

Abstract

Technical Requirements on Railway Vehicles in the cross-border Transport between Germany and Poland

– Study within the INTERREG Project InterRegioRail –

www.interregiorail.eu

info@interregiorail.eu



Technical Requirements on Railway Vehicles in the cross-border transport between Germany and Poland

Abstract

Due to Europe's stronger merging also the importance of barrier-free, cross-border traffic services has been increasing within the last years. This also impacts the interoperability requirements of the railway transport. A comfortable and cost-effective operation between the European countries is only possible if disturbing vehicle changes at the borders are not necessary. This study, which has been developed within the scope of the INTERREG project InterRegioRail, considers the technical requirements on the railway vehicles used for the cross-border traffic between Germany and Poland.

Besides the general examination of the legal framework and the technical requirements on the vehicles the following three reference vehicles have been considered more detailed:

1. Diesel railcar LINT as vehicle family (German inventory vehicle),
2. Diesel railcar PESA 219 M Atribo (Polish inventory vehicle),
3. Electric railcar Bombardier Talent 2.

Furthermore, the route-specific standards on five relevant transport corridors have been examined:

1. Berlin – Szczecin,
2. Berlin - Kostrzyn - Gorzów Wlkp.,
3. Berlin - Frankfurt - Poznań / Zielona Góra,
4. Cottbus - Guben - Zielona Góra,
5. Berlin - Cottbus – Wrocław.

Analysing the technical and regulatory framework on the European level, which Germany and Poland are subject to, revealed that the European Directives and Technical Specifications for Interoperability are already harmonized largely with the technical requirements and processes for obtaining the necessary authorisation for placing in service. Some of the technical specifications and also the primarily planned dates of implementation have been adjusted several times to the objectively given conditions. It has to be considered that the necessary measures to be implemented by the member states will cause substantial restrictions of their present leadership and considerable investments regarding the infrastructure. Thus, both the adjustment of the pace of the harmonization as well as the modification of insufficient specifications are necessary consequences and are to be expected in future, too. The following table lists the relevant directives for the herein considered requirements on the vehicle's side.

Technical Requirements on Railway Vehicles in the cross-border transport between Germany and Poland

Directive	Content	Implementation until
97/68/EC	Adjustment of the legal provisions within the member states concerning measures against the emission of aeroform pollutants and air-polluting particles from combustion engines for mobile machines and devices	30 th June 1998
2004/49/EC	Railway safety within the community and for the change of directive 95/18/EC of the council concerning the issue of permissions to railway companies and the directive 2001/14/EC concerning the allocation of track capacity of the railway, the charge of fees for the use of railway infrastructure and the safety certification	30 th April 2006
2008/57/EC	Interoperability of the railway system within the community (revised version)	19 th July 2010

Directive 97/68/EC applies to vehicles with a combustion engine which specifies the permitted exhaust emissions for a combustion engine that is put into circulation within the European Union. For rolling stock with a diesel engine which has fulfilled the aforementioned directive at its initial commissioning in a member state of the EU no increased requirements on the permitted exhaust emissions are arising in order to obtain an authorisation for placing in service for this vehicle in other member states.

Directive 2004/49/EC is focused on the safety of the railway system regarding operational and technical aspects. Besides the presentation of safety indicators, relevant safety measures, safety management systems and the handling of accidents the relevant safety certificates, safety approvals respectively for railway companies and infrastructure operators are involved. Furthermore, Article 14 refers to the authorisation procedures for placing in service (formerly: "homologation procedure") which, however, has been replaced by directive 2008/57/EC.

Directive 2008/57/EC describes extensively and bindingly the specifications regarding the interoperability of the railway systems and the authorisation procedures for placing in service within the European Community. It replaced the appropriate predecessor directives which have turned unclear to a certain extent by various modifications as well as Article 14 of directive 2004/49/EC.

Thus, the authorisation procedures for placing in service are divided into five cases:

1. First authorisation for placing in service of a TSI conform vehicle,
2. Additional authorisation for placing in service of a TSI conform vehicle (authorisation for placing in service as TSI conform vehicle for at least one EU Member State is existing),
3. First authorisation for placing in service of a non TSI conform vehicle,

Technical Requirements on Railway Vehicles in the cross-border transport between Germany and Poland

4. Additional authorisation for placing in service of a non TSI conform vehicle (authorisation for placing in service as non TSI conform vehicle for at least one EU Member State is existing) and
5. Authorisation for placing in service of vehicles of an already approved vehicle type

Therefore, not only a binding legal basis which allows all European railway vehicle manufacturers and railway companies to homologate vehicles throughout Europe is created, but also an unprecedented transparency, especially in connection with the authorisation processes. It is worth mentioning that concerning the procedures for obtaining additional authorisations for placing in service (case 2 and 4) binding periods have been defined in which the national safety authorities have to process their decisions. Even if several details are to be discussed between the European member states concerning the acceptance of their national requirements, expensive and market-blocking activities that appear random have been made extremely difficult. Currently, Poland and Germany are developing together with other countries a Cross-Acceptance Agreement which will bindingly regulate these details. It is expected that the agreement can be approved within the next year. Contrary to the flighty homologation procedures in the past, clearer and considerably easier procedures in connection with additional authorisations for placing in service can be expected in the future.

The analysis of the Technical Specifications for Interoperability (TSI) regarding obligations to upgrade rolling stock which could arise exclusively in connection with an additional authorisation procedure did not reveal any relevant requirements. It has to be considered that the rarely stipulated upgrade obligations are valid generally which means that they should be carried out on the total rolling stock. Retrofits which are done by integrating new train protection systems or train radio systems for instance are an exception. The components affected by the retrofit may have now to be built TSI conform, normally.

The comparison of the technical framework has been made in two steps. The first step was to consider the main data of the railway systems and in the second step the specific requirements in connection with specific, national demands.

Germany and Poland belong to the members of the International Union of Railways UIC which calls for a certain similarity of the railway systems. Furthermore, both countries have signed the contracts RIC and RIV which already allows basically a liberal, cross-border traffic of conform freight wagons and coaches.

However, the following major differences between both railway systems could be found. The differences between these major aspects have a considerable influence on the smooth cross-border traffic and allow the deduction of special, technical requirements on the vehicles and the necessary authorisation procedures.

Technical Requirements on Railway Vehicles in the cross-border transport between Germany and Poland

Aspect	Germany	Poland
Train protection system	PZB 90, LZB at $V_{max} > 160$ km/h	SHP
Train radio	GSM-R, some tracks analogue	analogue, GSM-R under construction
Pattern of the signal lights	UIC standard	additional signal patterns
Traction system	15 kV AC, 16,7 Hz	3 kV DC
Brake	Electromagnetic rail brake from $V > 140$ km/h	UIC-standard
Enforced braking via radio signal	not intended (emergency signal via train radio)	statutory

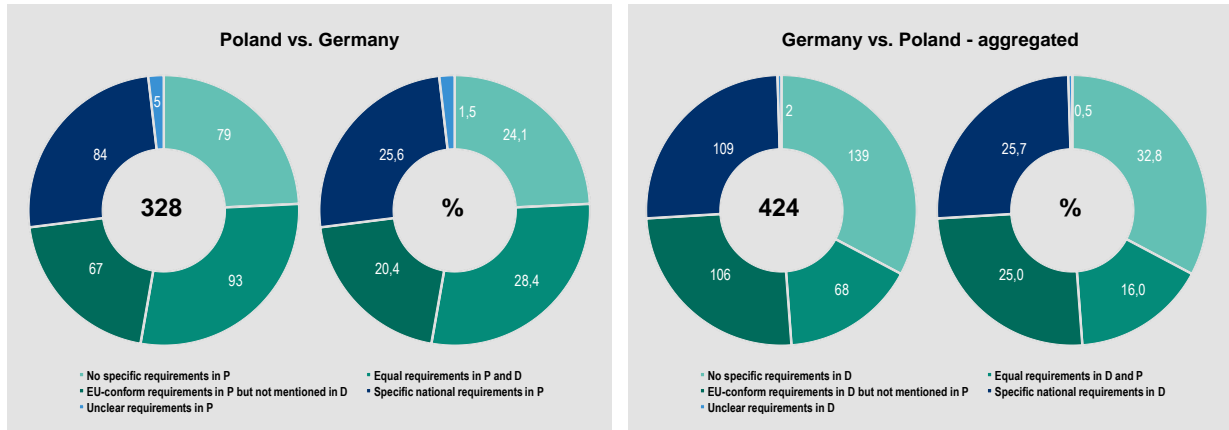
A detailed comparison of the single national requirements has been compiled on the basis of the Polish national reference document and the German checklist for the procedure of the authorisation for placing in service. The latter was used since the German reference document has not been published yet against the deadlines determined in the European Standards.

The results of this rather conservative comparison have been summarized in the following figures. The two diagrams arranged on the left side illustrate the comparison of the 328 Polish requirements according to the national reference document with the German requirements absolutely and in percentages. The other two figures show the requirements in Germany in comparison with the Polish ones. It has to be noted that the German checklist defines 893 single requirements for the 424 subdivided aspects to which this evaluation refers.

In both cases, approx. 75 % of the national requirements of both countries could be classified as comparable and 25 % as country-specific. The comparable requirements have been divided into aspects without specific national requirements, equal requirements and EU conform requirements.

According to this, a large part of the requirements between both countries is conform. Moreover, there will be requirements among the 25 % which will differ technically to a minor degree and can be treated as conform, actually. Nevertheless, the legally binding classification is effected by the Cross-Acceptance Agreement which is expected to contain a share of more than 75 % of similar requirements. The mentioned unclear requirements are based on specifications which cannot be allocated or on non-findable references to standards.

Technical Requirements on Railway Vehicles in the cross-border transport between Germany and Poland



In order to expose possibly existing limitations by the infrastructures, the route-specific requirements have been analysed and infrastructural particularities emphasized.

This consideration exposed that passenger trains with their typical axle load of max. 18 t can travel likely on the analysed routes without any restrictions due to the railway line classification. Two particularities could be found on the routes 2 and 5. These are a partial infringement of the G2 clearance in the upper area near Żagań (Polish side of relation 5: Berlin – Cottbus – Wrocław) and the non-existing GSM-R equipment on the German side of relation 2 (Berlin – Kostrzyn - Gorzów Wlkp). The clearance gauge issue calls for a specific consideration of each vehicle type and in case of a negative result the operation can be restricted while the travelling on one of the few German tracks without GSM-R requires generally the additional support of the German analogue train radio on the vehicle's side.

The results obtained have been projected on existing rolling stock and new vehicles and the resulting consequences for the technology and the necessary authorisation for placing in service procedure have been concluded.

Due to commercial and technical reasons the modification of electric vehicles has been identified as unfeasible in case that those vehicles are not yet particularly designed for such a retrofit. Thus, it is appropriate to purchase electric vehicles as multi-system capable with the corresponding homologations.

Technical Requirements on Railway Vehicles in the cross-border transport between Germany and Poland

The following table lists the results for the Polish and German infrastructure.

Relation	Min. railway line classification	Max. axle load	Max. load per metre	Maximum speeds	Train protection system	Train radio	Electrification	Clearance
-	-	t	t / m	km/h	-	-	-	
Polish infrastructure								
1	C3	20,5* / 20,5	7,2	80 – 160	partly SHP	analogue	partly	G2
2	C3	22,5* / 20	7,2	80 – 120	SHP	analogue	no	G2
3	D3	22,5* / 22,5	7,2	≥ 160	SHP	analogue	completely	G2
4	C3	22,5* / 20,9	7,2	40 – 120	SHP	analogue	partly	G2
5	C3	20* / 20	7,2	80 - 120	SHP	analogue	partly	G2**
German infrastructure								
1		D4 22,5	8	120	PZB	GSM-R	partly	G2
2		D4 22,5	8	100	PZB	analogue	partly	G2
3		D4 22,5	8	160	PZB	GSM-R	completely	G2
4		D4 22,5	8	120 – 160	PZB	GSM-R	partly	G2
5		D4 22,5	8	120 – 160	PZB	GSM-R	partly	G2*

*... only Bo'Bo' locomotives

**... local infringement of the standard clearance near Żagań (approx. 3.9 m above top of rail)

Technical Requirements on Railway Vehicles in the cross-border transport between Germany and Poland

With regard to the reference vehicles of this study, no technical criteria for exclusion, which would prevent the retrofit for the cross-border operation and the obtaining of the authorisation for placing in service in Poland and Germany, could be found. Certainly, it has to be considered that currently only one of the mentioned corridors is electrified completely. This is why the use of an electric vehicle would be presently stipulated on this one. The following table summarizes the gained findings.

Technically necessary retrofit measures	Talent 2		Pesa 219M		LINT	
	available	retrofit	available	retrofit	available	retrofit
Polish train protection system SHP	✗	✓	✓	✗	✗	✓
Polish analogue train radio with wireless emergency stop function	✗	✓	✓	✗	✗	✓
Polish vehicle signals patterns (light)	✗	✓	✓	✗	✗	✓
German analogue radio	✓	✗	✗	✓	✓	✗
System switchover Germany - Poland	✗	✓	✗	✓	✗	✓
System switchover Poland - Germany	✗	✓	✗	✓	✗	✓
E-traction: pantograph Poland	✗	✓	✗	✗	✗	✗
German train protection system PZB 90	✓	✗	✗	✓	✓	✗
German digital GSM-R train radio	✓	✗	✗	✓	✓	✗

To conclude the study, the derived necessary changes and activities with regard to the expected time schedule and costs have been analysed for the first vehicle (prototype) of the three reference vehicles. This consideration had to be developed on the basis of estimations since reliable references were missing. Basically, two extreme scenarios have been examined which generate an expected lower and upper limit for the periods of procedures and retrofit costs that could arise. Regarding the electric Talent 2 relevant parameters in connection with a new procurement have been listed.

Technical Requirements on Railway Vehicles in the cross-border transport between Germany and Poland

Vehicle	Total Expenditure of Time in months		Total Costs in T€	
	Prototype	Standard Vehicle	Prototype	Standard Vehicle
LINT	10 – 24 (7 - 17)*	1,5 – 3 (1,5 – 3)*	275 - 420	75 - 85
Pesa 219M			280 - 425	80 - 90
Talent 2	Newly built, deliveries: first vehicle approx. 24 months, further vehicles every 2 - 4 weeks		Newly built: Extra costs approx. 450 - 500** T€ compared to the German single-system version	

*... down time of the vehicle in brackets (retrofit and missing approval)

**... Without reference to this price supplement that has been derived from a technical point of view, it has to be considered that price differences of more than 1 million euros could be found on the market which are difficult to understand from the technical point of view. It can only be assumed that these prices also contain a considerable additional charge for innovation besides the formerly very high additional homologation expenditures.