COMMISSION

COMMISSION RECOMMENDATION

of 21 March 2001

on the basic parameters of the trans-European high-speed rail system referred to in Article 5(3)(b) of Directive 96/48/EC

(notified under document number C(2001) 745)

(Text with EEA relevance)

(2001/290/EC)

THE COMMISSION OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Community,

Having regard to Council Directive 96/48/EC of 23 July 1996 on the interoperability of the trans-European high-speed rail system [1], and in particular Article 6(1) thereof,

Whereas:

(1) The first stage in developing technical specifications for interoperability (TSIs) is to establish the characteristics of the basic parameters referred to in Article 5(3)(b) of Directive 96/48/EC.

(2) The Committee set up by Directive 96/48/EC has appointed the European Association for Railway Interoperability (AEIF) as the joint representative body in accordance with Article 2(h) of that Directive.

(3) The AEIF has drafted a text which includes definitions and proposals of characteristics to be respected for a number of basic parameters, based on the list contained in Annex II to Directive 96/48/EC and by adding those judged necessary in terms of interoperability.

(4) The first objective of this Recommendation is to guide the technical choices made by authorities responsible for planning, constructing, upgrading and operating the infrastructure and rolling stock to be put into service after the date on which this Recommendation takes effect, contributing to the operation of the rail system referred to in Directive 96/48/EC.

(5) The second objective of this Recommendation is to establish a common basis for the elaboration of TSIs. It does not preclude the need to establish these parameters in the corresponding TSIs, which will be adopted in accordance with Article 6(1) of Directive 96/48/EC. These parameters can also be updated as part of the review of the TSIs provided for in Article 6(2) of that Directive. In this context, the final results of the Safetrain project shall be taken into account in the revision of the parameter on boundary mechanical characteristics of rolling stock, as soon as they are made available to AEIF.

(6) Directive 96/48/EC provides for special implementing provisions in some specific cases. The specific cases mentioned in this Recommendation are not intended to be an incentive to maintain network discrepancies but rather a recognition of current important national specificities.

(7) The provisions contained in this Recommendation are in accordance with the opinion of the Committee set up by Directive 96/48/EC,

HEREBY RECOMMENDS:

1. The definitions and characteristics which should be respected for a number of basic parameters of the trans-European high-speed railway system referred to in Article 5(3)(b) of Directive 96/48/EC are given in the Annex to this Recommendation.
2. This Recommendation is addressed to the Member States.

Done at Brussels, 21 March 2001.

For the Commission

Loyola DE PALACIO

Vice-President

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[1] OJ L 235, 17.9.1996, p. 6.

ANNEX

Preamble:

In the text that follows:

(a) the three line categories defined in Annex I(1)(b) to Council Directive 96/48/EC of 23 July 1996 on the interoperability of the trans-European high-speed rail system, are referred to as:

— category I: specially built high-speed lines equipped for speeds generally equal to or greater than 250 km/h,

— category II: specially upgraded high-speed lines equipped for speeds of the order of 200 km/h,

— category III: specially upgraded high-speed lines which have special features as a result of topographical, relief or town-planning constraints, on which the speed must be adapted to each case.

(b) The specific cases provided for in Article 5(3)(d) of Directive 96/48/EC are mentioned. However, the conditions of application for the TSIs in these specific cases will be determined in the corresponding TSIs, as well as the tolerances when these are not included in the present Recommendation.

(c) Ireland and Northern-Ireland are not subject to the characteristics to be respected in the following basic parameters: 1, 2, 3, 5, 6, 8 and 16. Appropriate specific cases will be defined in the TSIs for these basic parameters in the context of the Irish standard structure gauge for new works, and the Irish standard track gauge of 1 602 mm for continuously welded track.

1. MINIMUM GAUGES FOR INFRASTRUCTURE AND ROLLING STOCK

1.1. Description of the parameter

The gauge is a concept designed to define external sizes so that rolling stock can be operated without encountering any obstacle associated with fixed installations (tunnel walls, catenary or signal posts, bridge parapets, platforms, etc.). The parameter is thus two-fold: the structure gauge which defines the minimum size of the infrastructure, and the gauge of the rolling stock which defines its maximum size.

1.1.1. *Structure gauge*

This is related to the infrastructure. It must leave the defined cross-section totally free of obstacles.

1.1.2. *Rolling stock gauge*

This is defined in terms of the envelope within which the rolling stock is contained when operating.

1.1.3. *Interaction rolling stock/structure gauges*

Using the above definitions, the gauge of rolling stock travelling on a given line section must always be smaller, by an appropriate safety margin, than the structure gauge of the line in question.

1.2. Characteristics to be respected

1.2.1. *Infrastructure gauges*

The minimum gauge for infrastructure on future category I lines is the GC gauge.

The minimum gauge for infrastructure on existing category I lines and category II lines is the GB gauge. The GC gauge is recommended where an economic survey can prove the advantages of such an investment.

1.2.2. *Rolling stock subsystem*

The three UIC gauges 505-1, GB and GC are applicable. Operators can chose the gauge they consider most appropriate to their needs, taking into account the structure gauge of the routes on which the rolling stock will be operated.

1.2.3. *Special cases*

In Great Britain the UK1 gauge is being used for category II and III lines and rolling stock being operated on these lines.

The FIN1 gauge is being used for lines on the territory of Finland.

2. MINIMUM RADIUS OF CURVATURE

2.1. Description of the parameter

The radius of curvature of a track determines the amplitude of curvature in the track when it is not straight. The radius of curvature, the cant and the cant deficiency and the maximum speed at which a vehicle can operate on the curve are four interdependent parameters.

The minimum radius of curvature will be based on three other parameters: maximum cant, maximum deficiency and the maximum speed permitted on the line by the infrastructure operator.

2.2. Characteristics to be respected

The following characteristics refer to the standard track gauge as defined in point 3. For other gauges, equivalent provisions are to be defined in the correspondent TSIs.

2.2.1. *Cant*

The cant chosen for new high-speed lines in the design phase shall be limited to 180 mm. On tracks in operation, a maintenance tolerance of ± 20 mm is allowed, without trespassing a maximum cant of 190 mm.

This value may be raised to 200 mm maximum on tracks reserved for passenger traffic alone.

2.2.2. *Cant deficiency*

2.2.2.1. Lines specially built for high speed

The cant deficiency value chosen in the design phase for these lines shall be limited to the values shown in the table below, according to the maximum speed of the line:

High-speed lines	Speed range (km/h)	Limiting value (mm)
	$250 \leq V \leq 300$	100
	$300 < V$	80

Values of cant deficiency higher than shown in the above table may be allowed for lines whose construction involves very tough topographical constraints. These will be specified in the TSI on infrastructure.

2.2.2.2. Lines specially upgraded for high speed and connecting lines

The cant deficiency allowed for high-speed trains on upgraded existing lines and their connecting lines shall be limited by design to the values in the table below, according to the line's maximum speed:

Upgraded lines	Speed range (km/h)	Limiting value (mm)
	$V \leq 160$	160
	$160 < V \leq 200$	150
	$200 < V \leq 230$	140
	$230 < V < 250$	130

The same values may be applied on existing high-speed lines.

Values of cant deficiency higher than shown in the above table may be allowed for lines whose construction involves very tough topographical constraints. These will be specified in the TSI on infrastructure.

2.2.2.3. Cant deficiency on diverging track of switches

During project design, the maximum values of cant deficiency on diverging track of switches shall be:

— 120 mm for switches allowing turnout speeds of $30 \leq V \leq 70$ km/h,

— 100 mm for switches allowing turnout speeds of $70 < V \leq 170$ km/h,

— 85 mm for switches allowing turnout speeds of $170 < V \leq 230$ km/h.

A tolerance of 10 mm on the previous values may be accepted for existing switches laid on lines to be upgraded for high speed.

2.2.3. *Tilting trains*

Authorisation to operate at a higher speed is granted to tilting trains or trains that are fitted with systems which enhance their performance under the condition that access for interoperable trains not fitted with similar equipment will not be restricted.

2.2.4. *Sidings and stabling tracks*

The minimum curve radius in sidings and stabling tracks is 150 m for the theoretical radius, with a maintenance tolerance of 25 m.

3. TRACK GAUGE

3.1. Description of the parameter

Track gauge is the distance between the gauge faces of the railheads measured at a height of 14,5 mm (± 0,5 mm) below the rail running surface.

3.2. Characteristics to be respected

The track gauge is set at 1 435 mm, based on the standard European network. The theoretical design values can be between 1 435 and 1 437 mm. Tolerances are to be defined in the infrastructure TSI.

3.3. Specific cases

The following values are acceptable:

— a gauge of 1 524 mm may be used on the territory of Finland;

— a gauge of 1 668 mm on the territory of Portugal, for lines of categories II and III.

4. MAXIMUM TRACK STRESSING

4.1. Description of the parameter

Any vehicle being operated on a rail track generates interaction forces at the level of rail-wheel contact in three directions: vertically, transversally and longitudinally.

These interaction forces are mainly due to the physical properties of the guided railway system given below:

— vertical static load of the vehicle,

— quasi-static load due to operating on curves for transversal forces, where they depend directly on cant deficiency at high speed, or to accelerating or decelerating forces for longitudinal forces,

— dynamic load due to faults in track geometry along the vertical and transversal planes, resulting from the track's geometry quality, cant deficiency and the design of the vehicle suspension,

— dynamic load due to the possible instability of the bogies, resulting from parameters associated with wheel-rail contact.

4.2. Characteristics to be respected

The following rules must be respected:

— infrastructure shall be able to withstand at least a lateral load per axle equal to

$$H_{\text{lim}} = 10 + \frac{P}{3}$$

in kN, P being in kN the static load per axle of any interoperable train,

— all interoperable vehicles shall demonstrate that they will not transmit to the track a lateral load higher than

$$H_{lim} = 10 + \frac{P}{3}$$

P being in kN the static load per axle of this vehicle,

— limit the quotient of transversal and vertical load on a wheel: $(Y/Q_{lim}) = 0,8$, where Y is the dynamic transverse force and Q_{lim} is the vertical force exerted by a wheel on the rail,
— avoid bogie instability by controlling the 'equivalent conicity' parameter to 0,15 with used rails and wheels,
— limit longitudinal acceleration to 2,5 m/s^2.

The above criteria must be respected, given the following provisos:

— the maximum value of the static axle load P is given in section 9,
— the maximum limit of the dynamic wheel load (Q) is:

V = 250 km/h	Q ≤ 180 kN
250 < V ≤ 300 km/h	Q ≤ 170 kN
V > 300 km/h	Q ≤ 160 kN

— the equivalent conicity shall be equal to or less than: 0,25 for speeds less than or equal to 280 km/h; 0,30 for speeds less than or equal to 250 km/h; 0,35 for speeds less than or equal to 230 km/h; 0,40 for speeds less than or equal to 200 km/h. Speeds higher than 230 km/h concern category I lines and speeds less than or equal to 250 km/h concern categories II and III lines.

5. MINIMUM PLATFORM LENGTH AND MAXIMUM TRAIN LENGTH

5.1. Description of the parameter

The whole train set of a passenger train must be positioned along a platform when it stops in a scheduled station to enable passengers to board and leave the train safely. This requires a match between the length of the platform and the train set. The length of the platform must be adapted to the operational length of the train set, as well as to certain operating rules such as good visibility of the departure signal.

5.2. Characteristics to be respected

— Train length: less than or equal to 400 m (with a tolerance of 1 %),
— Operational length of a platform: at least 400 m.

5.3. Specific cases

The following values are acceptable:

— on the territory of Great Britain and category II/III lines: maximum train length of 320 m and minimum operational platform length of 300 m,
— on the territory of Sweden: minimum operational platform length of 225 m,
— on the territory of Denmark: the minimum operational platform length is 320 m,
— on the territory of Finland: the minimum operational platform length is 350 m.

6. PLATFORM HEIGHT

6.1. Description of the parameter

Platform height is measured between the track running surface and the platform surface along the perpendicular.

6.2. Characteristics to be respected

The two permissible platform heights: 550 and 760 mm.

6.3. Specific cases

The following values are acceptable:

— on the territory of Great Britain, a platform height of 915 mm,

— on the territory of the Netherlands, a platform height of 840 mm.

7. POWER SUPPLY VOLTAGE

7.1. Description of the parameter

The average power voltage and spectrum available at the pantographs must be specified.

7.2. Characteristics to be respected

7.2.1. *Category I lines*

The power supply voltage for this category is 25 kV 50 Hz.

In countries with networks currently electrified at 15 kV 16⅔ Hz AC, this system may be used for new lines. The same system may also be applied in adjacent countries when it can be economically justified; in accordance with Article 7 of Directive 96/48/EC.

3 kV DC may be used in Italy for existing lines and for sections of new lines up to 250 km/h where 25 kV 50 Hz lines run the risk of disturbing ground-based and on-board signalling equipment on an existing line adjacent to the new line.

7.2.2. *Existing category I lines and lines in categories II and III*

The following voltages are to be used: 1,5 kV and 3 kV DC, 15 kV 16⅔ Hz and 25 kV 50 Hz AC.

8. CATENARY GEOMETRY

8.1. Description of the parameter

High-speed trains are supplied from the overhead contact line by means of pantographs. The reliable interaction of overhead contact line and pantograph is an important condition for the interoperable trans-European high-speed rail system. The interaction depends on the compatibility of the geometry of overhead contact lines and pantographs which is defined by the contact wire height, the permissible lateral position of the contact wire with and without action of crosswinds and on the dimensions of pantographs. The selection of the contact wire height depends also on the climatic conditions to be considered, especially on the ice load which could occur along the line route.

8.2. Characteristics to be respected

8.2.1. *Contact wire height*

On high-speed lines a constant contact wire height should be used in a defined part of the trans-European high-speed rail system, characterised for example by the adopted electrification system. Two values are possible: 5 080 mm and 5 300 mm. The latter value should be used where ice loads have to be considered.

For direct current lines a minimum contact wire height of 5 000 mm can be specified as the same level of safety would result as in the case of alternative current lines with 5 080 mm.

On category II and III lines, the contact wire height is subject to the limits set by local conditions. Special care has to be given to the transitions between differing contact wire heights. The following permissible gradients must be met:

Speed up to (km/h)	Maximum gradient	Maximum change in gradient
120	4 ‰	2 ‰
160	3,3 ‰	1,7 ‰
200	2 ‰	1 ‰
250	1 ‰	0,5 ‰

8.2.2. *Dimension of pantographs*

The width of the European standard pantograph collector head is 1 600 mm with a working range of 1 200 mm and a length of the collector strips of 800 mm.

8.2.3. *Permissible maximum lateral position*

The permissible lateral position of the contact wire has to be adjusted to the working range of the pantograph head and collector strips. The permissible maximal lateral deflection of the contact wire under crosswind is 400 mm.

8.2.4. *Specific cases*

8.2.4.1. Germany, Austria, Spain and Sweden

Trains circulating on existing category I lines, on category II and category III lines, as well as in the stations, must be equipped with secondary 1 950 mm pantographs.

8.2.4.2. Great Britain

The nominal contact wire height on category II and III lines in the United Kingdom is 4 720 mm (minimum 4 170 mm, maximum 5 940 mm).

8.2.4.3. Finland

The height of the contact wire is 6 150 mm. Trains may be equipped with 1 950 mm pantographs.

9. AXLE LOAD

9.1. Description of the parameter

When a train circulates on a rail track, the rail undergoes load strain and this must be tolerated. These loads are both static and dynamic and are transferred to the track through the axles.

The track and rolling stock must be constructed and maintained in such a way as to ensure that these loads remain within the line safety limits.

9.2. Characteristics to be respected

Axle load applied to the track may not exceed 170 kN.

For speeds less than or equal to 250 km/h, an axle load of 180 kN is accepted in the case of motorised axles.

A tolerance of 4 % is permitted for each of the axles and a tolerance of 2 % for the average load on the axles of the same train.

10. BOUNDARY ELECTRICAL CHARACTERISTICS OF ROLLING STOCK

10.1. Description of the parameter

This parameter targets the following characteristics:

(a) the voltage and frequency of the electricity supply,

(b) the power factor,

(c) the interference generated on the signalling and telecommunication system,

(d) radio frequency interference,

(e) electromagnetic immunity of on-board equipment.

10.2. Characteristics to be respected

The characteristics to be respected are the following:

(a) voltage and frequency of the electricity supply:

The voltage at the terminals of the substation and at the pantograph(s) shall comply with prEN 50 163 draft 1, 1/2000, section 4.1. Principal values are given below:

Power supply system	Lowest permanent voltage U_{min1} Volt	Nominal voltage Volt	Highest permanent voltage U_{max1} Volt
DC	1 000	1 500	1 800
(mean value)	2 000	3 000	3 600
AC	12 000	15 000	17 250
(mean value)	19 000	25 000	27 500

In AC 25 kV 50 Hz systems the frequency may vary between 49 and 51 Hz, in AC 15 kV 16⅔ Hz systems between 16⅓ and 17 Hz;

(b) power factor: a minimum value of 0,95 must be respected for rolling stock running on category I lines. A full set of power factor requirements are given in prENXXX(CII);

(c) interference generated on the signalling and telecommunication system: these characteristics vary in relation to the signalling and telecommunication system and will be specified in the corresponding TSIs. They will be covered by a heading in the infrastructure register;

(d) radio frequency interference: European standard 50 121;

(e) electromagnetic immunity of on-board equipment: European standard 50 121.

11. BOUNDARY MECHANICAL CHARACTERISTICS OF ROLLING STOCK

11.1. Description of the parameter

All rolling stock must protect passengers and staff in the event of a collision accident. This protection is based on building methods that must absorb the energy of the collision, restrict deformation of carriage bodies and prevent overriding.

Three collision scenarios are defined:

1. symmetrical collision at a relative speed of 36 km/h between the same high-speed train sets;
2. collision at a speed of 36 km/h between one high-speed train set and a rail vehicle equipped with side buffers (freight car compliant with UIC 571-2 leaflet, 80 t in weight);
3. collision at a speed of 110 km/h on a level crossing with a road vehicle of 15 t represented by a rigid mass above top-of rail with a vertical impact surface.

11.2. Characteristics to be respected

Scenario 1: the driver's cabin must not deform.

Scenarios 2 and 3: the driver's cabin may deform. In the rear of the cabin, there must be a non-deforming survival space for the driver of at least 0,75 m in length, and there must be free access to the side doors or to the technical room or passenger compartment located behind the cabin.

In other respects:

— at least 6 MJ of energy must be absorbed, 75 % of it in the front of the first car in the train set; the rest must be spread over each intercar along the train set;

— there must be an enhanced resistance for passenger compartments in the front car and for the driver's survival space. The sections limiting these spaces must be designed with static resistance of at least 1 500 kN over the average crash train of the fusible areas for all three test collisions,

— the resistance of the other cars must be consistent with that of the cars at the front and back of the train set,

— crash-generated forces across fusible areas must not lead to an average deceleration of more than 5 g in the passenger compartments of the front car and in the driver's survival space,

— there must be systems to prevent overriding at the front of the train and between each vehicle.

12. BOUNDARY CHARACTERISTICS LINKED TO OUTSIDE ELECTROMAGNETIC INTERFERENCE

12.1. Description of the parameter

Electromagnetic compatibility must be specified:

— between control/command subsystem equipment and the outside of the high-speed rail system on the one hand,

— between the control/command subsystem equipment and the other subsystems on the other hand.

The compatibility between the energy subsystem and the control/command subsystem is dealt with in section 10.

12.2. Characteristics to be respected

Standard EN 50 121 applies.

13. BOUNDARY CHARACTERISTICS LINKED TO INSIDE NOISE

13.1. Description of the parameter

These characteristics define the maximum noise level inside a train.

13.2. Characteristics to be respected

The interior noise level of passenger vehicles is not considered to be an interoperability constituent. However, the noise level within the driver's cab must be limited for safety reasons and here the boundary permissible value of noise at an equivalent level for 30 minutes (Leq dB(A) over 30 minutes) is 84 dB(A) (measured at 300 km/h in open country as defined in UIC leaflet 651).

14. MAXIMUM LIMIT FOR PRESSURE VARIATIONS

14.1. Description of the parameter

Operating trains in tunnels generates pressure waves, which depend on the aerodynamic properties of the nose and the tail, of the friction characteristics of the train and tunnel surfaces (hence of the train length), of the speed and of the blockage ratio — the ratio of the train cross section area to the free air section area of the tunnel. These waves are usually composed of sharp fronts corresponding to the train nose and tail leaving the tunnel, with smoother evolutions in between. They are subject to propagation along the tunnel space at the speed of sound, with reflections at the open air ends of the tunnel and an amplitude reversal. If two trains pass in a tunnel, the resulting pressure at any given point in the tunnel or any given time, is equal to the sum of the propagating waves inside the tunnel and of the pressure variation which follows the train during its run.

Two different types of risks are associated with these pressure variations, as far as passengers are concerned:

— above a certain level of pressure amplitude, there may be a risk of severe trauma to the ear drum,

— at lower amplitude values, the risk is of some aural discomfort.

14.2. Characteristics to be respected

The maximum limit for pressure variations that passengers must be subjected to in the worst conditions is 10 000 Pa. This value is based solely on the impact to health. It does not take into account the comfort of passengers.

15. MAXIMUM GRADIENTS

15.1. Description of the parameter

Steel-to-steel contact between wheel and rail gives a limited adhesion coefficient. This means that:

— the required traction power for a given mass grows rapidly as the upward gradient increases,

— braking distances, which depend on train speed and load, increase significantly depending on the downward gradient.

Maximum gradients are decided taking into account the planned usage of the line and the maximum value indicated hereafter.

15.2. Characteristics to be respected

The maximum value for category I high-speed lines is 35 ‰, provided the following requirements are observed:

— the downward gradient of the sliding average profile over 10 km is less than or equal to 25 ‰,

— the maximum length of continuous 35 ‰ gradient (upward or downward) does not exceed 6 000 m.

15.3. Specific case

The maximum gradient on the German Cologne-Rhine/Main high-speed line is 40 ‰.

16. MINIMUM TRACK CENTRE DISTANCE

16.1. Description of the parameter

Track centre distance is an infrastructure parameter linked to two different functional requirements.

— It must be defined in such a way that under no circumstances is there any risk that two vehicles running on adjacent tracks can collide; this is normally done by respecting the infrastructure gauge defined for the line, for each of the concerned tracks.

— It must be defined in such a way that the aerodynamic effects on crossing trains are compatible with the rolling stock design.

16.2. Characteristics to be respected

16.2.1. *Future category I lines*

The minimum track centre distance is 4,5 m (in conjunction with infrastructure gauge C).

This value may be reduced to 4,2 m for speeds up to 300 km/h, and 4 m for speeds up to 250 km/h.

16.2.2. *Category II lines*

Track centre distance is fixed at 4 m for lines operated at speeds in excess of 220 km/h. For lower speeds, it is sufficient to meet infrastructure gauge requirements.

16.2.3. *Specific cases*

In Great Britain, the track centre distance is reduced to 3 165 mm, taking into account the UK1 gauge for category II and III lines.

In Spain, a value of 3 808 mm is applied for category II lines.

17. CARRIAGE OF DISABLED PERSONS

Rolling stock and infrastructure have to take into account as appropriate the results of the COST 335 action. Mandatory specifications will be indicated in the correspondent TSIs.