

DIN EN 15302:2021-12 (E)

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

Contents		Page
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
Annex K (normative) Tolerances on equivalent conicity for testing calculations		109
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