

# DIN EN 15302:2021-12 (E)

## Railway applications - Wheel- rail contact geometry parameters - Definitions and methods for evaluation

---

<b>Contents</b>		<b>Page</b>
European foreword .....		7
Introduction .....		8
1	Scope .....	9
2	Normative references .....	9
3	Terms and definitions .....	10
4	Symbols and abbreviations .....	11
5	Overview of the process for determining contact parameters .....	12
6	Description of wheel and rail profiles .....	12
6.1	General .....	12
6.2	Uncertainty of the measuring systems .....	14
7	Plausibility check and processing of measured wheel and rail profiles .....	15
8	Determining the wheel-rail contact positions and contact functions .....	16
8.1	General .....	16
8.2	Determining the rolling radius difference function .....	16
8.3	Other wheel-rail contact geometry functions .....	17
9	Determining the equivalent conicity and the related nonlinearity parameter .....	17
9.1	Background to equivalent conicity .....	17
9.1.1	Mathematical description of the kinematic lateral wheelset motion .....	17
9.1.2	Determining the wavelength of a coned wheelset .....	18
9.2	Determining the equivalent conicity .....	19
9.3	Determining the nonlinearity parameter .....	19
10	Determining the rolling radii coefficient .....	20
10.1	Background and definition .....	20
10.2	Determining point E for the calculation of the rolling radii coefficient .....	22
11	Other wheel-rail contact parameters .....	23
12	Testing of calculation software for contact geometry parameters .....	24
12.1	Overview .....	24
12.2	Validation of the calculation algorithms .....	24
12.3	Assessment of the smoothing process .....	24
13	Assessment of the complete process for determination of wheel-rail contact parameters .....	28
13.1	General .....	28
13.2	Reproducibility of contact parameter determination based on rail profile measurement .....	28
13.2.1	Manual rail profile measuring devices .....	28
13.2.2	Vehicle based rail profile measuring systems .....	29
13.3	Reproducibility of contact parameter determination based on wheel profile measurement .....	30
13.3.1	Manual wheel profile measuring devices .....	30

13.3.2	Ground based wheel profile measuring systems .....	30
	Annex A (informative) Example of presentation of contact geometry functions .....	32
	Annex B (informative) Derivation of the kinematic equation of wheelset motion .....	33
	Annex C (informative) Determination of the lateral peak displacements .....	36
	Annex D (informative) Method for determining the wavelength of the wheelset motion by two-step integration of the nonlinear differential equation .....	38
D.1	General .....	38
D.2	Step 1 .....	38
D.3	Step 2 .....	38
	Annex E (informative) Method for determining the wavelength of the wheelset motion by direct integration of the nonlinear differential equation .....	40
	Annex F (informative) Method for determining the equivalent conicity by linear regression of the r function .....	41
F.1	General .....	41
F.2	Concerns regarding the method .....	41
	Annex G (informative) Method for determining linearization parameters by harmonic linearization .	43
G.1	General .....	43
G.2	Concerns regarding the method .....	44
	Annex H (informative) Handling of special cases of the r function .....	45
	Annex I (normative) Reference profiles for testing .....	48
I.1	General .....	48
I.2	Wheel A .....	49
I.2.1	Drawing .....	49
I.2.2	Analytic definition .....	49
I.2.3	Cartesian coordinates .....	50
I.3	Wheel B .....	52
I.3.1	Drawing .....	52
I.3.2	Analytic definition .....	52
I.3.3	Cartesian coordinates .....	53
I.4	Wheel C .....	55
I.4.1	Drawing .....	55
I.4.2	Analytic definition .....	55
I.4.3	Cartesian coordinates .....	56
I.5	Wheel H .....	58
I.5.1	Drawing .....	58
I.5.2	Analytic definition .....	58
I.5.3	Cartesian coordinates .....	59
I.6	Wheel I .....	61
I.6.1	Drawing .....	61
I.6.2	Analytic definition .....	61
I.6.3	Cartesian coordinates .....	62
I.7	Rail A .....	64
I.7.1	Drawing .....	64
I.7.2	Analytic definition .....	64
I.7.3	Cartesian coordinates .....	65
	Annex J (normative) Calculation results with reference profiles .....	67
J.1	General .....	67

J.2	Wheel A/Rail A .....	68
J.2.1	Representation of contact points, diagrams of r, tan, tane functions and representation of kinematic rolling movement of the wheelset on track .....	68
J.2.2	Numerical values for r function .....	69
J.2.3	Numerical values for tane function .....	70
J.3	Wheel B/Rail A .....	72
J.3.1	Representation of contact points, diagrams of r, tan, tane functions and representation of kinematic rolling movement of the wheelset on track .....	72
J.3.2	Numerical values for r function .....	73
J.3.3	Numerical values for tane function .....	74
J.4	Wheel C/Rail A .....	76
J.4.1	Representation of contact points, diagrams of r, tan, tane functions and representation of kinematic rolling movement of the wheelset on track .....	76
J.4.2	Numerical values for r function .....	77
J.4.3	Numerical values for tane function .....	79
J.5	Wheel H/Rail A .....	81
J.5.1	Representation of contact points, diagrams of r, tan, tane functions and representation of kinematic rolling movement of the wheelset on track .....	81
J.5.2	Numerical values for r function .....	82
J.5.3	Numerical values for tane function .....	83
J.6	Wheel I/Rail A .....	85
J.6.1	Representation of contact points, diagrams of r, tan, tane functions and representation of kinematic rolling movement of the wheelset on track .....	85
J.6.2	Numerical values for r function .....	86
J.6.3	Numerical values for tane function .....	87
J.7	Modified Wheel A (-2 mm on left wheel diameter)/Rail A .....	89
J.7.1	Representation of contact points, diagrams of r, tan, tane functions and representation of kinematic rolling movement of the wheelset on track .....	89
J.7.2	Numerical values for r function .....	90
J.7.3	Numerical values for tane function .....	91
J.8	Modified Wheel B (-2 mm on left wheel diameter)/Rail A .....	93
J.8.1	Representation of contact points, diagrams of r, tan, tane functions and representation of kinematic rolling movement of the wheelset on track .....	93
J.8.2	Numerical values for r function .....	94
J.8.3	Numerical values for tane function .....	95
J.9	Modified Wheel H (-2 mm on left wheel diameter)/Rail A .....	97
J.9.1	Representation of contact points, diagrams of r, tan, tane functions and representation of kinematic rolling movement of the wheelset on track .....	97
J.9.2	Numerical values for r function .....	98
J.9.3	Numerical values for tane function .....	99
J.10	Modified Wheel I (-2 mm on left wheel diameter)/Rail A .....	101
J.10.1	Representation of contact points, diagrams of r, tan, tane functions and representation of kinematic rolling movement of the wheelset on track .....	101
J.10.2	Numerical values for r function .....	102
J.10.3	Numerical values for tane function .....	103
J.11	(Right Wheel A - Left Wheel B)/Rail A .....	105
J.11.1	Representation of contact points, diagrams of r, tan, tane functions and representation of kinematic rolling movement of the wheelset on track .....	105
J.11.2	Numerical values for r function .....	106
J.11.3	Numerical values for tane function .....	107
<b>Annex K (normative) Tolerances on equivalent conicity for testing calculations .....</b>		<b>109</b>
K.1	General .....	109
K.2	Wheel A/Rail A .....	110
K.2.1	Diagram .....	110
K.2.2	Numerical values .....	111
K.3	Wheel B/Rail A .....	113
K.3.1	Diagram .....	113
K.3.2	Numerical values .....	114
K.4	Wheel C/Rail A .....	116
K.4.1	Diagram .....	116

K.4.2	Numerical values .....	117
K.5	Wheel H/Rail A .....	119
K.5.1	Diagram .....	119
K.5.2	Numerical values .....	120
K.6	Wheel I/Rail A .....	122
K.6.1	Diagram .....	122
K.6.2	Numerical values .....	123
K.7	Modified Wheel A (-2 mm on left wheel diameter)/Rail A .....	125
K.7.1	Diagram .....	125
K.7.2	Numerical values .....	126
K.8	Modified Wheel B (-2 mm on left wheel diameter)/Rail A .....	128
K.8.1	Diagram .....	128
K.8.2	Numerical values .....	129
K.9	Modified Wheel H (-2 mm on left wheel diameter)/Rail A .....	131
K.9.1	Diagram .....	131
K.9.2	Numerical values .....	132
K.10	Modified Wheel I (-2 mm on left wheel diameter)/Rail A .....	134
K.10.1	Diagram .....	134
K.10.2	Numerical values .....	135
K.11	(Right Wheel A - Left Wheel B)/Rail A .....	137
K.11.1	Diagram .....	137
K.11.2	Numerical values .....	138
Bibliography .....		140