|
| Measurement method | Chord or inertial of at least one rail<br>Measurement of the mean of both rails is possible provided that cross level is measured simultaneously | Chord measurement from inertially-corrected 3D profile of the left and right rails. | Not applicable (N/A) | Inertial or chord<br>Both rails  | The points of the measurement base of the TGMT are unloaded. |
| Wavelength range   | D1 from chord measurement with re-colouring process or from inertial measurement   | Custom chord lengths can be applied automatically to LRAIL measurement outputs.     | N/A                  | <ul style="list-style-type: none"> <li>• D1</li> <li>• D2</li> <li>• D3</li> </ul> | Refer to DIN EN 13848-4 2012-03                              |
| Resolution         | ≤ 0,5 mm   | ≤ 0,25 mm (vertical)  | N/A                  | D1 to DC: ≤ 0,5 mm   |  |
| Uncertainty        | ± 1 mm   | ± 1 mm  | N/A                  | • D1: ± 1 mm   |  |



|                     |  |  |     |  |  |
|---------------------|--|--|-----|--|--|
|                     |  |  |     | <ul style="list-style-type: none"> <li>• D2: <math>\pm 3</math> mm</li> <li>• D3: <math>\pm 5</math> mm</li> </ul>   |  |
| Range               | $\pm 50$ mm  | There is no effective limit for absolute value measurement, however the customer's chord length will ultimately apply a limit. | N/A | <ul style="list-style-type: none"> <li>• D1: <math>\pm 50</math> mm</li> <li>• D2: <math>\pm 100</math> mm</li> <li>• D3: <math>\pm 300</math> mm</li> </ul> |  |
| Analysis method     | No real time numerical analysis or additional processing required. | 3D range analysis can be performed either in near-real-time or post-processed.   | N/A | Mean to peak value   |  |
| Output requirements | Set of readings recorded in digital form                           | Set of readings recorded in digital form which can be presented in XML, CSV or SHP file formats.                               | N/A | Set of readings recorded preferably in digital form and shall also be presented graphically.   |  |
| Output presentation | Longitudinal level based on D1                                     | Absolute value of longitudinal level.  | N/A | <ul style="list-style-type: none"> <li>• Isolated defects</li> <li>• Standard deviation over a 200 m length</li> </ul>                                       |  |

### 3 CROSS LEVEL

*Table 3: Cross level - Comparison with the requirements of EN 13848-1:2003+A1:2008*

| Characteristics           | Requirements for TGMT   | LRAIL   | Requirements for MOD  | Requirements of EN 13848-1:2003+A1:2008   | Comments |
|---------------------------|---|---|---|---|----------|
| <b>Measurement method</b> | Angle between running surface and horizontal reference plane. | Height difference between left and right rails. Slope angle can also be calculated. | Angle between running surface and horizontal reference plane. | <ul style="list-style-type: none"> <li>• Angle between running surface and horizontal reference plane.</li> <li>• Difference in height of 2 running tables</li> </ul> |          |



|                     |  |   |  |   |   |
|---------------------|--|---|--|---|---|
| Wavelength range    | N/A  | N/A   | N/A  | N/A   |   |
| Resolution          | ≤ 0,5 mm   | ≤ 0,25 mm<br>(vertical height difference between rails)   | ≤ 0,5 mm   | ≤ 0,5 mm  |   |
| Uncertainty         | ± 1,5 mm up to a speed of 5 km/h<br>± 3 mm for a speed greater than 5 km/h | ± 1,5 mm up to a speed of 5 km/h<br>± 3 mm for a speed greater than 5 km/h                      | ± 1,5 mm up to a cross level of 50 mm<br>± 2 mm for a cross level greater than 50 mm | ± 5 mm (relative value + 1 mm)  | For TGMT, at speeds greater than 10 km/h, a centrifugal force-compensated system is required. |
| Range               | ± 225 mm   | There is no effective limit for absolute value measurement.                                     | ± 225 mm   | ± 225 mm  |   |
| Analysis method     | No real time numerical analysis or additional processing required.         | 3D range analysis can be performed either in near-real-time or post-processed.                  | No real time numerical analysis or additional processing required.                   | Mean to peak value.   |   |
| Output requirements | Set of readings recorded in digital form                                   | Set of readings recorded in digital form which can be presented in XML, CSV or SHP file formats | Digital or analogue output   | Set of readings recorded preferably in digital form and shall also be presented graphically |   |
| Output presentation | Absolute value   | Absolute value  | Absolute value   | Absolute value  |   |

## 4 ALIGNMENT

**Table 4: Alignment - Comparison with the requirements of EN 13848-1:2003+A1:2008:**

| Characteristics     | Requirements for TGMT   | LRAIL  | Requirements for MOD | Requirements of EN 13848-1:2003+A1:2008   | Comments   |
|---------------------|---|--|----------------------|---|--|
| Measurement method  | Chord or inertial of at least one rail.<br>Measurement of the mean of both rails is possible provided that track gauge is measured simultaneously | Chord measurement from inertially-corrected 3D profile of the left and right rails.              | Not applicable (N/A) | Inertial or chord<br>Both rails   | The points of the measurement base of the TGMT are unloaded. |
| Wavelength range    | D1 from chord measurement with re-colouring process or from inertial measurement  | Custom chord lengths can be applied automatically to LRAIL measurement outputs.                  | N/A                  | <ul style="list-style-type: none"> <li>• D1</li> <li>• D2</li> </ul>  | Refer to DIN EN 13848-4 2012-03                              |
| Resolution          | ≤ 0,5 mm  | ≤ 0,25 mm  | N/A                  | D1 to D3: ≤ 0,5 mm  |  |
| Uncertainty         | ± 1 mm  | ± 1 mm   | N/A                  | <ul style="list-style-type: none"> <li>• D1: ± 1,5 mm</li> <li>• D2: ± 4 mm</li> <li>• D3: ± 10 mm</li> </ul>   |  |
| Range               | ± 50 mm   | There is no effective limit.   | N/A                  | <ul style="list-style-type: none"> <li>• D1: ± 50 mm</li> <li>• D2: ± 100 mm</li> <li>• D3: ± 500 mm</li> </ul> |  |
| Analysis method     | No real time numerical analysis or additional processing required.  | 3D range analysis can be performed either in near-real-time or post-processed.                   | N/A                  | Mean to peak value.   |  |
| Output requirements | Set of readings recorded in digital form.   | Set of readings recorded in digital form which can be presented in XML, CSV or SHP file formats. | N/A                  | Set of readings recorded preferably in digital form and shall also be presented graphically                     |  |
| Output presentation | Alignment based on D1   | Absolute value of alignment  | N/A                  | <ul style="list-style-type: none"> <li>• Isolated defects</li> </ul>  |  |



|  |  |  |  |  |  |
|--|--|--|--|--|--|
|  |  |  |  | • Standard deviation over a 200 m length |  |
|--|--|--|--|--|--|

**NOTE:** If the measurement is made on only one rail, account should be taken of the fact that in curves, the outer rail is always the reference rail and that re-colouration is not practicable when measuring a succession of curves of different hands.

## 5 TWIST

**Table 5: Twist - Comparison with the requirements of EN 13848-1:2003+A1:2008**

| Characteristics    | Requirements for TGMT  | LRAIL  | Requirements for MOD   | Requirements of EN 13848-1:2003+A1:2008   | Comments |
|--------------------|--|--|--|---|----------|
| Measurement method | Indirect measurement calculated from cross levels at a fixed interval                                    | Calculated from cross level  | The twist is not measured directly by MODs but the cross level measurement can be used subsequently to calculate the twist | Direct measurement at a fixed distance<br>• Calculated from cross level   |          |
| Wavelength range   | N/A  | There is no effective limit for absolute value measurement   | N/A  | N/A   |          |
| Resolution         | ≤ 0,5 mm   | ≤ 0,25 mm  | N/A  | ≤ 0,5 mm  |          |
| Uncertainty        | For short bases $l \leq 5,5$ m: $\pm 2/l$ mm/m<br>For long bases $5,5$ m $< l \leq 20$ m: $\pm 3/l$ mm/m | For short bases $l \leq 5,5$ m: $\pm 2/l$ mm/m<br>For long bases $5,5$ m $< l \leq 20$ m: $\pm 3/l$ mm/m | N/A  | For short bases $l \leq 5,5$ m:<br>$1/l$ mm/m (direct)<br>$+ 1,5/l$ mm/m (computed)<br>For long bases $5,5$ m $< l \leq 20$ m:<br>$2/l$ mm/m (direct)<br>$13/l$ mm/m (computed) |          |
| Range              | $\pm 15$ mm/m  | There is no effective limit for absolute value measurement   | N/A  | $\pm 15$ mm/m   |          |



|                     |   |  |     |   |  |
|---------------------|---|--|-----|---|--|
| Analysis method     | No real time numerical analysis or additional processing required | 3D range analysis can be performed either in near-real-time or post-processed                    | N/A | Zero to peak value<br><br>Mean to peak value  |  |
| Output requirements | Set of readings recorded in digital form                          | Set of readings recorded in digital form which can be presented in XML, CSV or SHP file formats. | N/A | Set of readings recorded preferably in digital form and shall also be presented graphically |  |
| Output presentation | Unprocessed values  | Absolute twist values  | N/A | Isolated defects<br>Standard deviation over a 200 m length                                  |  |

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