INTEROPERABILITY UNIT

TECHNICAL DOCUMENT

SPECIFIC PROCEDURES FOR RUNNING DYNAMICS

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AMENDMENT RECORD

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1. Specific assessment concerning running dynamic testing following EN 14363

1.1. Conditions for testing on one rail inclination

- The parameter equivalent conicity tan γ_e for tangent track and large radius curves shall be distributed so that tan γ_e = 0,2 ± 0,05 occurs in a range of the amplitude (y) of the wheelsets lateral displacement between +/-2 and +/-4 mm for a minimum of 50% of track sections.
- The instability criterion in EN14363:2005 shall be assessed for low-frequency body motions on at least two track sections with equivalent conicities less than 0.05 (mean value over the track sections).
- The instability criterion in EN14363:2005 shall be assessed on at least two track sections with equivalent conicities in accordance with table 1.

Table 1: Conditions for contact conditions in relation to on-track testing

Maximum vehicle speed	Equivalent conicity
60 km/h < V ≤ 140 km/h	≥0,50
140 km/h < V ≤ 200 km/h	≥0,40
200 km/h < V ≤ 230 km/h	≥0,35
230 km/h < V ≤ 250 km/h	≥0,30

1.2. Limit values for running safety

The limit values for running safety specified in clause 5.3.2.2 of EN 14363:2005 and for axle loads above 22.5 t in clause 5.3.2.2 of EN 15687:2010 shall be met and verified.

When the quotient of guiding force and wheel force (Y/Q) limit is exceeded, it is allowed to recalculate the Y/Q estimated maximum value in accordance with the following process:

- create an alternative test zone made up of all track sections with 300 m ≤ R ≤ 500 m,
- for the statistical processing per section, use xi (97,5%) instead of xi (99,85%),
- for statistical processing per zone, replace k=3 (when using one-dimensional method) or Student coefficient t (N-2; 99%) (when using two-dimensional method) by Student coefficient t (N-2; 95%).

Both results (before and after recalculation) shall be reported.

1.3. Track loading limit values

The limit values for track loading specified in EN 14363:2005 clause 5.3.2.3 and for loads above 22,5 t in EN 15687:2010 clause 5.3.2.2 shall be met and verified when so required by the methodology of EN 14363:2005.

The quasi-static guiding force Y_{qst} limit value shall be evaluated for curve radii $250 \leq R < 400$ m.

The limit value shall be:

- $(Y_{qst})_{lim} = (30 + 10500/R_m)$ kN
- $(Y_{qst})_{lim} = (33 + 11550/R_m)$ kN for the 1668 mm track gauge network,

where Rm = mean radius of the track sections retained for the evaluation.

When this limit value is exceeded due to high friction conditions, it is permitted to recalculate the estimated value of Y_{qst} on the zone after replacing the individual $(Y_{qst})_i$ values on the track sections "i" where $(Y/Q)_{ir}$ (mean value of Y/Q ratio on the inner rail over the section) exceeds 0,40 by: $(Y_{qst})_i - 50[(Y/Q)_{ir} - 0,4]$. Both results (before and after recalculation) shall be reported.

The values of the Y_{qst}, Q_{qst} and mean curve radius (before and after recalculation) shall be recorded in the test report.

In case the Y_{qst} value exceeds the limit value expressed above, the operational performance of the unit (e.g. maximum speed) may be limited by the network, considering track characteristics (e.g. curve radius, cant, rail height).

2. Qualification of running gear

Following successful testing the acceptable parameter variation range is given by the range between the nominal tested parameters extended as illustrated in figure 2.

It is permitted to perform only one test and by doing so only validating the running gear for a limited range.

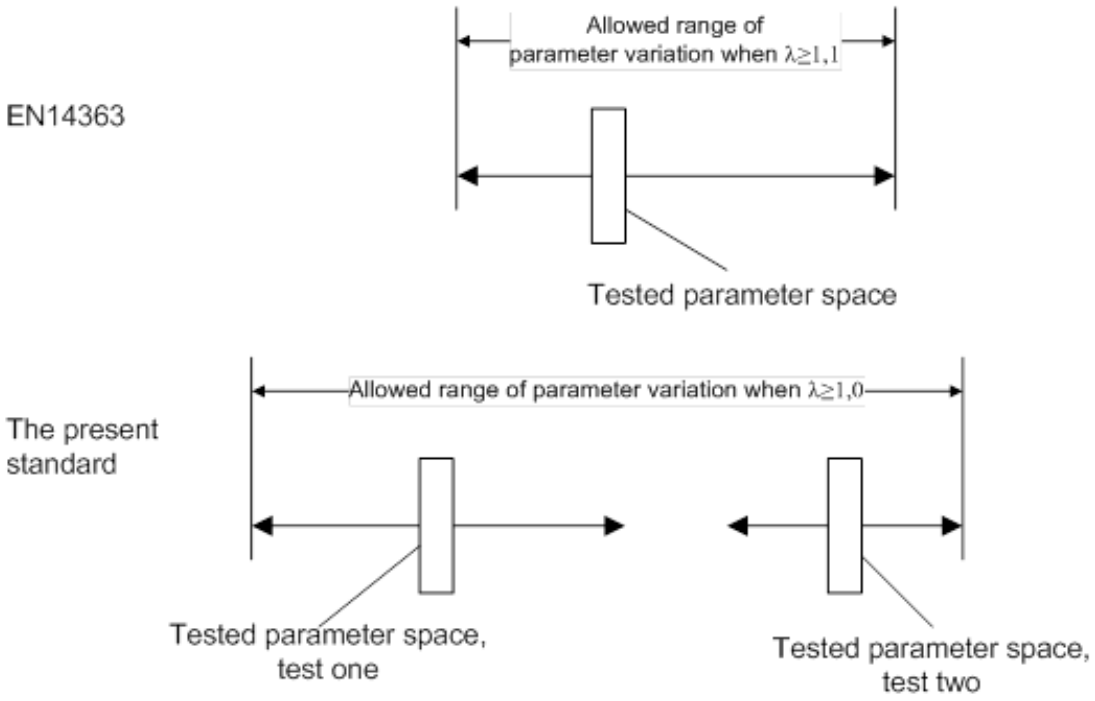

Figure 2: Parameter variation ranges for the acceptance after successful testing compared to the process in EN 14363:2005

2.1. Test extent

The tests shall be carried out in accordance with the complete procedure in chapter 5 of EN14363:2005, considering the specific procedures as set out in chapter 1.

Units with an axle load higher than 22,5 t up to 25t shall be tested in accordance with EN 15687:2010. The tests shall be performed for the same intended operating conditions (vadm and Iadm):

- One test with a wagon of short running gear distance.
- One test with a wagon of long running gear distance

Other values of body parameters shall be within the ranges defined in table 3.

Table 3:Body parameters

		2-axle wagons		Bogie wagons	
		Short test wagon	**Long test wagon**	**Short test wagon**	**Long test wagon**
Distance between running gear	$2a^*$ [m] a)	≤ 7	≥ 9	≤ 7	≥ 13
Acceptable range of torsional coefficient of vehicle body	c_t^* [kNmm²/rad]	$0{,}5 \times 10^{10}$ ... 8×10^{10}			
a) 2a* is the distance between wheelsets for 2-axle wagons or the distance between bogies for bogie wagons and ct* is the vehicle body torsional stiffness coefficient.					

Note 1: For the purposes of assessment of running behaviour a typical loading condition must be tested. It is not necessary to test the worst position of the centre of gravity.

In addition, two axle wagons for speeds ≥100 km/h shall be tested in loaded condition also in sections of test zone 2 with clearances given by a gauge of ≥1450 mm in combination with wheelsets having distances between active faces at the minimum operation limit.

If the design parameters and the operation parameters require the application of the normal measuring method, it is nevertheless acceptable to perform such tests with one of the vehicles based on measurements of lateral acceleration. In that case, it shall be demonstrated that a relationship exists between accelerations and the sum of the guiding forces on the vehicle tested according to the normal measuring method and a related limit value shall be established.

Note 2: This requirement is an extension of the application of the simplified measuring method, using information gathered with vehicle tested according to the normal measuring method.

Note 3: This requirement is intended to be transferred to the test conditions in EN 14363:2005.

2.2. Range of running gear parameters for dispensation from on-track tests

Following successful testing in accordance with section 2.1 the acceptable parameter variation range for dispensation from on-track tests is given by the range between the nominal tested parameters of the running gear and the extended range as illustrated in figure 2 and specified in tables 4 and 5.

All parameters given in these tables are nominal values. The upper limit of the acceptable range depends on the maximum tested value of the respective parameter, the lower limit on the minimum tested value.

In case of extension of the already applicable parameter range of a running gear, new tests shall be performed with parameters outside the previously tested range.

Table 4: Accepted parameter ranges for a single axle running gear which was tested successfully in accordance with section 2.1

Nominal parameter		**Minimum**	**Maximum**
Maximum axle load	P	-	P_{tested}
Vertical eigenfrequency	ν_z	0.9 ν_z in load range	1.12 ν_z in load range
Vertical damping		Nominal characteristics of tested running gear	
Lateral and longitudinal suspension characteristics		Nominal characteristics of tested running gear	
Distance between centres of axle bearings (suspension base)	$2b_z$	$2b_{z,\ tested}$ -100 mm	$2b_{z,\ tested}$ +170 mm
Wheel diameter	D	Diameter of tested application D_{tested} –90 mm	Diameter of tested application D_{tested} +90 mm

Table 5: Accepted parameter ranges for a bogie which was tested successfully in accordance with section 2.1

Nominal parameter		Minimum	Maximum
Maximum axle load	P_{max}	-	$1,05 \cdot P_{max,tested}$
Bogie axle distance (between outer axles of the bogie)	$2a^{+}$	$2a^{+}_{tested}$	$2a^{+}_{tested}$ + 0,2 m
Vertical eigenfrequency (see Appendix C)	ν_z	$0,90 \cdot \nu_{z,tested}$ in full range between empty and loaded conditions	$1,12 \cdot \nu_{z,tested}$ in full range between empty and loaded conditions
Vertical Damping		Nominal characteristics of tested running gear	
Axle guiding longitudinal		Nominal characteristics of tested running gear	
Axle guiding lateral		Nominal characteristics of tested running gear	
Lateral secondary susp. characteristics		Nominal characteristics of tested running gear	
Distance between centres of axle bearings (suspension base)	$2b_z$	$2b_z$, tested -100 mm	$2b_z$, tested +170 mm
Yaw resistance of bogie[a)]	M^{*}_z	$0,80 \cdot M^{*}_{z,tested}$	$1,20 \cdot M^{*}_{z,tested}$
Moment of inertia of whole bogie (around z-axis)	I^{*}_{zz}	-	$1,10 \quad I^{*}_{zz,tested}$
Wheel diameter	D	D_{tested} –90 mm	D_{tested} +90 mm
Nominal height of centre pivot	h_{cp}	$h_{cP,tested}$ – 150 mm	$h_{cP,tested}$ + 50 mm

a) for a friction based yaw resistance torque measured at two specified loads typical for empty and loaded condition. For other systems, appropriate parameters must be used to control stability and safety against derailment in empty condition and maximum guiding force in loaded conditions.

2.3 Range of vehicle body parameters for dispensation from on-track tests

Following successful testing according to section 2.1 the acceptable parameter variation range for a dispensation from on-track tests is given by the range between the nominal tested parameters of the vehicle body and the extended range where applicable as specified in table 6. All parameters given in this table are nominal values. The upper limit of the acceptable range depends on the maximum tested value of the respective parameter, the lower limit on the minimum tested value.

To extend the applicable vehicle parameter range of a standardised running gear, test results of a third tested vehicle outside the previously tested range shall be used.

Table 6: Accepted parameter range for vehicles (including articulated wagons and permanently coupled units) equipped with a running gear which was tested successfully according to section 2.1

Nominal parameter		Minimum	Maximum
Distance between wheelsets (non bogie vehicles)	$2a^*$	Lowest value of either 6 m or $2a^*_{tested}$	Highest value of either 10 m or $2a^*_{tested}$
Distance between centres bogies (bogie vehicles)	$2a^*$	Lowest value of either 6,5 m or $2a^*_{tested}$	$2a^*_{tested}$ + 3m
Centre of gravity height of empty wagon	h_{cg}	-	$1,2 \cdot h_{cg,empty,tested,\,max}$
Coefficient of height of centre of gravity - loaded vehicle [a)]	χ	-	$\chi_{loaded,tested,max}$ x (1+0,8(λ'-1)) with λ' – factor for track loading parameters.
Torsional coefficient per vehicle body	c_t^*	> 0,5 10^{10} kNmm²/rad	'-
Mean axle load of the tare unit (non-bogie wagon)	$P_{mean,tare}$	Smallest value of either 5,75 t or $P_{mean,tare,tested}$	-
Mean axle load of the tare unit (bogie wagon)	$P_{mean,tare}$	Smallest value of either 4 t or $P_{mean,tare,tested}$	-
Maximum axle load	P	-	$1,05 \cdot P_{tested}$
Mass distrib. coefficient (empty and loaded vehicle)	Φ	-	$1,2 \cdot \Phi_{tested}$

a) for evaluation of χ use admissible cant deficiency Iadm of 130 mm for axle loads ≤ 225 kN and 100 mm for axle loads> 225 kN and up to 250 kN.