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GAUGE COORDINATION

ATLANTIC RAIL MOTORWAY

ACTION 2016-EU-TA-0193-S

ADIF - SNCF

27 MAY 2020

Index

1 INTRODUCTION.

The Atlantic axis is the corridor that ensures the connection between Northern Europe and the Iberian Peninsula, which includes existing railway lines with itineraries between Germany, France, Spain and Portugal, that constitutes of a main route for freight traffic in Europe.

Ilustración 1. Corredor Atlántico

The need for the infrastructure to be capable of transporting 4 m high-2.55 and 2.6 m widths semi-trailers is established within the technical characteristics.

The lines documented in France correspond to an itinerary that allows service with Germany from the Paris region an alternative route to the main route, between Bordeaux and Poitiers and a main itinerary composed of a single branch line between the France-Spain border and the

Paris region and by two branch lines between the Paris region and northern France in which gauges GB1 and AFM423 are declared.

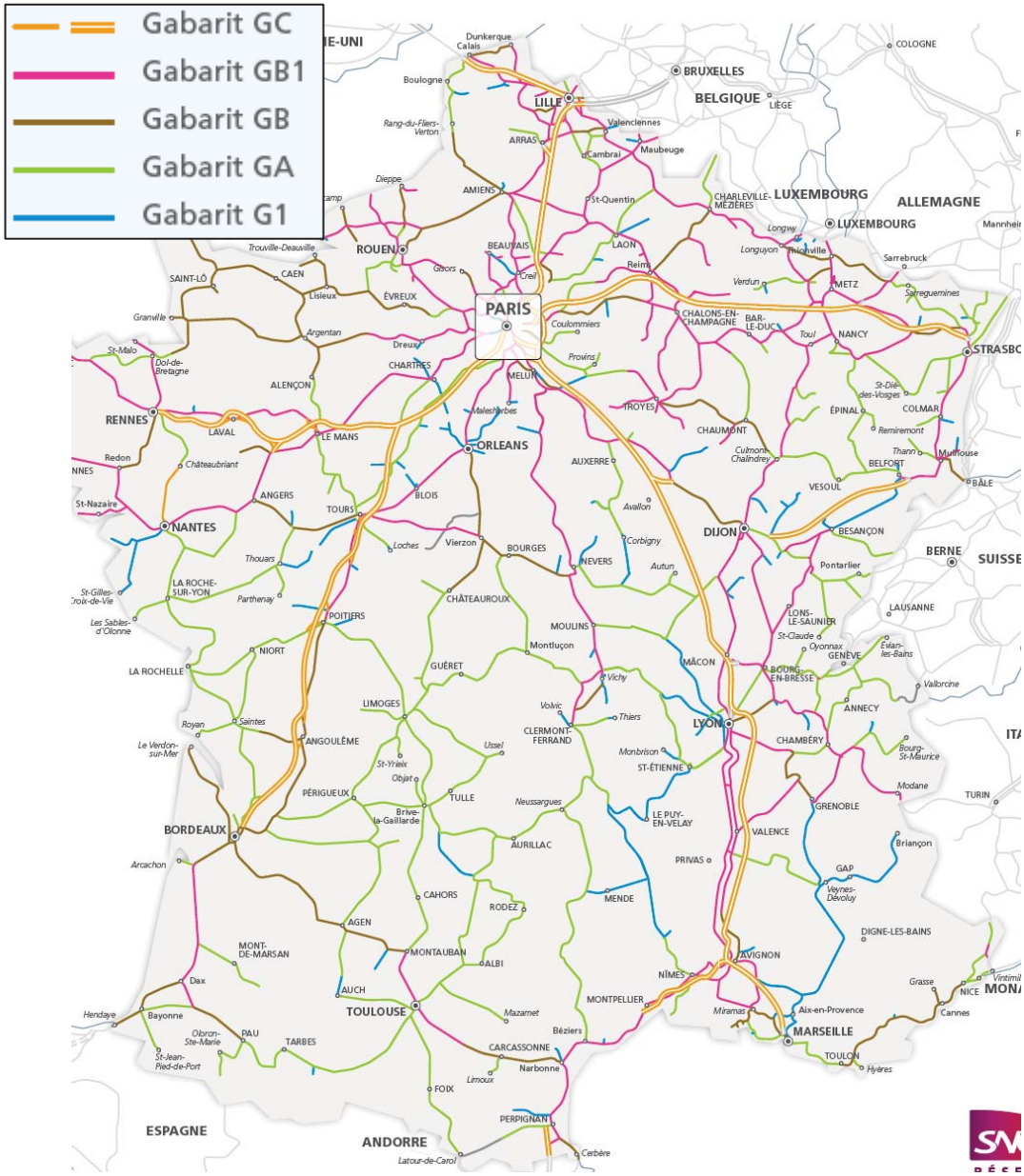

Ilustración 2. Map of National Rail Network interoperable and international gauges. Source: DRR map/situation April 2018

In Spain, the documented lines correspond to the Irún-Astigarraga itinerary with third rail (Iberian and UIC width) and GB gauge and Astigarraga-Vitoria with UIC width and GC gauge.

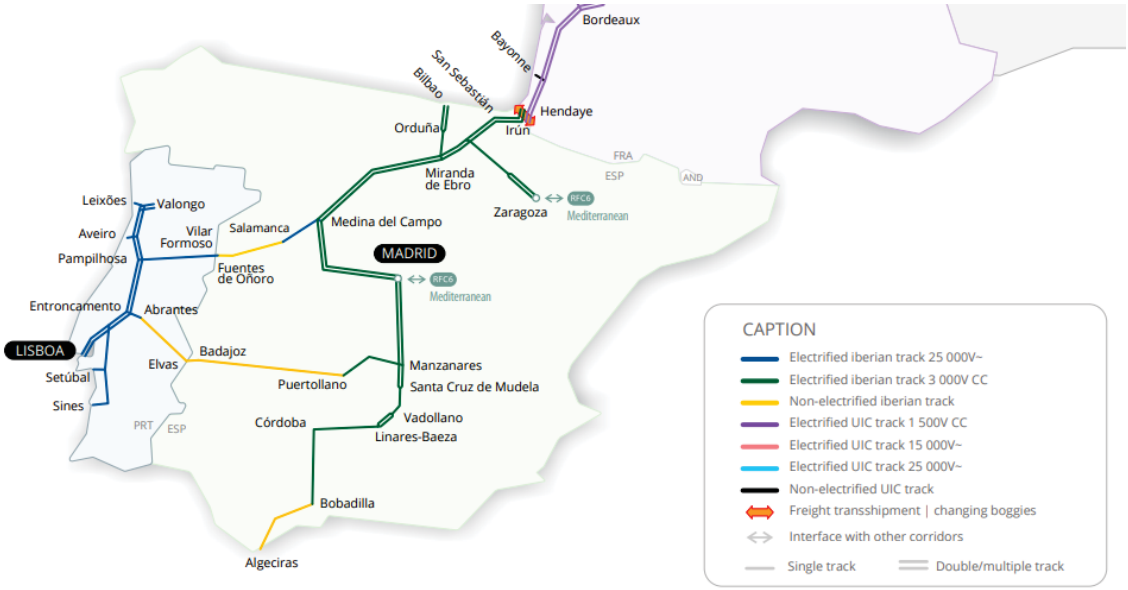

Figure3. Atlantic Corridor in Spain

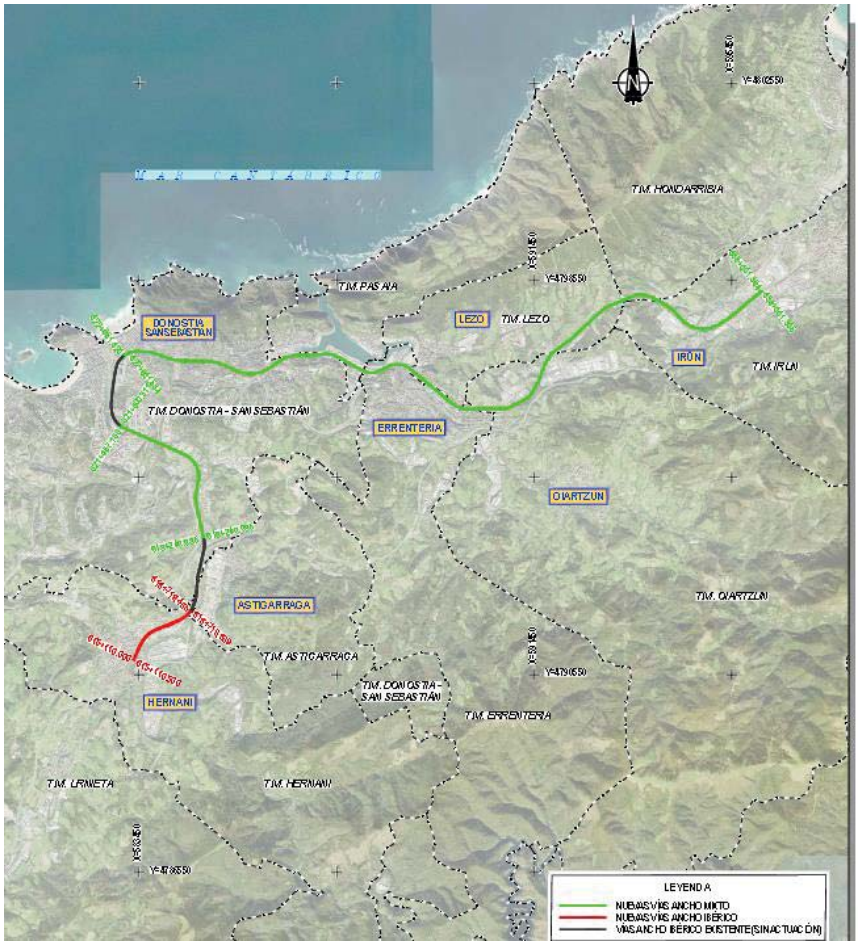

Figure 4. Astigarraga-Irún Layout Detailed Design

In the scope of the Action 2016-EU-TA-0193-S "Atlantic Motorway Rail: modal shift of all types of semi-trailers on the Atlantic Corridor" funded by INEA (Innovation and Networks Executive Agency), the need for coordination is established in the definition of the necessary gauge to be implemented in the Atlantic Corridor in the Spanish French passage.

2 SUBJECT.

The purpose of this report is, first of all, to state the actions that have been put in place by SNCF Réseau for the calculation of a new railway gauge for the transport of 4 meters semi-trailers.

Secondly, it is intended to communicate the decisions and actions carried out by ADIF for the establishment of the necessary gauge in the part of the infrastructure of the Atlantic Railway Motorway of its interest.

Finally, a compatibility and coordination analysis of the procedures for defining the gauge required and applied by both railway infrastructure managers is carried out.

3 SNCF RÉSEAU STUDY "GAUGE FOR TRANSPORT OF 4 METERS HIGH SEMITRAILERS".

This study is part of Task 1 "Appropriate structure gauge definition" of the Activity 2, "General studies" of the Action nº2016-EU-TA-0193-S: "Atlantic Rail Motorway: Modal shift of all types of semi-trailers on the Atlantic corridor ".

The purpose of this report is to review the latest developments and capitalize the process to define the different gauges that allow semi-trailers to be loaded into Poche wagons (Pocket wagons) or low-floor wagons (low load plane). The goal is to have a full range of gauges adapted to the different types of rolling stock that are available to transport semi-trailers 4 m high and 2.60 m wide

The sequence of activities associated with this report has been as follows and prior to the development of the definition of the LGP400 gauge are:

1. Identify the rolling stock that allows the transport of semi-trailers by rail. In order to carry out this first part of the study, in addition to the bibliographic research, the final report of the Consultation to manufacturers and designers of mobile material in the Call for expressions of interest for railway motorway services (AF) on the Atlantic and Mediterranean axes issued by the French and Spanish transport ministries was used.

   The wagons that allow the transport of semi-trailers in the European network, currently, can be divided into two groups:

   a. Poche wagons (pocket wagons), which require semi-trailers to be loaded vertically. Type T3000 or Twin II

   b. Low floor wagons, which usually require specific loading terminals, but with a lower load plane, with the advantages that this brings to the gauge. Type Modalohr or CargoBeamer

2. A second phase of study has consisted of carrying out an inventory of gauges and related documentation for existing railway motorways and their deployment in the French network.

   As a result of such inventory:

   a. GB1. Standard gauge in the first Rail Motorway services.

   b. AFM423/AFM425/AFM427. They were defined to improve the load capacity of the Perpignan-Luxembourg railway motorway services. These gauges are included in the internal SNCF Réseau standard.

   c. AFG. This gauge was defined for the requirements of the Perpignan-Luxembourg Railway Motorway, based on the same principles as the standard gauges.

   d. G1/GA/GB/GC interoperable gauges. The reference gauge of the French network is the GA. any rail traffic requiring a larger gauge is based on a special transport authorization.

The GC gauge has been developed mainly in France for high-speed lines, not accessible to freight traffic, with the exception of routes between Avignon - Nimes and Perpignan - Figueras.

3. A manufacturers' consultation procedure was established to determine the conditions of both wagons and semi-trailers. Additional requests for information were made at the INNOTRANS show and during COOPERE meetings

4. Analysis of network load capacity. These calculations were performed based on the refrigerated semitrailer, which is the widest authorized, as well as the technical specifications available for the wagons. In the absence of data, either because the manufacturers did not provide the data or because they were inconsistent, 0,3 was used for the wagon flexibility / combined semi-trailer and at 0,5 m for the height of the center of rotation.

   The table with results provided in the report is attached, although it is indicated that the values are not accurate enough to be used in load validation to operate wagons. A more detailed study is needed for this purpose.

Wagon	Centring	GA	GB	GB1	AFM423	AFG
Reference wagon UIC596-6 (10 mm)	10 mm	3.41	3.58	3.85	3.84	3.93
Standard pocket wagon (high value)	50 mm	3.39	3.53	3.92	3.63	3.98
Standard pocket wagon (low value)	50 mm	3.33	3.46	3.8	3.43	3.85
Low-floor model wagon (low value)	10 mm	3.49	3.65	3.97	3.63	4.04
Low-floor model wagon (high value)	10 mm	3.58	3.78	3.97	3.99	4.04

Figure 5. Network load capacity

3.1 GAUGE DEFINITION LGP400.

For the definition of the gauge of the wagon–semi-trailer assembly, two fundamental considerations are referred to as starting points:

1. Chapter 1.4 of the general part of the data sheet UIC 596-6 sets out the technical characteristics of the type carriage, however, it is used the available data of a real carriage.

   The technical specifications of the T3000 or Twin II wagon as well as the characteristics of the semitrailer with a semi-width of 2.60 m and 4 m high are used as a reference point. Due to the lack of data provided by the manufacturers, along with the misunderstood specifications of the wagon– cargo set, a conservative position is maintained based on experience using 0.3 for flexibility and 0.5 m for the center of rotation.

- Distance between bogie pivots (a)	11 200 mm
- Bogie wheelbase (p)	1 800 mm
- Height of ST loading plane	330 mm
- Maximum overhang (n_a)	2 000
- Load tolerance	10 mm
- Dissymmetry	1°
- Height of ST + wagon roll centre (H_c)	1 000 mm
- q + w play	11,5 mm
- Play in side bearers (J)	12 mm
- Half-distance between side bearers (b_G)	850 mm
- ST + wagon flexibility (s)	0,3

Figure 6. Technical features of standard wagon (Chapter 1.4 – Leaflet UIC 596-6)

2. With respect to the cargo contour, a simplification is made compared to the one defined on the UIC 596-6 data sheet. This contour definition procedure, set out in the UIC data sheet, has been used for the development of gauges, however, it is referred in the presentation to compelling reasons supported by operators being reasonably justified on the basis of a sustainability criterion.

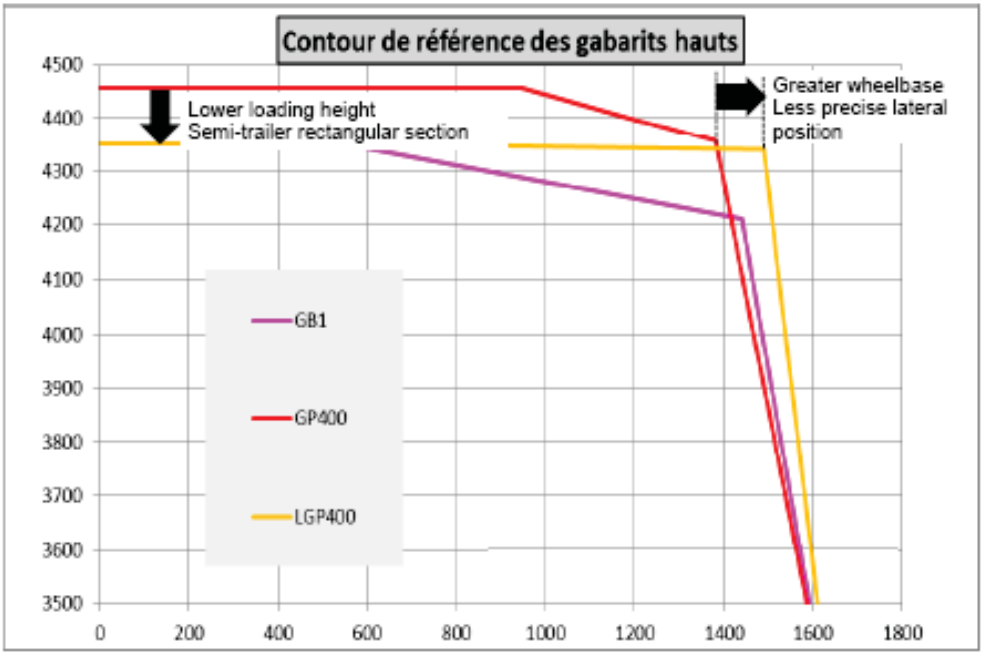

Figure 7.Cargo Contour comparison

To obtain the semi-widening of the set we must start from the semi-widening of 1.30 m of the reference semi-trailer, to which 50 mm per load centering tolerance is added, as well as 10 mm per deflection of the tyres.

For the height, it is set the height of the cargo, 4 m.

Because the construction of this gauge is based on a methodology that uses the load capacity on the GB1 gauge and with specifications of the wagon–semi-trailer set, which are not fully known, additional add-ons are added:

- Transversal: 10 mm
- Vertical: 50 mm

The result of the reference contour of the LGP400 gauge is shown in the following figure:

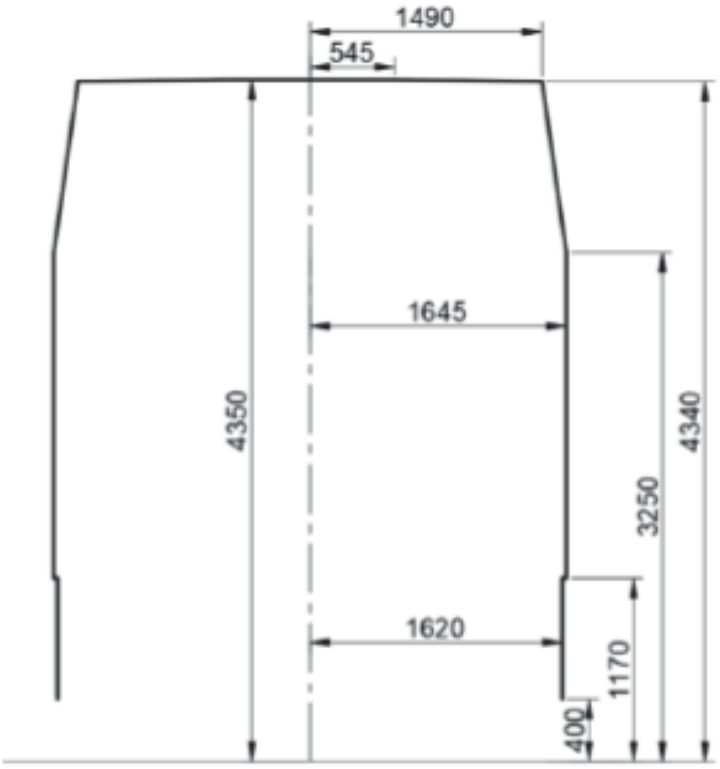

Figure 8. Contour definition LGP400

4 GAUGE STUDY FOR SECTION ASTIGARRAGA – IRÚN.

Following that, a gauge study is carried out on the Astigarraga - Irún section of the Madrid-Hendaya Line, which is motivated by the implementation of the third lane in the current railway corridor.

In the rest of the Atlantic corridor between Vitoria and Astigarraga, the GC gauge has been already implemented in all the projects for the development of the new high speed corridor for mixed traffic, passengers and freight

4.1 GAUGE STUDY ACCORDING TO RAIL INSTRUCTION FOR GAUGES.

According to the Rail Instruction for Gauges approved by Order FOM/1630/2015, of July 14, a retrofitting of an existing line consists of any performance of improvement of a line, being understood by improvement any performance that increases or enhances any of its gauge parameters, load per permissible axis, speed, maximum length of train allowed or its capacity.

It is considered “new line” the one that creates an itinerary where none previously exist. Therefore, we consider that the actions described are not included in the above definition, adopting the criteria for improved lines.

In this case, the recommended gauge corresponds to a uniform gauge GEC16 and GC, allowing the implementation of the uniform gauge GEB16 and GB for technical or economic reasons. Since the criteria under which this analysis is carried out are that of the minimum total cost, maximum use of existing infrastructures and maximum reduction of the actions to be carried out, it is considered that the adequate gauge to be implemented is the GB for standard width and GEB16 for Iberian width, thus complying with the current regulations. However, this gauge has no capacity for the transport of semi-trailers of 4 m.

4.2 GAUGE STUDY ACCORDING TO TSI.

For the high parts obstacle implementation gauge of the path, it has been chosen the application of an interoperable gauge.

In paragraph 4.2.3.1 of Regulation No 1299/2014 on the technical specifications for the interoperability of the 'infrastructure' subsystem in the European Union rail system governing the obstacle implementation gauge and in accordance with point"4.2.1. Line TSI Categories" is established that for TSI categorization purposes, lines are usually classified according to the type of traffic (traffic code) characterized by the following characteristic parameters:

- Gauge
- Load per axls
- Line speed
- Train length
- Useful platform length

The data of the line under study are as follows:

- Load per axls: 22,5 t (Source: Circulation manual)
- Maximum Line speed for passenger traffic: 115 km/h (Source: Maximum speed frame)
- Maximum Train length authorized: 450 m (basic) y 550 meters (special) freight trains and 325 m for passengers' trains. (Source: Network Statement).
- Approximate Useful platform length: 200 m

The application of the parameters "gauge" and "load per axls" should be made as minimum requirements since they directly control the trains that can run. However, the line speed, useful platform length, and train length parameters are considered indicative, that is, they indicate the range of values that are typically applied for different types of traffic since they do not impose restrictions on traffic that can travel along the line.

For mixed traffic lines, the line category will be a combination of passenger traffic code and line code for freight traffic.

Cuadro 2. Parámetros de prestación para tráfico de viajeros

Código de tráfico	Gálibo	Carga por eje [t]	Velocidad en la línea [km/h]	Longitud útil de los andenesl [m]
P1	GC	17*	250-350	400
P2	GB	20*	200-250	200-400
P3	DE3	22.5**	120-200	200-400
P4	GB	22.5**	120-200	200-400
P5	GA	20**	80-120	50-200
P6	G1	12**	n.d.	n.d.
P1520	S	22.5**	80-160	35-400
P1600	IRL1	22.5**	80-160	75-240

(*) La carga por eje se basa en la masa de diseño en orden de trabajo para cabezas tractoras (y para locomotoras P2) y en masa operativa bajo carga útil normal para vehículos capaces de transportar una carga útil de pasajeros o equipaje, como se define en el punto 2.1 de EN 15663:2009+AC:2010. Los valores de carga por eje ** correspondientes para vehículos capaces de transportar una carga útil para pasajeros o equipaje son 21,5 t para P1 y 22,5 t para P2, como se define en el apéndice K de la presente ETI.

(**) La carga por eje se basa en la masa teórica en condiciones de funcionamiento para cabezas tractoras y locomotoras, como se define en el punto 2.1 de En 15663:2009+AC:2010 y en la masa teórica en condiciones de carga útil excepcionales para otros vehículos definidos en el apéndice K de la presente ETI.

Figure 9. Regulance (UE) nº 1299/2014 de la Comisión, de 18 de noviembre de 2014

Based on the only minimum requirements to consider and taking into account that the load per axis of the line under study is 22.5 t, for passenger traffic the unique line traffic code associated with an application gauge in Spain corresponds to the P4 code.

The interoperable gauge for the line code associated with the line usage conditions, P4, corresponds to the GB gauge.

Cuadro 3. Parámetros de prestación para tráfico de mercancías

Código de tráfico	Gálibo	Carga por eje [t]	Velocidad en la línea [km/h]	Longitud del tren [m]
F1	GC	22.5**	100-120	740-1050
F2	GB	22.5**	100-120	600-1050
F3	GA	20**	60-100	500-1050
F4	G1	18**	n.d.	n.d.
F1520	S	25**	50-120	1050
F1600	IRL1	22.5**	50-100	150-450

(*) La carga por eje se basa en la masa de diseño en orden de trabajo para cabezas motrices y locomotoras, como se define en el punto 2.1. de la norma EN15663:2009+AC:2010, así como en la masa de diseño bajo carga útil normal para otros vehículos, de acuerdo con el punto 6.3. de la norma EN15663:2009+AC2010

Figure 10. Regulance (UE) nº 1299/2014 de la Comisión, de 18 de noviembre de 2014

For freight traffic, the load per axis of 22.5 t is met in line categories F1 and F2. Because it is needed to choose between the two, they are contrasted with the rest of the line requirements. Having both line categories the same speed, this is not a differentiating parameter. According to the maximum train length, the alternative from 600 to 1,050 m seems to be more in line with the characteristics of the section under study. Therefore, the traffic code for goods is F2, with the gauge associated with it being the GB gauge.

The gauges obtained for the traffic categories set out in the tables above are associated gauges for a track with standard width. For the Iberian track width (1.668 mm) the high-part gauge parameter should be fixed on the gauges set out in Tables 29 and 30 of paragraph 7.7.15.1 of Regulation No 1299/2014 which are based on those defined in EN 15273-3 which are presented:

Código de tráfico	Gálibo
P1	GEC16
P2	GEB16
P3	GEC16
P4	GEB16
P5	GEB16
P6	GHE16

Cuadro 29. Gálibos para tráfico de pasajeros en la red española

Código de tráfico	Gálibo
F1	GEC16
F2	GEB16
F3	GEC16
F4	GHE16

Cuadro 30. Gálibos para tráfico de mercancías en la red española

With the TSI category of the line of traffic obtained from the application of paragraph "4.2.1. Line TSI categories" can be obtained which are the gauges to be implanted in Iberian wide railways. For the F2 and P4 traffic categories the obstacle deployment gauge in both cases is GEB16.

Gauges to be implanted in Iberian width railways, are d carried out on the basis of the TSI category of the traffic code of the line obtained from the application of paragraph "4.2.1. Line TSI Categories". For the F2 and P4 traffic categories the obstacle deployment gauge in both cases is GEB16

Therefore, according to the technical specifications of interoperability, of the Astigarraga – Irún section of the Madrid-Hendaye Line, this would be P4 and F2, resulting in both cases a GEB16 application gauge for Iberian width and GB for standard width. Although, this gauge has no capacity for the transport of semi-trailers of 4 m.

5 DEFINITION OF THE GAUGE TO BE IMPLEMENTED BY ADIF AND ADIF - SNCF RÉSEAU GAUGE COORDINATION.

Once the gauges established by the implementing regulations for ADIF have been defined, it is clear that the gauges indicated by ADIF are insufficient for 4 m semi-trailer traffic. The following table is shown together with the gauge defined by SNCF Réseau:

Ancho de vía	Reglamento	IFG	SNCF
Estándar	GB	GB	LGP400
Ibérico	GEB16	GEB16	-

The following graph shows the reference contours of all gauges related to Railway Motorway services.

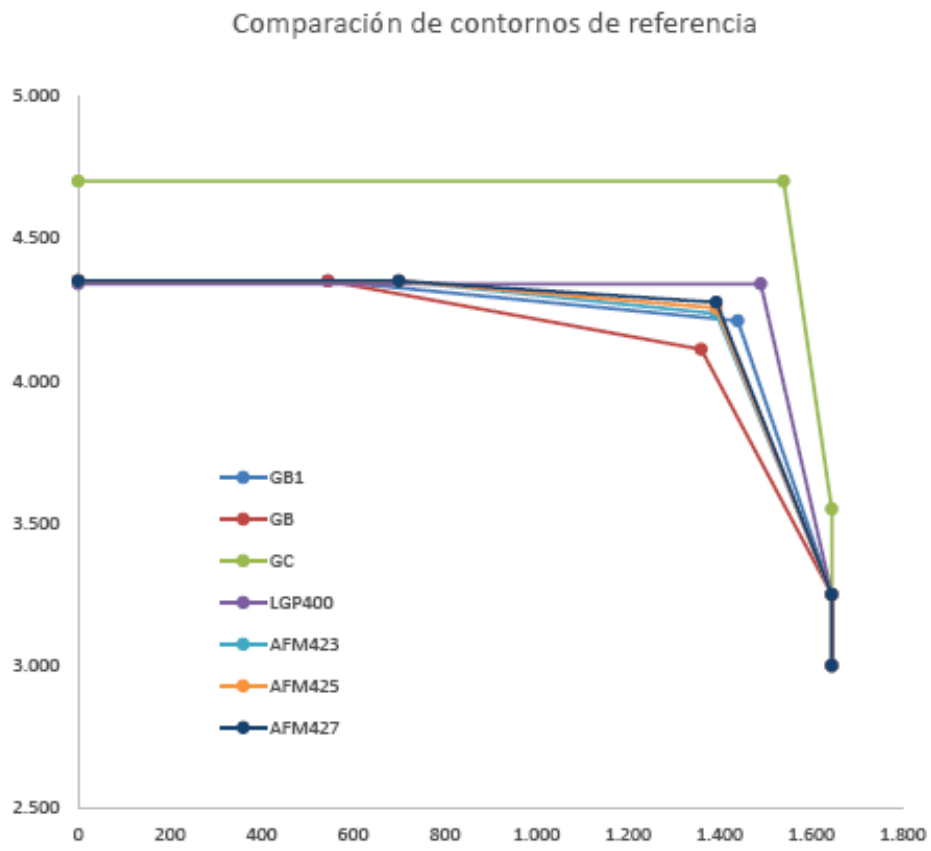

Figure 11 Cargo Contour comparison

As can be seen, the only contour that can ensure that it wraps around the new LGP400 gauge, defined by the SNCF Réseau, is the GC gauge. As the IFG states that for this line the recommended gauge corresponds to a uniform gauge GEC16 and GC, although it allowed the implementation of the uniform gauge GEB16 and GB for technical or economic reasons, it is considered that in order to meet all the requirements that can be required in terms of gauges to a line belonging to the Atlantic corridor with compatibility for the transports of 4 m in height envisaged , it is appropriate to implant the GC gauge in standard width and the GEC16 gauge in Iberian width in high parts.

Likewise, according to the Railway Instruction for Gauges (Order FOM/1630/2015), in general the gauge of implementation of obstacles to be respected in conditioned lines is the uniform gauge of the implementation of obstacles, although, for technical or economic reasons and in exceptional situations, a limit or nominal gauge can be authorized in certain sections or sections of the line.

6 CONCLUSIONS.

Following the analysis of the documentation provided by SNCF Réseau, the LGP400 reference gauge is considered suitable to ensure the transport of semi-trailers four meters high. This gauge would need a homologation process by the Spanish Rail National Safety Agency before its application to the Spanish Railway Network.

For Adif, It is not possible to wait until this homologation is done because track bed detailed design for Astigarraga-Irún section on the Spanish side are already finished and ready for their approval. Thus, for Adif it is necessary to make a decision about gauges from the spanish side to solve the urgent need of solving the current restrictions for rail traffic in the current section Astigarraga – Irun, which will be solved with the implementation of works foreseen in the detailed design. It is also necessary to assure the place in service by the National Railway Safety Agency according to the current National Rail Procedure.

According to the National Rail Instruction for Gauges approved by Order FOM/1630/2015, of July 14, for this line the recommended gauge corresponds to a uniform gauge GEC16 (section French Border – Astigarraga in third/mixed rail) and gauge GC (section Astigarraga – Vitoria).

A cost analysis comparison between the implementation of GEC16 and GC or GEB16 and GB (+GB1 for Rail Motorway purposes) in this section has been done. Cost impact has been estimated in a 9% aprox for this section. Also it has been analyzed that GB1 has no capacity for the transport of semi-trailers of 4 m which is the main objective.

Adif is implementing GEC16 and GC gauge in the detailed design to be implemented in section Astigarraga Irún. Adif decision making process was done in the first quarter of 2020. It was motivated by three main issues.

- GEC16 and GC gauge in Spanish side don´t have an impact over French side as its reference contour is bigger than LGP400, ensuring that all trains from France could arrive at Vitoria.

- Decision must be taken urgently as the new detailed design for track bed works in French Border - Astigarraga Section was at review phase and works tendering is foreseen to be published by the end of the year. Also previous works tasks stopped at tunnel enlargement phase, and they should be finished before the end of 2023. The stop of these works has created considerable restriction for the managament of the rail traffic which require to be solved as soon as possible.

- The Astigarraga Vitoria section is in standard width. It has been designed and it is being buil with GC gauge, so from the point of view of the Spanish network it was not reasonable to introduce a restriction just at the end of the line

In the ADIF area of influence, GC and GEC 16 has exceptionally been chosen as it will allow the transport of any type of semi-trailer and container that needs to be transported, being feasible to absorb the possible increase in dimensions of these in the long term.

From ADIF perspective, in the French side any gauge lower than LGP400 wouldn´t be valid to achieve the objective of development the Atlantic Rail Motorway between Vitoria and Dax due to the capacity restrictions for the transport of semi-trailers of four meters high, for load height up to 270 mm

Madrid, May 27, 2020

Technical Direction