Ricardo Certification

Sprinter Next Generation

NoBo Technical File for 3-car trainset & 4-car trainset

for Construcciones y Auxiliar de Ferrocarriles S.A.

May 7th 2019

Reference: 750083.SNG.NoBo.TechnicalFile.08

Issue: 8.0

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Document history and authorisation

Issue	Date	Changes
1.0	September 14th 2016	Version for ISV Design stage
2.0	June 9th 2017	Draft ISV for track tests approval
3.0	August 3rd 2017	Version for ISV for track tests approval
4.0	June 14th 2018	Version for 3-car and 4-car trainsets. Brake assessment open.
5.0	July 3rd 2018	Version for 3-car and 4-car trainsets
6.0	September 19th 2018	SW Configuration List in Section 3 updated. Design evidence in Section 5.2 updated. Provisions for operation in Section 5.5 updated. Provisions for maintenance in Section 5.6 updated. Reference to Assessment Reports in Section 6.1 updated
7.0	October 11th 2018	SW Configuration List in Section 3 updated. Certificates reference updated in Section 2. Details form the surveillance audit included in Section 5.3
8.0	May 7th 2019	SW Configuration List in Section 3 updated. Certificates reference updated in Section 2.

Compiled by:

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Signed: E-sign: 10 2 e .....Date: 01-05-2019 .....

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Distribution list

Name	Organisation	From (Issue)	To (Issue)
10 2 e	Construcciones y Auxiliar de Ferrocarriles S.A.	1.0	Current
	Construcciones y Auxiliar de Ferrocarriles S.A.	1.0	Current
	Construcciones y Auxiliar de Ferrocarriles S.A.	1.0	Current
Project File 750083	Ricardo Certification Iberia S.L.	1.0	Current

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Glossary of Abbreviations and Acronyms

Applicant	The body responsible for making the application for authorisation. This may be the contracting entity or the manufacturer (or their authorised representative within the Community).
Assessment Module	An assessment procedure defined in a TSI or other EC document that is used to assess an interoperability subsystem or constituent.
Assessment Report	A detailed review of the design and production processes (undertaken by the notified body) to confirm that they meet the TSI requirements.
Authorisation	Authorisation to place into service granted by a National Safety Authority, as defined in Interoperability Directive.
CCO	Control Command & Signalling Onboard subsystem.
CCS TSI	Control Command and Signalling Technical Specification for Interoperability (2012/88/EU) (as amended)
Certification Plan	A document setting out the strategy for conformity assessment certification.
DeBo	Body designated by a Member State for the assessment of conformity of subsystems to notified national technical rules.
EN	EuroNorm
ETCS	European Train Control System
GSM-R	Global System for Mobile communications - Railway
ILT	Inspectie Leefomgeving en Transport. National Safety Authority in The Netherlands.
Interoperability Constituent	An elementary component of a subsystem, as defined in a specific TSI.
Interoperability Directive	Directive 2008/57/EC of The European Parliament and of the Council of 17 June 2008 on the interoperability of the rail system within the Community (Recast) (as amended)
ISV	Intermediate Statement of Verification
LOC&PAS TSI	Conventional Rail Rolling Stock (Locomotives and Passenger Carriages) Technical Specification for Interoperability (1302/2014/EU)
NB-Rail	Coordination group of NoBos for railway products and systems
NOI TSI	Conventional Rail “Rolling Stock – Noise” Technical Specification for Interoperability (1304/2014/EU)
NoBo	Body which is responsible for assessing the conformity or suitability for use of the interoperability constituents or for appraising the ‘EC’ procedure for verification of the subsystems
NS	Nederlandse Spoorwegen. Operator.
Open Point	Any technical aspects corresponding to the essential requirements that could not be explicitly covered in a TSI and clearly identified in an annex to the TSI.
Operator	The Transport Undertaking responsible for operating the units
PRM TSI	Persons of Reduced Mobility Technical Specification for Interoperability (1300/2014/EU)

RIS	Regeling indiensstelling spoorvoertuigen, published by the Ministry of Infrastructure and Environment. National regulation for the Netherlands.
RFU	Recommendation For Use: a document produced by NB-Rail setting out a common European approach to conformity assessment
SRT TSI	Safety in Railway Tunnels Technical Specification for Interoperability (2008/163/EC) (as amended)
Subsystem	A division of the whole rail system, as defined in the Interoperability Directives – in this document, the term “subsystem” refers to both the rolling stock and control command onboard subsystems.
NoBo/DeBo Technical File	A document that is produced by the notified body and designated body, which supports the certification and summarises the means by which compliance has been demonstrated.
TSI	Technical Specification for Interoperability: a European Specification relating to an interoperable subsystem of the Trans-European rail network.

Summary

This Technical File applies to the **Sprinter Next Generation 3-car and 4-car trainsets** manufactured by **Construcciones y Auxiliar de Ferrocarriles S.A**. (hereinafter CAF).

This Technical File has been structured to meet the standardised requirements of the European NoBo co-ordination group, NB-Rail (RFU-STR-011 Issue 07 dated 14/06/2018).

Ricardo Certification Limited is designated as a Notified Body for the EU interoperability directive 2008/57/EC.

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1. Actors

1.1 Notified Bodies

The following certification bodies are involved in the conformity assessment of the CAF SNG train sets:

Ricardo Certification Limited

Edward Lloyd House, 8 Pinnacle Way, Pride Park

Derby, DE24 8ZS

United Kingdom

NoBo Identification number 2673.

Ricardo Certification Limited is the Notified Body for the conformity assessment of the subsystem rolling stock (TSI LOC&PAS, TSI PRM, TSI NOI and TSI SRT).

CETREN

Pº de la Castellana, 91 – Planta 10

28046 Madrid

Spain.

CETREN is the Notified Body for the conformity assessment of the on-board control-command and signalling subsystem (TSI CCS).

1.2 Designated Body

Ricardo Certification B.V.

Catharijnesingel 33-J

P.O. Box 2248, 3500 GE Utrecht

The Netherlands

1.3 Applicant

Construcciones y Auxiliar de Ferrocarriles S.A.

José Miguel Iturrioz, 26.

20.200 Beasain (Guipúzcoa).

Spain

2. Notified Body Certificate(s)

This Technical File supports the following Notified Body (NoBo) certificates:

Certificate	Certificate number
EC Type Examination Certificate Sprinter Next Generation 3-car trainset	2673/1/SB/2018/RST/EN/N20180388 - Issue 4 (03-706751)
EC Certificate of Verification Sprinter Next Generation 3-car trainset	2673/6/SD/2018/RST/EN/N20180390 - Issue 4 (03-706758)
EC Type Examination Certificate Sprinter Next Generation 4-car trainset	2673/1/SB/2018/RST/EN/N20180389 - Issue 4 (03-706761)
EC Certificate of Verification Sprinter Next Generation 4-car trainset	2673/6/SD/2018/RST/EN/N20180392 - Issue 4 (03-706762)
Quality Management System Approval	2673/4/SD/2018/RST/EN/N20180391 - Issue 4 (03-706722)

Table 1. NoBo certificates

3. Limits and Constraints on Use of the Subsystem

1. This Technical File applies for the 3-car and 4-car trainsets with software versions defined in the Software Configuration List, reference C.I4.96.006.01 M of 25-04-2019 (03-738019).
2. The SNG trainsets are not allowed to pass over rail brakes and other activated shunting and stopping devices.
3. The SNG trainsets are not allowed to run over contact ramps.
4. The SNG trainsets are compatible with the platform heights 0,55 and 0,76 m +TOR as defined in TSI INF 2014/1299 section 4.2.9.2.
5. Assessed minimum horizontal curve radius 150 m.
6. Vmax = 160 km/h.
7. Cant deficiency ≤130 mm.
8. Access to serviceable equipment on the roof of the train is only allowed after execution of the proper grounding procedures using the HV safety keys as per the CAF instructions in the applicable manuals.
9. The Energy Measurement Function unit has to be sent back to factory after 10 years in service for current and voltage measurements accuracy verification as per the CAF instructions in the applicable manuals.
10. The driver shall be informed that the service brake effort can be limited automatically when slip is detected. Additionally, the service brake distances can increase with an extra 10% when the ED-brake is partially unavailable during sliding conditions.

4. Project Scope and Definition

Construcciones y Auxiliar de Ferrocarriles S.A. (CAF) has received an order for the supply of 118 trainsets of the type “Sprinter Next Generation” (SNG).

The Sprinter Next Generation (SNG) will be composed of 118 trainsets consisting of 68 short trainsets versions (3-car trainset) and 50 middle trainset versions (4-car trainset).

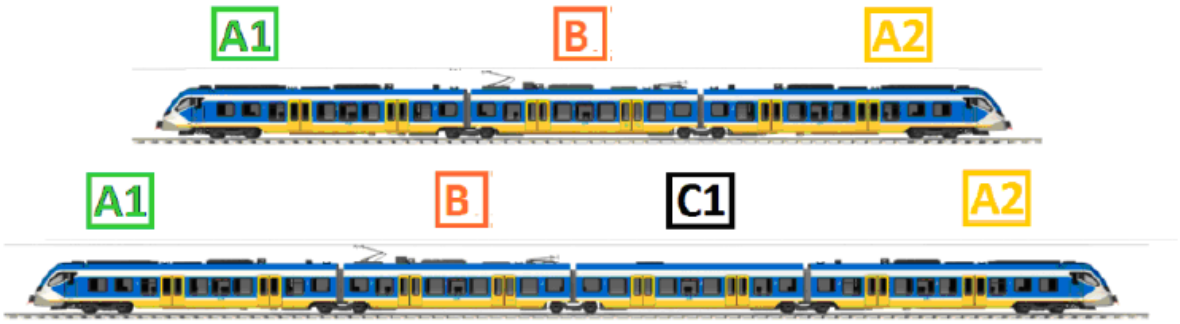

Figure 1. Trainsets configuration (3-car and 4-car)

The different EMUs can be coupled between them with a maximum of 3 EMUs coupled together. Combinations between units of different number of cars are also possible. The following train formations are foreseen for the Sprinter Next Generation trainsets:

- 3 car trainset + 3 car trainset.
- 3 car trainset + 4 car trainset.
- 4 car trainset + 4 car trainset.
- 3 car trainset + 3 car trainset + 3 car trainset.
- 3 car trainset + 3 car trainset + 4 car trainset.
- 3 car trainset + 4 car trainset + 3 car trainset.
- 3 car trainset + 4 car trainset + 4 car trainset.
- 4 car trainset + 3 car trainset + 4 car trainset.
- 4 car trainset + 4 car trainset + 4 car trainset.

4.1 General project information

CAF has to obtain the authorizations from the Dutch National Safety Authority (ILT) to allow NS to operate the SNG trainsets on the Dutch railway network. For this, the SNG trainsets must be certified according to the applicable standards and legislations.

As set out in the Request for Proposal by CAF, the following assurance processes must be covered for these trainsets:

- NoBo (Notified Body) process – implying the assessment against the relevant applicable Technical Specifications of Interoperability (TSI’s) as linked with the Railway Interoperability Directive 2008/57/EC.

- DeBo (Designated Body) process – implying the assessment against the relevant applicable National Notified Technical Rules (NNTR's).

CAF has therefore asked for an EC type examination to obtain an EC Certificate of Type Examination (Module SB) and an EC verification based on quality management system of the production process to obtain a quality management system approval and an EC Certificate of Verification (module SD).

The assessment activities have been defined in the Certification Plan generated by Ricardo Certification and updated along the life of the project with reference 1304.SNG.CertPlan.

Document	Reference	Issue
Certification Plan for SNG	1304.SNG.CertPlan.5	5

Table 2. Certification Plan

Objective of the assessment work is to issue a Certificate of Verification for both trainset configurations in case of proven compliance with the requirements for certification. With this Certificates of Verification, the applicant is able to issue EC Declarations of Verification with which he can apply for an Authorisation for placing in Service for operation of the trainsets in The Netherlands.

4.2 Technical scope and interfaces

The Trainsets Sprinter Next Generation are part of the CIVITY platform of EMU trains developed by CAF for the European market.

The trains are single deck, electrical multiple units with cabins on both ends. The cars of the trainsets all have 2 doors per side.

The sprinter next generation (SNG) will be composed of 118 trainsets consisting of 68 short trainsets versions (3-car trainset) and 50 middle trainset versions (4-car trainset). Cars are linked by means of intercommunicating gangway, at both ends in intermediate cars and at rear ends in front cars.

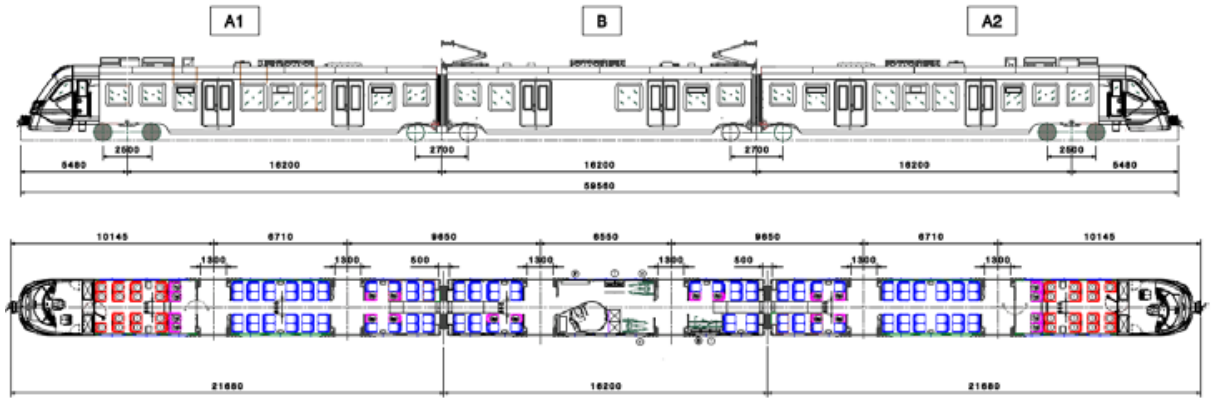

Figure 2. 3 car trainset layout

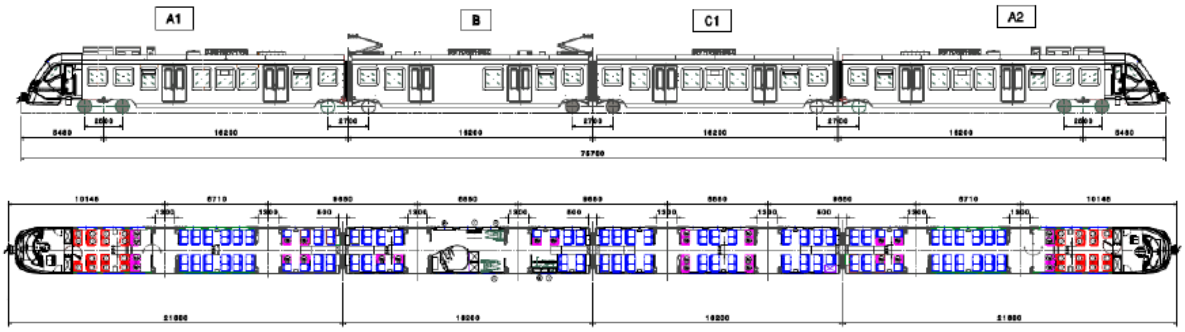

Figure 3. 4 car trainset layout

- A1 and A2 cars: They are the end-cars in all trainset configurations. They both have the same interior arrangement, but some differences exist in terms of on-board equipment for communications.
- B car: It is the intermediate car with the current collector system, multi-functional area with wheelchair spaces and the universal toilet.
- C1 car: It is an intermediate car.

The same type of end car or intermediate car of a trainset version is exchangeable with the end car or intermediate car of the same type of the other trainset version. Therefore, A1 car of any trainset version can be exchanged with the A1 car of any other trainset configuration. The same applies respectively to the A2, B and C1 car type.

The main equipment will be installed on the roof. Power supply is given by catenary through pantographs.

The main dimensions of the SNG trainsets are specified in Table 3:

	A1 and A2	B	C1
Body length	21.650	16.200	16.200
Length between coupler faces		59.500 (3 car trainset) 75.700 (4-car trainset)	
Maximum width	2.880	2.880	2.880
Roof height above rail level	808	808	808
Distance between bogie centers	16.200	16.200	16.200
Front overhang	5.450	0 (Jacobs bogie)	0 (Jacobs bogie)
Rear overhang	0 (Jacobs bogie)	0 (Jacobs bogie)	0 (Jacobs bogie)

Table 3. Main dimensions in mm

Table 4 presents some of the interface characteristics with the infrastructure:

Characteristic	Value
Maximum track speed	160 km/h
Maximum design speed	176 km/h

Nominal track gauge	1.435 mm
Cant ramp	4 mm/m
Maximum track slope	65 ‰
Maximum slope	80 ‰
Platform height above rail level	760, +30, -35 mm
Distance from platform edge to track center	Min 1650mm; Max 1735mm
Catenary height	Limited to 5860 + top of rail
Gauge reference document	G2
Catenary voltage	1500 Vdc

Table 4. Infrastructure interface

Table 5 shows the environmental conditions:

Characteristic	Value
Minimum temperature	-25 ºC
Maximum temperature	40 ºC
Initial operating temperature	-25 ºC
Relative humidity	100%

Table 5. Environmental conditions

The general technical specification of these trainsets is described in document “Vehicle Description” (C.I4.94.600.00). This Technical File applies for the 3-car and 4-car trainsets with software versions defined in the Software Configuration List, reference C.I4.96.006.01 M of 25-04-2019 (03-738019).

4.3 Project History

An overview of CAF’s Authorisation Plan is provided in “Authorisation Plan - Sprinter Next Generation – Civity NS” (C.I4.96.002.00). The Key dates in this project are as follows:

Milestone	Estimated date
Appoint Notified, Designated & Assessment Bodies	March 2015
Begin manufacture of the first trainset (4-car trainset)	November 2015
Begin manufacture of the first trainset (3-car trainset)	April 2016
Begin factory tests (4-car trainset)	January 2017
Begin factory tests (3-car trainset)	May 2017
Begin testing of coupled compositions at the Velim test track	May 2017
Begin testing of the first trainset at the Velim test track (4-car trainset)	July 2017
Begin testing of the first trainset at the Velim test track (3-car trainset)	July 2017
Begin running dynamics on-track testing in the Czech Republic (4-car trainset)	August 2017

Begin on-track testing of first trainset in The Netherlands (4-car trainset)	October 2017
Begin on-track testing of first trainset in The Netherlands (3-car trainset)	October 2017
Authorization and customer acceptance of the first trainset (4-car trainset)	Mid - 2018
Authorization and customer acceptance of the first trainset (3-car trainset)	Mid - 2018

Table 6. Project key dates

4.4 Derogations / Limitation of TSI Application

There are no derogations against Technical Specifications for Interoperability requirements for SNG trainsets.

4.5 List of specific cases

There are not specific cases for trainsets operating in The Netherlands according to TSI LOC&PAS 1302/2014/EU.

5. Project documentation

The following sub-headings contain or reference all of the technical documentation supplied to the NoBo by the applicant and used during verification activities.

5.1 Applied Standards / Technical Specification / Alternative Solutions

The following certification framework for the SNG trainsets is being used.

Reference	Title	Date
2008/57/EG	Directive on the European parliament and the council on the interoperability of the rail system within the community, amended by directives 2009/131/EC, 2011/18/EU, 2013/9/EU, 2014/38/EU and 2014/106/EU.	17.06.2008
2010/713/EU	COMMISSION DECISION of 9 November 2010 on modules for the procedures for assessment of conformity, suitability for use and EC verification to be used in the technical specifications for interoperability adopted under Directive 2008/57/EC of the European Parliament and of the Council	09.11.2010
Technical Specifications for Interoperability		
(EU) 1302/2014	COMMISSION REGULATION (EU) No 1302/2014 of 18 November 2014 concerning a technical specification for interoperability relating to the 'rolling stock — locomotives and passenger rolling stock' subsystem of the rail system in the European Union.	18.11.2014
(EU) 1303/2014	COMMISSION REGULATION (EU) No 1303/2014 of 18 November 2014 concerning the technical specification for interoperability relating to 'safety in railway tunnels' of the rail system of the European Union Text with EEA relevance	18.11.2014
(EU) 1300/2014	COMMISSION REGULATION (EU) No 1300/2014 of 18 November 2014 on the technical specifications for interoperability relating to accessibility of the Union's rail system for persons with disabilities and persons with reduced mobility.	18.11.2014
(EU) 1304/2014	COMMISSION REGULATION (EU) No 1304/2014 of 26 November 2014 on the technical specification for interoperability relating to the subsystem 'rolling stock — noise' amending Decision 2008/232/EC and repealing Decision 2011/229/EU.	26.11.2014

Table 7. Applicable Standards

5.2 Design evidence

For this project all information is stored in the Ricardo Certification Iberia S.L. server under project number E750083.

The documentation that has been supplied to Ricardo Certification to enable assessment is listed in each one of the correspond at Assessment Reports in Section 6.1.

Table 8 lists the documentation described at section 4.2.12 and requested in clause 2.4 of Annex VI of Directive 2008/57/EC. This documentation is included as part of this Technical File.

Document	Reference	Issue
Vehicle general arrangement 3 car	C.I4.00.001	H
Vehicle general arrangement 4 car	C.I4.00.002	J
A1 car	C.I4.00.101	H
A2 car	C.I4.00.901	J
B car	C.I4.00.301	H
C1 car	C.I4.00.501	H
Electric diagrams – A1 car	C.I4.75.100	H
Electric diagrams – B car	C.I4.75.300	H
Electric diagrams – C1 car	C.I4.75.500	H
Pneumatic scheme A1/A2 car	C.I4.21.199	J
Pneumatic scheme B car	C.I4.21.399	J
Pneumatic scheme C1 car	C.I4.21.599	H
Bio-reactor description	C.I4.94.381.00	C
Toilet module description	C.I4.94.382.00	D
Train main functions controls functional description	C.I4.75.015.10	E
Magnetic track brake technical description	M.J5.97.019.00	-
TCMS HMI screens specification	C.I4.98.101.00	H
Exterior lighting description	C.I4.97.086.03	C
Interior lighting description	C.I4.97.086.02	F
Dynamic and friction brake WSP (Wheel slide protection)	C.I4.94.550.02	B
Technical description of the energy measurement system	C.I4.94.369.00	C
Signalling system technical description	C.I4.94.364.00	C
Description of EVR	C.I4.94.363.00	E
TCMS Technical description	C.I4.94.362.00	E
Description of PIS	C.I4.94.361.04	G
Description of PAS-PA	C.I4.94.361.01	E
Sliding steps technical description	C.I4.94.343.00	F
Access doors technical description	C.I4.94.341.00	L
Technical description of brake, pneumatic system and air supply	C.I4.94.331.00	F

Technical description harmonic detection system	C.I4.94.310.06	G
Technical description of traction system	C.I4.94.301.00	E
Technical description of the pantograph	C.I4.94.302.00	E
Technical description of traction inverter	C.I4.94.301.01	C
Kinematic gauge calculation	C.I4.93.101.00	C
Lateral G2 Gauge	C.I4.00.025	A
Upper parts G2 Gauge	C.I4.00.026	B
Lower parts G2 Gauge	C.I4.00.027	B
Lower gauge extreme bogie	M.J5.93.019	-
Lower gauge Jacobs motor bogie	M.J6.93.019	-
Lower gauge Jacobs trailer bogie	M.J6.93.041	-
Weight report	C.I4.93.110.01	G
Traction performance calculations	C.I4.93.201.00	C
Test report. Dynamic behaviour.	C.I4.92.375.70	E
Calculation report for end bogie frame	M.H6.93.019.02	A
Load specification for Jacobs motor bogie frame calculation	M.J6.93.001.00	B
Load specification for Jacobs trailer bogie frame calculation	M.J6.93.004.00	C
Jacobs motor bogie frame calculation	M.J6.93.025.00	A
Jacobs trailer bogie frame calculation	M.J6.93.027.00	B
FMECA Analysis	C.I4.96.806.00	F
FMECA Analysis Brake System	C.I4.96.812.01	-
Brake performance calculation	C.I4.93.231.00	G
Water quality test report	-	-
Conformity declaration Bioreactor	-	-
Environmental conditions	C.I4.97.075.10	D
Side wind stability assessment specification	C.I4.97.011.01	-
Wind tunnels test report	C.I4.97.011.05	-
Distances between pantographs	C.I4.00.079	A
Coupler description	C.I4.94.391.00	D
Automatic coupler assembly	C.I4.18.001	A
Maintenance instruction Wheelset – Wheel Reprofiling	C.I4.97.516.08	A

NS Trailer Wheelset	X.01.01256	J
NS Motor Wheelset	X.01.01255	J
Motor wheelset – Assembly control	M.J5.90.100	A
Bogie: serial numbers	M.J5.90.600	C
Wheel	M.J5.01.010	E
Metal free area around wheels	M.J5.93.033	A
Carbody description	C.I4.97.352.00	B
Bogie description	M.J5.97.001.00	A
Hot axle box detection	M.J5.97.002	A
Hot axle box detection	M.J6.97.002	-
Bearing test report	M.J5.92.812.50	A
Brake resistor simulations	C.I4.93.202.01	A
Test report: Saloon HVAC	C.I4.92.251.50	-
Confirmation of current limitation	HCN-L6923-59	0
Maintenance Plan	C.I4.97.500.00	G
Evidence of functional safety (EFS)	C.I4.96.909.00	H
Fire safety plan	C.I4.97.050.00	C
Accesibility. ETI-PMR Step-Platform position	C.I4.00.062	-
Pantograph test report	C.I4.92.302.50	A

Table 8. Design evidence

5.3 Evidence related to quality management system

The Quality system implemented by CAF during the manufacturing stage (SD assessment module) of 118 Sprinter Next Generation trainsets has been assessed and audited by Ricardo Certification as a Notified Body the production of Sprinter Next Generation of CAF according to TSI LOC&PAS, PRM, NOI & SRT.

The Sprinter Next Generation have also been assessed to the requirements of the Dutch RIS (Regeling Indienststelling Spoorvoertuigen) regulation.

Ricardo Certification took into account the existing CAF's ISO 9001 certification, especially by limiting the quality documentation that has to be requested, and by performing an on-site audit of two days. Therefore, a TSI/SD and RIS audit of the production quality management system CAF has been performed on 15th – 16th November 2016 in CAF's factory at Beasain, Spain.

The observations raised during the audit have been captured and managed in The Assessment Record 01.

Ricardo Certification has advised that CAF is competent to produce the Sprinter Next Generation in accordance to the RIS, and TSI/SD.

Ricardo Certification shall carry out periodic audits to verify that CAF maintains and applies the quality management system and shall provide the applicant with an audit report. The frequency of the periodic audits shall be at least once every 2 years.

Audit report and related documentation is referred in Table 9 and included as part of this Technical File.

Ricardo Certification has performed a surveillance audit on 27th September 2018 to verify that CAF maintains and applies the quality management system. Details from the audit have been recorded in the Surveillance Audit Report referred in Table 9 included as part of this Technical File. The observations raised during the audit have been captured and managed in The Assessment Record 01.

Document	Reference	Issue
Sprinter Next Generation - Audit Report	1304 SD Audit Report	2.0
Sprinter Next Generation – Audit Plan	1304 Audit plan	3.0
Assessment Record 01 – SD Audit for SNG trainset production	1304 Record 01	4.0
Sprinter Next Generation – Surveillance Audit Report	750083 – Surveillance Audit Report	2.0

Table 9. Evidence related to Quality Management System

5.4 List of manufacturers and main subcontractors

The production is performed by Construcciones y Auxiliar de Ferrocarriles S.A. at Beasain factory in Spain.

Main subcontractors are listed in Table 10.

Manufacturer / Subcontractor	Scope of production
10 1 c	Traction system
	Traction motor
	Access door
	Access ramp & PMR Elevator
	HSCB
	Grounding Device
	Gear Unit
	Carbody Break & WSP System
	Bogie Brake System
	Air Production System (PTA)
	Passenger HVAC
	CAB HVAC
	Auxiliary Converter & Battery Charge (CVS)
10 1 c	WC PMR
	Pantograph

10 1 c	BIOREACTOR
	ERTMS & ATB
	TCMS
	Coupler
	Brake Resistors
	Master controller
	Event Recorder
	CCTV
	Energy Measurement System
	On Board ITE Platform (OBITP)
	PA System
	Gangway
	Battery
10 1 c	Radio GSMR

Table 10. List of manufacturers and main sub-contractors

5.5 Provisions for operation

The provisions for operation are described in the documents listed in Table 11.

Document	Reference	Issue
Operation manual for drivers and guards	C.I4.97.402.00	D
Rescue manual	C.I4.97.403.00	-
Train general functional description	C.I4.75.010.00	F
TCMS HMI Screens specification	C.I4.98.101.00	H
Lifting and rerailing	C.I4.97.351.00	B

Table 11. Provisions for operation

5.6 Provisions for maintenance

The provisions for maintenance are described in the documents listed in Table 12

Document	Reference	Issue
Maintenance Plan	C.I4.97.500.00	G
Maintenance Instructions/manuals	C.I4.97.5xx	A
RCM Model Bogie	C.I4.96.853.01	-
RCM Model Air Conditioning	C.I4.96.853.02	-

RCM Model Traction	C.I4.96.853.05	-
RCM Model Brake system	C.I4.96.853.06	-
RCM Model Doors	C.I4.96.853.07	-
RCM Model WC	C.I4.96.853.11	-
RCM Model Couplers & intercar	C.I4.96.853.13	-
Environmental conditions	C.I4.97.075.10	D
Weight report	C.I4.93.110.01	G
Electric diagrams – A1 car	C.I4.75.100	H
Electric diagrams – B car	C.I4.75.300	H
Electric diagrams – C1 car	C.I4.75.500	H
Train brake system functional description	C.I4.75.015.30	D
Spare list	C.I4.97.404.00	A

Table 12. Provisions for maintenance

5.7 Interoperability Constituents

The applicable interoperability constituent are detailed in CAF's document reference C.I4.96.070_A, containing all the interoperability certificates and listed in the tables below:

TSI LOC&PAS 1302/2014

Interoperability Constituent	Reference
5.3.4 Wheels	0056/2/CH1/2016/RST/ESEN/001/ESP 0056/4/CH1/2016/RST/ESEN/002/ESP
5.3.5. WSP (wheel slide protection system)	0893/1/CB/15/RST/DEEN/2765 0893/4/CD/15/RST/DEEN/2236
5.3.6. Head lamps	1133/1/CB/2016/RST/ENEN/1334
5.3.7. Marker lamps	1133/1/CB/2016/RST/ENEN/1334
5.3.8. Tail lamps	1133/1/CB/2016/RST/ENEN/1334
5.3.9. Horns	1010/4/CH/2016/RST/DEEN/TRRC1931545
5.3.10. Pantograph	1714/1/CB/15/RST/EN/1790 1714/4/CD/15/RST/EN/1791
5.3.11. Contact strips	0893/2/CH1/16/RST/DEEN/2848
5.3.12. Main circuit breaker	2593/1/CH1/2017/RST/EN/8909/0004 ed.1 0942/4/CH1/2012/RST/EN/8259/0009 ed. 4
5.3.13. Driver's seat	0986/4/CH/2017/RST/ES-EN/046

	EC Declaration of conformity
5.3.14. Toilet discharge connection	EC Declaration of conformity 1910161215DS
5.3.15. Inlet connection for water tanks	EC Declaration Inlet connection for water tanks

Table 13. Interoperability Constituents TSI LOC&PAS

TSI PRM 1300/2014

Interoperability Constituent	Reference
5.3.2.1. Interface of the door control device	0893/1/CB/16/RST/DEEN/2627
5.3.2.2. Standard and universal toilets: common parameters	0986/1/CB/2017/RST/ES-EN/004 EC Declaration Universal Toilet
5.3.2.4. Universal toilet	0986/1/CB/2017/RST/ES-EN/004 EC Declaration Universal Toilet
5.3.2.5. Baby nappy changing table	EC Declaration of conformity 20100513
5.3.2.6. Interface of the call for aid device	0893/1/B/15/INS/DE EN/2209 0893/1/B/15/INS/DE EN/2210
5.3.2.7. Internal and External Displays	2673/1/CB/2017/RST/EN/N20170313 EC Declaration of conformity MMD 181 D
5.3.2.8. Boarding aids: movable steps and bridging plates	2411/1/CB/16/RST/DEEN/TNL1622-01 2411/4/CD/16/RST/DEEN/TNL1622-02

Table 14. Interoperability Constituents TSI PRM

6. EC verification process information

The certification assessment is being carried out by employees of Ricardo Certification, under the accreditation from Ricardo Certification Limited.

The method of certification examination is based on the conformity assessment procedures (modules) as described in Chapter 6 of the TSI and in Decision 2010/713/EU. For this project the combination of the modules SB + SD was chosen, where:

- SB module – EC Type Examination.
- SD module – EC verification based on quality management system of the production process.

The assessed documentation consists of calculations, analyses, drawings, schemes, reports and declarations of conformity. All the documentation has been assessed to determine to what extend the specific requirements have been satisfied.

The results of the assessments are recorded in the so-called Assessment Reports (section 6.1). Furthermore, the review covers such things as inspections, audits and factory visits.

All authorisation relevant aspects (defined in Appendix A) have been assessed by Ricardo Certification based on the provided documentation delivered by CAF.

All the assessed documentation, including assessment reports and issued certificates is put together in one file. This file is called the Technical File.

6.1 Overview of NoBo assessments

TSIs requirements are grouped in different Assessment Reports. Ricardo Certification has prepared the assessment reports listed in Table 15.

Section	Subject	Reference	Issue
TSI LOC&PAS § 4.2.2.9	Mechanical characteristics of glass (other than windscreens)	580536	4
TSI LOC&PAS § 4.2.4	Braking	580538	33
TSI LOC&PAS § 4.2.5.2	Audible communication system	580539	5
TSI LOC&PAS § 4.2.5.4	Communication devices for passengers		
TSI LOC&PAS § 4.2.2.1	Structure and mechanical parts: General	580540	20
TSI LOC&PAS § 4.2.2.2	Mechanical interfaces		
TSI LOC&PAS § 4.2.2.3	Gangways		
TSI LOC&PAS § 4.2.12.	Documentation for operation and maintenance	580541	15
TSI LOC&PAS § 4.2.12.1	General		
TSI LOC&PAS § 4.2.12.2.	General documentation		
TSI LOC&PAS § 4.2.12.3.	Documentation related to maintenance		
TSI LOC&PAS § 4.2.12.4.	Operating documentation		
TSI LOC&PAS § 4.2.12.5.	Lifting diagram and instructions		

Section	Subject	Reference	Issue
TSI LOC&PAS § 4.2.12.6.	Rescue related descriptions		
TSI LOC&PAS § 4.2.9.1	Driver's cab	580542	25
TSI LOC&PAS § 4.2.9.2	Windscreen		
TSI LOC&PAS § 4.2.9.3	Driver machine interface		
TSI LOC&PAS § 4.2.9.4	On-board tools and portable equipment		
TSI LOC&PAS § 4.2.9.5	Storage facility for staff personal effects		
TSI LOC&PAS § 4.2.9	Recording device		
TSI LOC&PAS 4.2.6.1	Environmental conditions	580543	10
TSI LOC&PAS 4.2.6.2	Aerodynamic effects		
TSI LOC&PAS 4.2.7	External lights & visible and audible warning devices	580544	11
TSI LOC&PAS §4.2.5.5	Exterior doors: passenger access to and egress from Rolling Stock	580545	12
TSI LOC&PAS §4.2.5.6	Exterior door system construction		
TSI LOC&PAS §4.2.5.7	Inter-unit doors		
TSI LOC&PAS §4.2.10.1	General and Categorisation	580546	12
TSI LOC&PAS §4.2.10.2	Measures to prevent fire		
TSI LOC&PAS §4.2.10.3	Measures to detect/control fire		
TSI LOC&PAS §4.2.10.4	Requirements related to emergencies		
TSI LOC&PAS §4.2.10.5	Requirements related to evacuation		
TSI LOC&PAS §4.2.3.1	Gauging	580547	5
TSI LOC&PAS § 4.2.2.10	Load conditions and weighed mass	580548	6
TSI LOC&PAS §4.2.5.3	Passenger alarm	580549	9
TSI LOC&PAS § 4.2.3.3	Rolling stock parameters which influence ground base systems	580551	11
TSI LOC&PAS § 4.2.3.2	Axle load and wheel load	580552	21
TSI LOC&PAS § 4.2.3.4	Rolling stock dynamic behaviour		
TSI LOC&PAS § 4.2.3.6	Minimum curve radius		
TSI LOC&PAS § 4.2.3.5	Running gear	580553	21
TSI LOC&PAS § 4.2.3.7	Life guards		
TSI LOC&PAS § 4.2.5.1	Sanitary systems	580555	4
TSI LOC&PAS § 4.2.5.8	Internal air quality		
TSI LOC&PAS § 4.2.5.9	Body side windows		

Section	Subject	Reference	Issue
TSI LOC&PAS § 4.2.11	Servicing	580556	9
TSI LOC&PAS § 4.2.2.4	Strength of vehicle structure	580557	21
TSI LOC&PAS § 4.2.2.5	Passive safety		
TSI LOC&PAS § 4.2.2.6	Lifting and jacking		
TSI LOC&PAS § 4.2.2.7	Fixing of devices to carbody structure		
TSI LOC&PAS § 4.2.8	Traction and electrical equipment	580560	21
TSI PRM §4.2.2.1	Seats	580562	23
TSI PRM §4.2.2.2	Wheelchair spaces		
TSI PRM §4.2.2.3	Doors		
TSI PRM §4.2.2.4	Lighting		
TSI PRM §4.2.2.5	Toilets		
TSI PRM §4.2.2.6	Clearways		
TSI PRM §4.2.2.7	Customer information		
TSI PRM §4.2.2.8	Height changes		
TSI PRM §4.2.2.9	Handrails		
TSI PRM §4.2.2.10	Wheelchair accessible sleeping accommodation		
TSI PRM §4.2.2.11	Step position for vehicle access and egress		
TSI PRM §4.2.2.12	Boarding aids		
TSI NOI	Noise for rolling stock	580563	4

Table 15. Overview of NoBo Assessments

6.2 Conformity Process Information

The CAF SNG trainsets are being assessed against the applicable TSI's.

The trail of assessments is contained within the clause-by-clause Assessment Reports produced by Ricardo Certification as described in Section 6.1. Note that, where greater than one iteration of submissions was required to demonstrate compliance, only the outcome of the final iteration has been included in this technical file (in all cases this has been written in such a way as to fully address the applicable clause). A record of all iterations is maintained by Ricardo Certification Iberia S.L.

In the paragraphs below, the TSIs assessment results that are relevant for the authorisation of the trainsets in The Netherlands are described.

6.2.1 TSI LOC&PAS 4.2.2 Structure and mechanical parts

The assessment of the **Inner coupling** (TSI LOC&PAS 4.2.2.2.2) has proven compliance with EN12663-1:2010. SNG Inner couplings between the different vehicles are capable of withstanding the forces due to the intended operating conditions. The inner coupling between two vehicles sharing the same running gear comply with the requirements of EN12663-1:2010.

The **End coupling** (TSI LOC&PAS 4.2.2.2.3) has been assessed and it has been proven that the resilient coupling system is capable of withstanding the forces due to the intended operational and rescue conditions. SNG units are equipped with end couplings Scharffenberger T10 type capable of withstanding the forces due to the intended operational and rescue conditions.

SNG units are not equipped with rescue coupler on board. Rescue will be done by means of the end coupling.

Gangways (TSI LOC&PAS 4.2.2.3) assessment has been performed according EN16286-1:2013 with positive results. It has been checked that gangways in the SNG trainsets can accommodate all relative movements of vehicles in normal operation not exposing passengers to undue risk.

The **Strength of the vehicle structure** (TSI LOC&PAS 4.2.2.4) assessment has proven that the vehicle structure complies with the structural requirements of EN 12663-1:2010. SNG trainsets are classified as Category P-II (Fixed units and coaches). Proof of the strength of the vehicle body has been demonstrated by calculations and by testing, according to the conditions set up in the specification referenced in EN 12663-1:2010.

As for **Passive Safety** requirement **(**TSI LOC&PAS 4.2.2.5), SNG units comply with the detailed crashworthiness requirements specified in the specification referenced in EN 15227:2008+A1:2011 related to crashworthiness design category C-I. The four scenarios described in EN 15227:2008+A1:2011 have been considered.

Lifting and jacking (TSI LOC&PAS 4.2.2.6) has been assessed proven that is possible to safely lift or jack each vehicle composing the unit for recovery purposes. Suitable vehicle body interfaces (lifting/jacking points) are provided, which permit the application of vertical or quasi-vertical forces. The vehicle is designed for complete lifting or jacking, including the running gear. It is also possible to lift or jack any end of the vehicle with the other end resting on the remaining running gear(s). Jacking/Lifting points are located such as to enable the safe and stable lifting of the vehicle. The structure is designed with consideration of the loads specified in the specification referenced in EN 12663-1:2010.; proof of the strength of the vehicle body has been demonstrated by calculations and testing. Jacking and lifting diagram and corresponding instructions have been provided.

Attachments of **Fixing of devices to carbody structure** (TSI LOC&PAS 4.2.2.7) have been designed according to EN12663-1:2010 considering P-II category for passenger rolling stock. Fixed devices including those inside the passenger areas are attached to the carbody structure in a way that prevents these fixed devices becoming loose and presenting a risk of passenger injuries or lead to a derailment.

The modification related to the introduction of weight in cars A1 and A2 to improve the levelling of the trainsets has impact in requirement 4.2.2.7. A calculation has been performed for static loads and fatigue loads for new equipment (ballast) in combination with total weight of the equipment. Calculation results show that in all the load cases the stresses obtained around the attachment of the ballast equipment are very low. The stress values are far from the limits of the material of the area.

Mechanical characteristics of glass (other than windscreens) (TSI LOC&PAS 4.2.2.9). The glasses equipped in the SNG trainsets are either laminated or toughened glass in accordance with one of the relevant publicly available standards suitable for railway application with regard to the quality and area of use, thereby minimising the risk to passenger and staff being injured by breaking glass.

Load conditions and weighed mass (TSI LOC&PAS 4.2.2.10) have been determined for both compositions based on weigh tests of the trainsets. A weight calculation has been performed and assessed. Vehicle mass, mass per axel and mass per wheel have been determined for each trainsets type and for each one of the load conditions. Weighing tests have been performed on the 4-car trainset

and 3-car trainset, measuring the weighed mass for a design mass in working order condition and calculating the design mass under normal payload and design mass under exceptional payload.

The modification related to the introduction of weight in cars A1 and A2 to improve the levelling of the trainsets, has impact in the requirement. Weighing tests have been performed on the 4-car and 3-car modified trainsets, measuring the weighed mass for a design mass in working order condition and calculating the design mass under normal payload and design mass under exceptional payload.

The above items have been assessed and it has been concluded that CAF has provided sufficient evidence related to structure and mechanical parts to prove compliance to the related requirements.

6.2.2 TSI LOC&PAS 4.2.3 Track interaction and gauging

Compliance of **Gauging** (TSI LOC&PAS 4.2.3.1) according to EN15273-2:2009 reference profile G2 has been proven. The SNG trainsets comply to the reference profile G2, as defined in the EN 15273-2:2013. For the lower area the reference contour is GI2, as described in EN 15273-2:2013. The GI2 profile applies to vehicles that shall not pass over rail brakes and other activated shunting and stopping devices. Zone (c) for contact ramp brushes is not taken into account, so the unit is not allowed to pass contact ramps (crocodiles). Compliance has been reached for the requirements of EN 15273-2:2013 Chapter A.3.14 for opening the doors and for doors in open position for platform heights of 760 (+30; -35) mm +TOR.

Axle load parameter (TSI LOC&PAS 4.2.3.2.1) for both compositions and the three load conditions has been determined. All wheel and axle loads are within the requirements.

Regarding **Wheel load** (TSI LOC&PAS 4.2.3.2.2), the ratio of the wheel load difference per axel has been evaluated for both compositions to check that is less than a 5% based on the values obtained from the weight factory tests. The wheel load over the wheel diameter (Q/D) in “design mass under normal payload” condition is lower than 0.15 kN/mm for both trainset types measured for a minimum worn wheel diameter and design mass under normal payload.

The modification related to the introduction of weight in cars A1 and A2 to improve the levelling of the units has impact in requirements 4.2.3.2.1 and 4.2.3.2.2. All wheel and axle loads of the modified units are within the requirements.

The **Rolling Stock characteristics for the compatibility with train detection systems** (TSI LOC&PAS 4.2.3.3.1) are compliant according to document ERA/ERTMS/033281 for the different detection systems (4.2.3.3.1.1 for **compatibility with train detection systems based on track circuits**, 4.2.3.3.1.2 for **compatibility with train detection systems based on axle counters** and, 4.2.3.3.1.3 for **compatibility with loop equipment**). The open points which are covered by NTR’s are assessed in the DeBo Technical File.

The **Axel bearing condition monitoring** (TSI LOC&PAS 4.2.3.3.2) is performed by means of **compatibility with trackside equipment** (TSI LOC&PAS 4.2.3.3.2.2). SNG trainsets maximum design speed is 160 km/h, therefore on-board detection equipment for axle bearing condition monitoring is not required. Axle bearing monitoring is made possible by using trackside equipment. The zone visible to the trackside equipment on rolling stock is the area as defined in EN 15437-1:2009.

Safety against derailment running on twisted track (TSI LOC&PAS 4.2.3.4.1) has been proven according to method 2 of EN14363:2005. Dynamic calculations have been assessed proving than no derailment is expected. Furthermore, wheel unloading tests and 150m curve dynamic tests have been performed to obtain the minimum vertical wheel load (Q_{min}) and guiding foce (Y) and thus obtaining the Y/Q value. Results shows that Y/Q value is lower than the limit value specified in EN14363:2005 so the vehicle is considered to be safe against derailment.

The modification related to the introduction of weight in cars A1 and A2 to improve the levelling of the units has impact in requirements 4.2.3.4.1. The modified units fulfil the requirements concerning safety against derailment.

The **Running dynamic behaviour** (TSI LOC&PAS 4.2.3.4.2) and its sub-sections **Limit values for running safety** (TSI LOC&PAS 4.2.3.4.2.1) and **Track loading limit values** (TSI LOC&PAS 4.2.3.4.2.2) have been assessed by means of simulation reports and measurement reports. The dynamic behaviour of the vehicle has been tested on the Velim test circuit and on the network in the Czech Republic. A 4-car trainset has been tested. The measurements have been carried out according EN14363:2016 simplified method. The bogies of the 3-car trainset have been proven by λ-procedure and parameter comparison. The result is that there is compliance to all the requirements of EN14363:2016 Annex U. Therefore, the 3-car trainset is approved for this subject.

The modification related to the introduction of weight in cars A1 and A2 to improve the levelling of the units has impact in requirements 4.2.3.4.2. The acceptance of the initial vehicle (dynamic behaviour and stability) car be extended to the 4 and 3-car trainset modified with underframe ballasts without performing any additional testing.

Design values for new wheel profiles (TSI LOC&PAS 4.2.3.4.3.1) have been deemed compliant as per EN13715:2006 based on the measurements performed on the train.

For **Structural design of bogie frame** (TSI LOC&PAS 4.2.3.5.1) the integrity of the structure of SNG bogie frames, axle box housing and all attached equipment has been demonstrated based on methods as set out in EN 13739:2011. CAF has performed structural analysis, static and fatigue tests and track tests to prove compliance for the end motor bogies and the Jacobs motor and trailer bogies. The series production bogie frames and the test frames have been audited in order to check if they are manufactured according to an equivalent set of specifications, including drawings, procedures and quality plan.

The body to bogie connection complies with the requirements of EN 12663-1:2010. The main fatigue load inputs arisen from traction and braking and vehicle dynamic interactions have been considered.

The **Wheelsets** (TSI LOC&PAS 4.2.3.5.2) have been tested to prove that they are able to transmit forces and torques between the fitted elements. The assemblies are capable of withstanding an axial force F for 30 s without there being any displacement between one element and another. The characteristics of the axles ensure the transmission of forces and torque.

The axle boxes have been designed with consideration of mechanical resistance and fatigue characteristics. SNG axel boxes have been subjected to performance tests against EN 12082:2007. Temperature limits have been determined by testing.

The geometric dimensions of the wheelsets are compliant with limit values specified for the relevant track gauge.

Mechanical and geometrical characteristics of wheels (TSI LOC&PAS 4.2.3.5.2.2) have been proven compliant by means of an IC Certificate of the wheels.

SNG is equipped with **Lifeguards** (TSI LOC&PAS 4.2.3.7) to protect the wheels against damages caused by minor items on the rails. The lifeguard has been designed to withstand a minimum longitudinal static force without permanent deformation of 20 kN and has been designed so that, during plastic deformation, it does not foul the track or running gear and that contact with the wheel tread, if it occurs, does not pose a risk of derailment.

Minimum curve radius (TSI LOC&PAS 4.2.3.6) has been proven compliant. It has been proved that the vehicle is capable of negotiating a curve with a minimum radius of 150 m.

The above items have been assessed and it has been concluded that CAF has provided sufficient evidence related to track interaction and gauging to prove compliance to the related requirements under the following conditions:

- **Assessed minimum horizontal curve radius 150 m;**
- **Vmax = 160 km/h;**
- **Cant deficiency ≤ 130 mm.**
- **The SNG trainsets are not allowed to pass over rail brakes and other activated shunting and stopping devices.**
- **The SNG trainsets are not allowed to run over contact ramps.**
- **The SNG trainsets are compatible with the platform heights 0,55 and 0,76 m +TOR as defined in TSI INF 2014/1299 section 4.2.9.2.**

6.2.3 TSI LOC&PAS 4.2.4 Braking

Functional requirements (TSI LOC&PAS 4.2.4.2.1) have been assessed for both compositions by means of design documentation, braking calculations, static factory tests and dynamic tests. It has been proven that the units are equipped with a main brake function to be used for service and emergency braking and with parking brake. The continuity and automaticity of the main brake function has been successfully tested. The braking energy available on board the train is consistent with the design of the brake system, to ensure the application of the required brake forces.

Inexhaustibility and braking in case of an unintentional train separation has been successfully tested for both type of compositions. It has been proven that it is possible to hold in a stationary position the unit with maximum braking load on a 40 ‰ gradient by using the friction brake of the main brake system alone for at least two hours.

The unit control system has three control modes: emergency braking, service braking and parking braking and a brake application command, whatever its control mode, takes control of the brake system. It has been proven that the maximum jerk due to the use of brakes is lower than 4 m/s^3 as required.

For **Safety requirements** (TSI LOC&PAS 4.2.4.2.2.) the risk based analysis related to braking performance has been evaluated. Safety requirements as defined in Table 1 of 4.2.4.2.2. (2) have been considered, proving that the corresponding risk is controlled to an acceptable level, considering the functional failure with their typical credible potential to lead directly to the severity as defined within the table.

The **Brake command** (TSI LOC&PAS 4.2.4.4) comprises the following requirements:

- **Emergency braking command** (TSI LOC&PAS 4.2.4.4.1). Two independent emergency brake command devices are available, allowing the activation of the emergency brake by a simple and single action from the driver in his normal driving position, using one hand. The activation of the emergency brake is also possible by the Control-Command and signalling on-board system. Activation of the emergency brake leads permanently unless the command is cancelled. Design documentation, static tests and dynamic tests have been assessed.
- **Service braking command** (TSI LOC&PAS 4.2.4.4.2) has been assessed for both compositions by means of design documentation and static factory tests. The service brake function allows the driver to adjust (by application or release) the brake force between a minimum and a maximum value in order to control the speed of the train. The graduability of the service brake in 2 steps has been verified in the static factory tests.

The service braking command can be active only in one location in a train. When the speed of the train is higher than 15 km/h, the service brake activation by the driver leads automatically to the cut-off of all tractive effort and cannot be reset until the traction command is cancelled by the driver. This has been verified in the static factory tests.

- **Dynamic braking command** (TSI LOC&PAS 4.2.4.4.4) has been assessed for both compositions by means of design documentation and static factory tests. Units are equipped with dynamic brake system. The possibility to prevent regenerative braking has been verified testing that the use of regenerative braking can be controlled via HMI. Blending will be used at SNG trains when available. ED brake can be used only in non-degraded mode.
- **Parking braking command** (TSI LOC&PAS 4.2.4.4.5) The parking brake applies a defined brake force for an unlimited period of time whatever the status of the others system in the train. The release of the parking brake at standstill has been successfully tested. Parking brake can be applied or released from the enabled cab and is possible only if the train is stopped. Once the train is in the process to shutdown, the parking brake is automatically applied. This has been verified in the static factory tests.

The **Braking performance** (TSI LOC&PAS 4.2.4.5) comprises the following requirements.

- **General requirements** (TSI LOC&PAS 4.2.4.5.1). Braking performance has been determined by means of calculations as defined in EN14531-6:2009. The brake calculations for both compositions have been completed. They include all required calculations, performed according to the requirements and correctly validated by the results of the dynamic tests. Friction coefficients have been determined as per EN14531-1:2005. Braking performance calculations have been performed for the two control modes: emergency brake and maximum service brake. The maximum average deceleration is well below the limit of 2,5 m/s^2.
- **Emergency braking** (TSI LOC&PAS 4.2.4.5.2). The equivalent response time evaluated on the total emergency braking force developed in case of the emergency brake command is lower than 5 seconds. The delay time is lower than 2 seconds. The deceleration profile and stopping distances at the required speeds have been determined in the calculations and validated with test results. Emergency braking performance calculations have been performed with a brake system in normal mode and degraded mode and considering degraded conditions. They have been performed for the three specified load conditions.
- **Service braking** (TSI LOC&PAS 4.2.4.5.3). The maximum service braking performance has been calculated in accordance with EN14531-6:2009. Tests have been performed to validate the maximum service braking calculation. The maximum performance of the service brake, assessed by comparing the stopping distance from all initial velocities for the load condition DMuNP (SB), is not higher than that of the emergency brake
- **Calculations related to thermal capacity** (TSI LOC&PAS 4.2.4.5.4). The brake energy capacity has been verified by calculations showing that the braking system in normal mode is designed to withstand the dissipation of the braking energy. Two successive emergency brake applications from the maximum speed on level track for the load condition “maximum braking load” have been considered. Thermal calculations have been validated with dynamometer tests. The brake force and deceleration used in the thermal calculation and validation match the maximum values obtained from the brake calculations.

  The maximum line gradient, associated length and operating speed for which the brake system is designed in relation with brake thermal energy capacity has also been defined in the thermal calculation for the load condition “maximum braking load”, with the service brake being used to

maintain the train at a constant operating speed. Continuous braking with SB 0%ED, for the TSI reference load case (46 km, slope of 21‰, v= 80 km/h), followed by an emergency brake application has been considered. The maximum calculated brake disk temperature is below maximum allowable temperature defined by the manufacturer. The thermal calculation has been validated in the dynamometer tests.

- **Parking brake** (TSI LOC&PAS 4.2.4.5.5). Both compositions in load condition "design mass in working order" without any power supply available, and stationary permanently on a 40‰ gradient, are kept immobilised. The maximum slope has been calculated. Results are 62.3‰ gradient for 3-cars configuration and 49.7‰ gradient for 4-cars configuration, fulfilling the required 40‰ gradient. The units parking brake performance has been calculated as defined in EN14531-6:2009.

The **Wheel rail adhesion profile – Wheel slide protection system** (TSI LOC&PAS 4.2.4.6) comprises the following requirements:

- **Limit of wheel rail adhesion profile** (TSI LOC&PAS 4.2.4.6.1) Calculations have been assessed. The braking system of the units has been designed so that emergency brake performance and the service brake performance do not assume a calculated wheel/rail adhesion for each wheelset in the speed range > 30 km/h and < 250 km/h higher than 0.15. The parking brake calculation assumes an available adhesion of 0.12, and is included for all load conditions. The calculation is force-based and independent of the wheel diameter.

- **Wheel slide protection system** (TSI LOC&PAS 4.2.4.6.2). EC Interoperability certificates have been provided and dynamic tests have been performed to prove compliance. SNG units are fitted with a wheel slide protection system and applies to both the pneumatic brake and the dynamic brake (with blending with the pneumatic brake). The dynamic brake is controlled by a specific WSP.

  The purpose of the WSP functionality is to "make the best use of available adhesion by a controlled reduction and restoration of the brake force to prevent wheelsets from locking and uncontrolled sliding, thereby minimising the extension of stopping distances and possible wheel damage" (§ 4.2.4.6.2 (1)).

  The brake test report shows that the full service brake of the 3-car in low adhesion conditions results in longer brake distances than in dry conditions and that this increase in service brake distance is considerably higher than the proportional increase in brake distance of the emergency brake. The WSP for the full service brake of the 3-car is only marginally complying to the requirement as the low-adhesion mode enforces all bogies to a limit of 12%, whilst the available adhesion for some bogies might be higher. This mode is not restored when the adhesion conditions improve during the brake application. The total brake effort is redistributed to equalize the brake effort for all bogies, however the brake effort achieved is less because of the maximum adhesion of 12% and equals the brake effort achieved by a full pneumatic service brake. The test results show that this behaviour of the brake system in low adhesion conditions leads to additional brake distance elongation, on top of the elongation which could be expected by the driver in low adhesion conditions.

  According to CAF, the WSP-system, both the parametrization of the TCU as the pneumatic WSP, is identical in the 3-car and the 4-car. Regarding the 4-car, each TCU controls three instead of two axles, one motor-bogie of the end-bogies and one axle of the center bogie. The pneumatic brake of the center bogie is controlled on bogie level, different from the control of the ED-brake. As each TCU controls three instead of two axles, the slip is determined based on more axles, of which the axle with the least available adhesion is normative. Furthermore, a consequence of the

blending design is that in case of a traction cut-off of only one TCU, the possible pneumatic brake effort of the center bogie is limited based on the adhesion limit of the axle that is still ED-braked. As the ED-brake is responsible for most of the brake effort of the motor-bogies, the effort of the axle without ED-brake is strongly decreased. When possible, the brake effort lacking on the second axle of the center motor-bogie is compensated by the other bogies. In low adhesion mode this is not fully achievable as the maximum adhesion is limited to 12%. Assuming the results of the 3-car can be extrapolated to the 4-car, an additional 10% brake distance elongation must be added to take into account the effect of the cut-off of one TCU. The train driver is informed of the TCU-status by a red symbol at the status line of the HMI when one or two TCU's is cut-off.

The possible stopping distance elongation for the service brake in low adhesion conditions of the 3-car and the additional stopping distance elongation of the 4-car can be unexpected for the driver. The brake distance elongation can be actively counteracted by the train driver by inducing an emergency brake when slip is detected. Therefore, Ricardo Certification includes the following constraint in the assessment and the technical file:

- The driver shall be informed that the service brake effort can be limited automatically when slip is detected. Additionally, the service brake distances can increase with an extra 10% when the ED-brake is partially unavailable during sliding conditions.
  Information: this information has been included in the operation manual for drivers and guards.

Braking system independent of adhesion conditions (TSI LOC&PAS 4.2.4.8). SNG units are equipped with **Magnetic track brake** (TSI LOC&PAS 4.2.4.8.2) to be used as additional emergency brake together with the friction brake. The magnetic track brake is active during an emergency brake under normal mode, but is not included in the calculated emergency brake performance. No other wheel-rail adhesion independent brake systems are available. The magnetic track brake is only available during an emergency brake application above 10 km/h. It is pneumatically and electrically controlled for every car separately by the BCUs with a redundancy of 2. The end elements of the magnetic track brake are according to UIC 541-06, type 6.

Brake state and fault indication (TSI LOC&PAS 4.2.4.9). Main indications regarding brake status and failures are displayed at TCMS HMI. Functionality has been verified by means of tests. Specific information regarding parking brake status is given at TCMS HMI. Brake state and fault indication is available when stopped and running.

When at standstill, the train staff can check the continuity of the train brake control command line, the availability of the braking energy supply along the train and the status of the main brake and parking brake systems.

When running, the driver can check from the driving position in the cab the status of the train brake control command line, the status of the train brake energy supply, the status of the dynamic brake and braking system linked to traction system and the status applied or released of the main brake system.

Brake requirements for rescue purposes (TSI LOC&PAS 4.2.4.10). Factory static tests have been performed for both compositions proving compliance. All brakes (emergency, service, parking) are fitted with devices allowing their release and isolation. It is possible to rescue a train with no energy available on board by a recovery power unit equipped with a pneumatic brake system compatible with the UIC brake system.

The above items have been assessed and it has been concluded that CAF has provided sufficient evidence related to braking to prove compliance to the related requirements under the following conditions:

- **The driver shall be informed that the service brake effort can be limited automatically when slip is detected. Additionally, the service brake distances can increase with an extra 10% when the ED-brake is partially unavailable during sliding conditions.**

6.2.4 TSI LOC&PAS 4.2.5 Passenger related items

Sanitary system (TSI LOC&PAS 4.2.5.1) at SNG trainsets complies with European Directive 2006/7/EG (EG-directive concerning the management of bathing water quality) and 2006/11/EG (EG-directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the community).

The **Audible communication system** (TSI LOC&PAS 4.2.5.2) have been assessed by means of design documentation and factory test reports. It complies with the established requirements for both type of compositions. Trainsets are equipped with means of audible communication for the train crew to address the passengers.

The **Passenger alarm** (TSI LOC&PAS 4.2.5.3) have been assessed by means of design evidence and factory test reports. All sub-requirements are considered compliant for both compositions. Each area at SNG trainsets intended for passengers is equipped with at least one clearly visible and indicated alarm device to inform the driver of a potential danger.

The **Communication devices for passengers** (TSI LOC&PAS 4.2.5.4) has been assessed by means of design documentation and factory test reports. It complies with the requirements for both compositions. The SNG trainsets are equipped with a Passenger Emergency Communication Intercom for communication between driver and passengers. The Saloon Speaking Points can be used for communication between the driver and staff in the passenger area.

Exterior doors: passenger access to and egress from rolling stock (TSI LOC&PAS 4.2.5.5). Design evidence and factory test reports have been assessed. Requirements related to door opening, closing and locking have been deemed compliant. SNG trainsets have 2 access doors per car at both sides of the train. Each access door is equipped with a movable step. Doors at both sides of the train can be centrally open and unlocked or closed and locked from the cabins. Also doors can be locked and closed before train departure by a triangular key at each entrance door. Each door system is equipped with a manually operated mechanical locking or out of service device Doors incorporate devices that detect if they close on an obstacle. The status of the doors and steps is monitored by a wired train loop that picks up all the information which indicates locally that every door and step is closed. when not all the doors are closed and locked that traction loop opens and no traction can be applied. Doors are equipped with internal and external egress devices installed inside and outside the car, beside the doorway at each door. In case that any of the doors within the trainset formation gets released by means of the interior or exterior emergency handle, a visual an audible alarm is issued.

Exterior doors system construction (TSI LOC&PAS 4.2.5.6) is compliant according to the requirement for both type of trainsets. Characteristics of the exterior doors are according the TSI requirements.

The **Internal air quality** (TSI LOC&PAS 4.2.5.8) have been assessed for both type of compositions by means of design evidence and factory test reports. The SNG ventilation system has been proven to maintain an acceptable interior CO2 level under operational conditions. Interior CO2 levels do not exceed 5.000 ppm in all operating conditions. In case of emergency provision through battery supplied force ventilation the duration in which CO2 level remains below 10000 ppm is longer than 120min.

The above items have been assessed and it has been concluded that CAF has provided sufficient evidence related to passenger related items to prove compliance to the related requirements.

6.2.5 TSI LOC&PAS 4.2.6 Environmental conditions and aerodynamic effects

For **Environmental conditions** (TSI LOC&PAS 4.2.6.1) the nominal environmental parameters have been taken into consideration. Applicable **Temperature** (TSI LOC&PAS 4.2.6.1.1) range is T1 (-25ºC to +40ºC) as a client requirement according to EN50125-1:2014. The different equipment installed in the SNG trainsets take this into consideration and take into account their integration in the rolling stock.

SNG trainsets meet the requirements when subject to **Snow, ice and hail** (TSI LOC&PAS 4.2.6.1.2) as defined in EN 50125-1:2014, which correspond to the nominal conditions (range).

Aerodynamic effects (TSI LOC&PAS 4.2.6.2) requirements are not applicable due to the maximum speed of the SNG trains (160 km/h) with the exception of **Cross wind** (TSI LOC&PAS 4.2.6.2.4). The characteristic wind curve (CWC) has been determined in accordance with the specification referenced in EN 14067-6:2010.

The above items have been assessed and it has been concluded that CAF has provided sufficient evidence related to environmental conditions and aerodynamic effects to prove compliance to the related requirements.

6.2.6 TSI LOC&PAS 4.2.7 External lights & visible and audible warning devices

External lights (TSI LOC&PAS 4.2.7.1) have been assessed for both type of compositions. Sub requirements **Head lights** (TSI LOC&PAS 4.2.7.1.1), **Marker lights** (TSI LOC&PAS 4.2.7.1.2), **Tail lights** (TSI LOC&PAS 4.2.7.1.3) and **Lamp controls** (TSI LOC&PAS 4.2.7.1.4), have been deemed compliant for both compositions. Location, colours and intensity characteristics of the lights are according the requirements. Driver can control the head, marker lamps and tail lamps of the unit from the normal driving position.

SNG trains are fitted with warning **Horns** (TSI LOC&PAS 4.2.7.2) in order to make the train audible. The horn can be activated by the driver from within the cab. The warning horn sound levels of the low and high tone frequency horn are inside the required limits.

The above items have been assessed and it has been concluded that CAF has provided sufficient evidence related to external lights & visible and audible warning devices to prove compliance to the related requirements.

6.2.7 TSI LOC&PAS 4.2.8 Traction and electrical equipment

Traction performance (TSI LOC&PAS 4.2.8.1) have been proven to be compliant by providing calculations and design evidence. Unit traction force profiles have been determined by calculation; the unit running resistance have been determined by calculation for the load case “design mass under normal payload”. The design maximum speed has been defined for the load case “design mass under normal payload” on a level track. The trainsets are capable of an acceleration of at least 0.05 m/s² for the load case “design mass under normal payload”. SNG trainsets are equipped with two (3-car trainset) or three (4-car trainset) traction inverters.

Power supply (TSI LOC&PAS 4.2.8.2) comprises the following requirements:

- **Operation within range of voltages and frequencies** (TSI LOC&PAS 4.2.8.2.2). The values and limits of the voltage and frequency comply with EN 50163:2004. For both compositions, static factory tests to prove that the value of the line voltage is available in the driver cab in driving configuration have been performed with positive results.
- **Regenerative brake with energy to the overhead contact line** (TSI LOC&PAS 4.2.8.2.3) have been proven to be compliant. Electric units returning electrical energy to the overhead contact

line in regenerative braking mode are compliant with EN50388:2012. It is possible to control the use of the regenerative brake from the cabin.

- **Maximum power and current from the overhead contact line** (TSI LOC&PAS 4.2.8.2.4). If the current exceeds again the limit, a power limitation will be applied in order to comply with the maximum current limitation. SNG trainsets are equipped with automatic regulation of the current within abnormal operation condition regarding voltage. The requirement has been proven performing tests as per EN50388:2012 proving that line current limitations works correctly.
- **Maximum current at standstill for DC systems** (TSI LOC&PAS 4.2.8.2.5). Maximum current at standstill has been calculated and verified by measurement. The test results show a highest measured temperature increase of 78,3 °C., the maximum wire temperature was 95,1 °C. This temperature increase meets the requirement.
- **On-board energy measurement system** (TSI LOC&PAS 4.2.8.2.8). The requirements of Appendix D of TSI LOC&PAS for on board energy measurement system have been assessed with positive results.
- The **Requirements linked to pantograph** (TSI LOC&PAS 4.2.8.2.9) are compliant. **Height of interaction with contact wires** (TSI LOC&PAS 4.2.8.2.9.1.1) complies with the defined heights. For **Working range in height of pantograph** (TSI LOC&PAS 4.2.8.2.9.1.2), **Pantograph head geometry** (TSI LOC&PAS 4.2.8.2.9.2), **Pantograph current capacity** (TSI LOC&PAS 4.2.8.2.9.3), **Contact strip** (TSI LOC&PAS 4.2.8.2.9.4), **Pantograph static contact force** (TSI LOC&PAS 4.2.8.2.9.5) and **Pantograph contact force and dynamic behaviour** (TSI LOC&PAS 4.2.8.2.9.6), IC Certificates have been provided proving compliance.

  Arrangement of pantographs (TSI LOC&PAS 4.2.8.2.9.7) has been proven by means of dynamic uplift and contact force measurements performed in single traction. The triple trainset configuration has been used in the dynamic testing for being the most critical. Uplift measurements were performed in single traction. The maximum uplift meets the requirement. Contact force measurements were performed in single and multiple traction. The maximum contact force stays under the maximum limit.

  Insulation of pantograph from the vehicle (TSI LOC&PAS 4.2.8.2.9.9) is adequate for voltage used in the line, 1,5 kV.

  Pantograph lowering (TSI LOC&PAS 4.2.8.2.9.10) is compliant. The pantograph is able to lower to the stowed position in less than 10 seconds. This has been proven by means of dynamic measurements in the Netherlands (Eindhoven – Venlo). Reports lowering time to reach the stowed position: maximum 2,2 seconds at a speed of 160km/h in both directions. At standstill: 2,7 seconds. SNG trainsets pantographs are equipped with automating dropping service (ADD)
- For **Electrical protection of the train (**TSI LOC&PAS 4.2.8.2.10) it has been proven that the units are protected against internal short-circuits and IC Certificate for the Main Circuit Breaker has been provided.
- **Protection electrical hazards** (TSI LOC&PAS 4.2.8.4). has been proven by showing compliance with EN 50153:2014 requirements.

The above items have been assessed and it has been concluded that CAF has provided sufficient evidence related to traction and electrical equipment to prove compliance to the related requirements under the following conditions:

- **Access to serviceable equipment on the roof of the train is only allowed after execution of the proper grounding procedures using the HV safety keys as per the CAF instructions in the applicable manuals.**
- **The Energy Measurement Function unit has to be sent back to factory after 10 years in service for current and voltage measurements accuracy verification as per the CAF instructions in the applicable manuals.**

6.2.8 TSI LOC&PAS 4.2.9 Driver's cab and driver-machine interface

SNG trainsets **Driver's cabs** (TSI LOC&PAS 4.2.9.1) are designed to permit operation by a single driver accessible from both side of the train and by the internal door situated directly in the area behind the driver. The cab external doors may be used as emergency exit means. Driver's cabs are designed to allow the driver at his seated driving position a clear and unobstructed line of sight. The cab is designed to allow the driver to have a rear view of each side of the train at stand still.

Driver's cab interior is designed taking into account the anthropometric measurements of the driver.

SNG Driver's seat is designed for an area of use defined by the range of possible adjustments in height and longitudinal position. Ergonomics and health aspects have been considered in the design of the seat, and its use by the driver.

Requirements related to climate control, air quality and internal lighting are compliant with the required.

The **Windscreen** (TSI LOC&PAS 4.2.9.2) with the specifications with regards to dimension, location, shape and finishes. Windscreen mechanical and optical characteristics have been deemed compliant to the requirements. Windscreen is equipped with de-icing, de-misting and external cleaning means, under control of the driver.

For **Driver machine interface** (TSI LOC&PAS 4.2.9.3), the driver's cab is equipped with a means to monitor the driver's activity, and to automatically stop the train when a lack of driver's activity is detected.

Onboard tools and portable equipment (TSI LOC&PAS 4.2.9.4). A space is available in the driver´s cab to store the required equipment for emergency situations.

Storage facility for staff personal effects (TSI LOC&PAS 4.2.9.5) has been proven by means of drawings showing that the driver's storage box dimensions are compliant.

The **Recording device** (TSI LOC&PAS 4.2.9.6) has been considered compliant after the assessment of design evidences and factory test results. The list of information to be recorded is as defined in the TSI OPE. Functional requirements specified in the specification referenced in EN/IEC 62625-1:2013 are met. Recording performance is according to class R1 of the specification EN/IEC 62625-1:2013. The integrity (consistency; correctness) of the recorded and extracted data is according EN/IEC 62625-1:2013.

The above items have been assessed and it has been concluded that CAF has provided sufficient evidence related to driver's cab and driver-machine interface to prove compliance to the related requirements.

6.2.9 TSI LOC&PAS 4.2.10 Fire safety and evacuation

Regarding **Measures to prevent fire** (TSI LOC&PAS 4.2.10.2), **Materials** (TSI LOC&PAS 4.2.10.2.1) used in the SNG trainsets have been selected taken into account their fire behaviour properties, such as flammability, smoke opacity and toxicity. Materials satisfy the requirements in the EN45545-2:2013 for a Hazard Level 2 (HL2) vehicle.

Regarding **Measures to detect/control fire** (TSI LOC&PAS 4.2.10.3), the unit is equipped with adequate and sufficient portable fire extinguishers as requested in **Portable fire extinguishers (**TSI LOC&PAS 4.2.10.3.1). **Fire detection systems** (TSI LOC&PAS 4.2.10.3.2) have been proven compliant by means of design evidences and factory tests results for both compositions. Each propulsion inverter and HSCB has internally a linear thermal cable that detects the presence of a fire in the equipment interior. The presence of fire will be announced to the driver via an indicator lamp and a buzzer.

Requirements related to emergencies (TSI LOC&PAS 4.2.10.4) are compliant. SNG trainsets are equipped with **emergency lighting system** (TSI LOC&PAS 4.2.10.4.1) providing a suitable lighting level in the passenger and in the service areas. In case of a complete breakdown the emergency lighting will be switched off after 120 min. Lighting level will be at least 5 lx at the center line of the escape route at floor level.

For **Smoke control** (TSI LOC&PAS 4.2.10.4.2) it is possible to switch-off or close all means of external ventilation to prevent outside smoke from entering the unit. Regarding **Running capability** (TSI LOC&PAS 4.2.10.4.3) the Analysis performed by CAF on each system/function of the braking systems shows that the running capability can be maintained for 4 minutes despite of the impact of Type 2 fire due to the location of the circuits and the protection provided to the equipment.

Requirements related to evacuation (TSI LOC&PAS 4.2.10.5) are also compliant. **Passenger emergency exits** (TSI LOC&PAS 4.2.10.5.1) are provided in sufficient quantity along through route(s) on both sides of the unit. They are accessible and sufficient in size to allow the release of persons and can be opened from inside the train. All external passenger doors are equipped with emergency opening devices allowing them to be used as emergency exits.

The above items have been assessed and it has been concluded that CAF has provided sufficient evidence related to fire safety and evacuation to prove compliance to the related requirements.

6.2.10 TSI LOC&PAS 4.2.11 Servicing

Train exterior cleaning (TSI LOC&PAS 4.2.11.2) is compliant. For the **Cleaning of driver's cab windscreen** (TSI LOC&PAS 4.2.11.2.1) is possible for the front windows of drivers' cabs to be cleaned from outside the train without need to remove any component or covering. For **Exterior cleaning through a washing plant** (TSI LOC&PAS 4.2.11.2.2) it has been proven that it is possible to control the speed of trains that are intended to be cleaned externally through a washing plant on level track at a value between 2 km/h and 5 km/h.

The **Connection to the toilet discharge system** (TSI LOC&PAS 4.2.11.3) and **Water refilling equipment** (TSI LOC&PAS 4.2.11.4), comply with the specifications. EC Declaration of Conformities of the Interoperability Constituents have been delivered.

Regarding **Special requirements for stabling of trains** (TSI LOC&PAS 4.2.11.6), the unit can be parked for a period of at least 14 hours with power supply from the catenary. Local external auxiliary power supply 400 V that can be connected to socket type "3P+ground" according to EN60390-2. Requirement is compliant.

The above items have been assessed and it has been concluded that CAF has provided sufficient evidence related to servicing to prove compliance to the related requirements.

6.2.11 TSI LOC&PAS 4.2.12 Documentation for operation and maintenance

Clause 4.2.12 of the TSI describes the documentation requested in clause 2.4 of Annex VI of Directive 2008/57/EC (clause titled "Technical file").

This documentation, being part of the technical file, is compiled by the notified body and has to accompany the EC declaration of verification.

CAF has provided the General documentation as requested in the clauses of 4.2.12.2.

The documentation related to maintenance has been provided, explaining how maintenance activities are defined and designed in order to ensure that the Rolling stock characteristics will be kept within acceptable limits of use during its lifetime and explaining how maintenance activities will be performed.

CAF has provided the technical documentation necessary to operate the units.

CAF has provided Lifting diagram and instructions and rescue related descriptions.

The above items have been assessed and it has been concluded that CAF has provided sufficient evidence related to documentation for operation and maintenance to prove compliance to the related requirements.

6.2.12 TSI PRM 4.2.2 Subsystem Rolling Stock

SNG is equipped with **Seats** (TSI PRM 4.2.2.1) with handholds, complying the requirements of TSI PRM with regards to location, dimensions and contrast.

SNG is equipped with sufficient priority seats for the use of persons with disabilities and persons with reduced mobility clearly identified by appropriate signs. Clearance of priority seats is compliant with the required distances.

SNG is equipped with two **Wheelchairs spaces** (TSI PRM 4.2.2.2) at car B. wheelchairs can be positioned either facing or back to the direction of travel. Wheelchair spaces distances are compliant with the required dimensions, are clearly identified by appropriate signs and are equipped with call for aid devices.

Exterior **Doors** (TSI PRM 4.2.2.3) dimensions are compliant with the required width and height. Door opening and closing control height is also compliant. Exterior doors are clearly marked on the outside, including the designated wheelchair exterior accessible doorways. Doors are equipped with visual and acoustic opening and closing warning devices.

SNG is equipped with an interior glass partition door, separating the first class compartment.

Lighting levels (TSI PRM 4.2.2.4) have been measured to check compliance

SNG trainsets are equipped with a universal **Toilet** (TSI PRM 4.2.2.5) at car B. EC Interoperability constituent certificate has proven compliance.

Clearways (TSI PRM 4.2.2.6) dimensions and height changes are compliant according to TSI PRM specifications.

Regarding **Customer information** (TSI PRM 4.2.2.7), SNG trainsets are equipped with easily readable displays providing information like safety instructions and route information. SNG trainsets are also equipped with audible information system coupled with visible signals in case of emergency.

SNG trainsets are equipped with internal and external displays in order to show route information like final destination or next stops.

SNG trainsets are equipped with public address system which can be used either for routine or emergency announcements

Regarding **Height changes** (TSI PRM 4.2.2.8), for the steps to reach the elevated seats at the car ends, depth distance is not applicable as there is only one step to the plateau where the seats are mounted. There a no other steps in the trainsets. Steps are indicated by a contrasting band.

SNG is equipped with **Handrails** (TSI PRM 4.2.2.9), complying the requirements of TSI PRM with regards to location, dimensions and contrast.

SNG is equipped with movable steps (TSI PRM 4.2.2.12). Functioning of the movable step has been assessed and considered compliant according to TSI PRM.

The above items have been assessed and it has been concluded that CAF has provided sufficient evidence related to persons with reduced mobility to prove compliance to the related requirements.

6.2.13 TSI NOI 4.2 Functional and technical specifications of the subsystems

Interior and exterior noise tests have been performed in two of the 4-car SNG trainsets. Tests have been performed at Velim test track. The aim of these tests consists on the determination of the noise levels inside the driver's cabin and emitted to the exterior in order to prove compliance with the defined levels defined in TSI Noise.

Regarding **Limits for stationary noise** (TSI NOI 4.2.1), the obtained sound pressure levels at the nearest point of the main air compressor are lower than the required value. The recorded exterior sound pressure levels in stationary and at the nearest point of the exhaust valve of the air dryer fulfil the admitted value

Regarding **Limits for starting noise** (TSI NOI 4.2.2), the registered exterior noise levels in acceleration do not exceed the required limit.

For **Limits for pass-by noise** (TSI NOI 4.2.3), he acquired exterior noise levels at constant speed (160 and 80 km/h) fulfil the admitted value. It must be remarked that the exterior sound pressure levels have been obtained in a track with non-compliant rail roughness. Therefore, the measured pass-by noise levels must be considered as non-comparable.

Regarding **Limits for the driver's cab interior noise** (TSI NOI 4.2.4), the acquired interior noise levels in stationary, in driver's cabin and with the warning horn fulfil the required admitted value in both tones (low and high). In terms of interior noise with constant speed (160 km/h), results demonstrate that the recorded sound pressure levels do not exceed and fulfil the admitted limit.

Measurements performed in the 4-car trainset for 'stationary noise', 'starting noise' and 'driver's cab interior noise' are applicable for the 3-car trainset. For the 'pass-by noise' a calculation acoustically comparing the 3-car trainset with the measured 4-car trainset has been performed applying the simplified evaluation defined in section 6.2.3 of TSI NOI.

The calculated exterior noise levels at constant speed (80 km/h and 160 km/h) fulfil the admitted value.

The above items have been assessed and it has been concluded that CAF has provided sufficient evidence related to noise to prove compliance to the related requirements.

6.2.14 Coupled compositions

For the approval of the coupled compositions, factory and track tests have been performed in diverse compositions of two or three units coupled. The tests to be performed in coupled compositions have been agreed between Ricardo Certification and CAF and reflected in the test procedure "Coupled trainsets testing protocol" with reference C.I4.92.366.00. The assessment of the tests procedure performed by the NoBo is reflected in the assessment document with reference 1304 / TP COUPLED COMPOSITIONS.

The results of the tests performed are reflected in the Test Report “Coupled trainsets” with reference C.I4.92.366.50. The assessment of the test results shows positive results of all the tests performed.

Document
C.I4.92.366.00 - Test procedure – Coupled trainsets testing protocol - Issue E
C.I4.92.366.50 – Test report – Coupled trainsets – Issue B
Assessment TP Coupled Compositions V3

Table 16. Coupled compositions documentation

6.3 Audits and Inspections

The Quality system implemented by CAF during the manufacturing stage (SD assessment module) of 118 Sprinter Next Generation trainsets has been assessed and audited by Ricardo Certification as a Notified Body the production of Sprinter Next Generation of CAF according to TSI LOC&PAS, PRM, NOI & SRT.

Details of the audit can be found in Section 5.3 of this Technical File.

Type inspection has been performed to the SNG trainsets. Inspection report a Table 17 presents the results of the inspection. The trainsets were in good order and conform the assessed documentation.

Document	Reference	Issue
Sprinter Next Generation – Type Inspection	OC/JBO/04940/03-676676	1.0

Table 17. Type inspection report

6.4 Tests attendance

Ricardo Certification has witnessed type tests at origin, factory tests and track tests as part of the SNG certification activities.

NB Rail’s RFU-STR-022 “Use of Test Results from Testing Bodies other than Notified Bodies sets criteria that notified bodies must consider to enable test results, collected by other testing bodies, to be used to support notified body assessments without the need to repeat those tests. Module SB implies that notified bodies must carry out or participate in all tests that form part of conformity assessment.

If the testing body is accredited against the EN 17025, it is assumed that the criteria of competence, independence and quality of the test results are satisfied. On the contrary, if the testing body (manufacturer or other) is not accredited against the EN 17025 (or the accreditation does not cover the test methods required by the relevant TSI), the notified body shall confirm that the systems for control of competence, independence, testing and material handling processes, facilities and equipment and other processes relevant to the contribution to the subsystem are controlled.

Test attendance reports have been generated. References to test attendance reports related to TSI requirements are included in Table 18.

Scope of tests	Reference
CSTB wind tunnel test	OC/RM/4940/03-596805
Traction tests	1304 - Traction Tests Attendance

Gangway tests	1304 - Gangway Tests Attendance
Door tests	OC/GJvW/4940/03-618583
Weighing tests	1304 - Weighing Tests Attendance
Windshield Wipers Factory Tests	1304 - Windshield Wiper Tests Attendance
Earthing Verification Factory Tests	1304 - Earthing verification Tests Attendance
Evacuation Factory Tests	1304 - Evacuation Tests Attendance
Ground System Factory Tests	1304 - Ground System Tests Attendance
Auxiliary Converter and Battery Charger Factory Tests	1304 – Auxiliary converter and battery charger tests attendance
Cab HVAC Factory Tests	1304 - Cab HVAC Tests Attendance
Train HVAC cabin, HVAC department, Interior lights and exterior lights controls Factory tests	1304 - Train HVAC cabin, HVAC department, Interior lights, and exterior lights controls Tests Attendance
Exterior Lighting Factory Tests	1304 - Exterior Lighting Tests Attendance
Interior Lighting Factory Tests	1304 - Interior Lighting Tests Attendance
Train Brake System Factory Tests	1304 - Brake and safety loops Tests Attendance
Cab Auxiliaries controls Factory Tests	1304 - Cab Auxiliaries controls Tests Attendance
Fire detection Factory Tests.	1304 – Fire detection Tests Attendance
Start up and Auxiliaries Factory Tests	1304 - Start up and Auxiliaries Tests Attendance
PIS static Factory Tests	1304 – PIS Static Tests Attendance
Pneumatic brake & air production Factory Tests	1304 - Pneumatic brake & air production Tests Attendance
PRM Verifications	1304 - PRM Verifications Tests Attendance
Boarding Control System Factory Tests	1304 - Boarding control system Tests Attendance
Door and Sliding Steps Factory Tests	1304 – Doors and sliding steps Tests Attendance
Event Recorder Factory Tests	1304 – Event Recorder Tests Attendance
First class partition door Factory Tests	1304 - First class partition door
Propulsion management system Factory Tests	1304 - Propulsion management system tests attendance
Saloon HVAC Factory Tests	1304 - Saloon HVAC Tests Attendance
Protection Against Direct Contact Factory Tests	1304 - Protection Against Direct Contact Tests Attendance
Pantograph Static Factory Tests	1304 – Pantograph Static Tests Attendance
Battery Capacity Factory Tests	1304 - Battery Capacity Tests Attendance
OBIS passenger information system	TCC/RB/04940/03-688732

Table 18. Tests Attendance Reports

Appendix A Checklist of TSI Requirements

Closed

Open

Not compliant

N.A./Information/Reference/No requirements/Header

Checklist TSI LOC&PAS 1302/2014

Section	Aspect	Report Reference	Status 4-car trainset	Status 3-car trainset
4.2.1. General				
4.2.1.1	Breakdown	No requirements		
4.2.1.2	Open points	No requirements		
4.2.1.3	Safety aspects	580554	Reference	
4.2.2. Structure and mechanical parts				
4.2.2.1	General	Informative		
4.2.2.2	Mechanical interfaces	Header		
4.2.2.2.1	General and definitions	Informative		
4.2.2.2.2	Inner coupling	580540	CLOSED	CLOSED
4.2.2.2.3	End coupling	580540	CLOSED	CLOSED
4.2.2.2.4	Rescue coupling	Not applicable		
4.2.2.2.5	Staff access for coupling and uncoupling	Not applicable		
4.2.2.3	Gangways	580540	CLOSED	CLOSED
4.2.2.4	Strength of vehicle structure	580557	CLOSED	CLOSED
4.2.2.5	Passive safety	580557	CLOSED	CLOSED
4.2.2.6	Lifting and jacking	580557	CLOSED	CLOSED
4.2.2.7	Fixing of devices to carbody structure	580557	CLOSED	CLOSED
4.2.2.8	Staff and freight access doors	Not applicable		
4.2.2.9	Mechanical characteristics of glass (other than windscreens)	580536	CLOSED	CLOSED
4.2.2.10	Load conditions and weighted mass	580548	CLOSED	CLOSED
4.2.3. Track interaction and gauging				
4.2.3.1	Gauging	580547	CLOSED	CLOSED
4.2.3.2	Axle load and Wheel load	Header		
4.2.3.2.1	Axle load parameter	580552	CLOSED	CLOSED

4.2.3.2.2	Wheel load	580552	CLOSED	CLOSED
4.2.3.3	Rolling stock parameters which influence ground based systems	Header		
4.2.3.3.1	Rolling stock characteristics for the compatibility with train detection systems	580551	CLOSED	CLOSED
4.2.3.3.1.1	Rolling stock characteristics for compatibility with train detection systems based on track circuits	580551	CLOSED	CLOSED
4.2.3.3.1.2	Rolling stock characteristics for compatibility with train detection systems based on axle counters	580551	CLOSED	CLOSED
4.2.3.3.1.3	Rolling stock characteristics for compatibility with loop equipment	580551	CLOSED	CLOSED
4.2.3.3.2	Axle bearing condition monitoring	580551	CLOSED	CLOSED
4.2.3.3.2.1	Requirements applicable to on board detection equipment	Not applicable		
4.2.3.3.2.2	Rolling stock requirements for compatibility with trackside equipment	580551	CLOSED	CLOSED
4.2.3.4	Rolling stock dynamic behaviour	Header		
4.2.3.4.1	Safety against derailment running on twisted track	580552	CLOSED	CLOSED
4.2.3.4.2	Running dynamic behavior	580552	CLOSED	CLOSED
4.2.3.4.2.1	Limit values for running safety	580552	CLOSED	CLOSED
4.2.3.4.2.2	Track loading limit values	580552	CLOSED	CLOSED
4.2.3.4.3	Equivalent conicity	Informative		
4.2.3.4.3.1	Design values for new wheel profiles	580552	CLOSED	CLOSED
4.2.3.4.3.2	In-service values of wheelset equivalent conicity	580552	CLOSED	CLOSED
4.2.3.5	Running gear	Header		
4.2.3.5.1	Structural design of bogie frame	580553	CLOSED	CLOSED
4.2.3.5.2	Wheelsets	580553	CLOSED	CLOSED
4.2.3.5.2.1	Mechanical and geometric characteristics of wheelsets	580553	CLOSED	CLOSED
4.2.3.5.2.2	Mechanical and geometrical characteristics of wheels	580553	CLOSED	CLOSED
4.2.3.5.2.3	Variable gauge wheelsets	Not applicable		
4.2.3.6	Minimum curve radius	580552	CLOSED	CLOSED
4.2.3.7	Life guards	580553	CLOSED	CLOSED
4.2.4. Braking				
4.2.4.1	General	Informative		
4.2.4.2	Main functional and safety requirements	Header		
4.2.4.2.1	Functional requirements	580538	CLOSED	CLOSED

4.2.4.2.2	Safety requirements	580538	CLOSED	CLOSED
4.2.4.3	Type of brake system	Not applicable		
4.2.4.4	Brake command	Header		
4.2.4.4.1	Emergency braking command	580538	CLOSED	CLOSED
4.2.4.4.2	Service braking command	580538	CLOSED	CLOSED
4.2.4.4.3	Direct braking command	Not applicable		
4.2.4.4.4	Dynamic braking command	580538	CLOSED	CLOSED
4.2.4.4.5	Parking braking command	580538	CLOSED	CLOSED
4.2.4.5	Braking performance	Header		
4.2.4.5.1	General requirements	580538	CLOSED	CLOSED
4.2.4.5.2	Emergency braking	580538	CLOSED	CLOSED
4.2.4.5.3	Service braking	580538	CLOSED	CLOSED
4.2.4.5.4	Calculations related to thermal capacity	580538	CLOSED	CLOSED
4.2.4.5.5	Parking brake	580538	CLOSED	CLOSED
4.2.4.6	Wheel rail adhesion profile – Wheel slide protection system	Header		
4.2.4.6.1	Limit of wheel rail adhesion profile	580538	CLOSED	CLOSED
4.2.4.6.2	Wheel slide protection system	580538	CLOSED	CLOSED
4.2.4.7	Dynamic brake – Braking system linked to traction system	Not applicable		
4.2.4.8	Braking system independent of adhesion conditions	Header		
4.2.4.8.1	General	Not applicable		
4.2.4.8.2	Magnetic track brake	580538	CLOSED	CLOSED
4.2.4.8.3	Eddy current track brake	Not applicable		
4.2.4.9	Brake state and fault indication	580538	CLOSED	CLOSED
4.2.4.10	Brake requirements for rescue purposes	580538	CLOSED	CLOSED
4.2.5. Passenger related items				
4.2.5.1	Sanitary systems	580555	CLOSED	CLOSED
4.2.5.2	Audible communication system	580539	CLOSED	CLOSED
4.2.5.3	Passenger alarm	Header		
4.2.5.3.1	General	Informative		
4.2.5.3.2	Requirements for information interfaces	580549	CLOSED	CLOSED
4.2.5.3.3	Requirements for activation of the brake by the passenger alarm	580549	CLOSED	CLOSED
4.2.5.3.4	Criteria for a train departing from a platform	580549	CLOSED	CLOSED

4.2.5.3.5	Safety requirements	580549	CLOSED	CLOSED
4.2.5.3.6	Degraded mode	580549	CLOSED	CLOSED
4.2.5.3.7	Applicability to units intended for general operation	Not applicable		
4.2.5.4	Communication devices for passengers	580539	CLOSED	CLOSED
4.2.5.5	Exterior doors: passenger access to and egress from rolling stock	Header		
4.2.5.5.1	General	Informative		
4.2.5.5.2	Terminology used	Informative		
4.2.5.5.3	Door closing and locking	580545	CLOSED	CLOSED
4.2.5.5.4	Locking a door out of service	580545	CLOSED	CLOSED
4.2.5.5.5	Information available to the train crew	580545	CLOSED	CLOSED
4.2.5.5.6	Door opening	580545	CLOSED	CLOSED
4.2.5.5.7	Door-traction interlock	580545	CLOSED	CLOSED
4.2.5.5.8	Safety requirements for clauses 4.2.5.5.2 to 4.2.5.5.7	580545	CLOSED	CLOSED
4.2.5.5.9	Door emergency opening	580545	CLOSED	CLOSED
4.2.5.5.10	Applicability to units intended for general operation	Not applicable		
4.2.5.6	Exterior door system construction	580545	CLOSED	CLOSED
4.2.5.7	Inter-unit doors	Not applicable		
4.2.5.8	Internal air quality	580555	CLOSED	CLOSED
4.2.5.9	Body side windows	Not applicable		
4.2.6. Environmental conditions and aerodynamic effects				
4.2.6.1	Environmental conditions - general	580543	CLOSED	CLOSED
4.2.6.1.1	Temperature	580543	CLOSED	CLOSED
4.2.6.1.2	Snow, ice and hail	580543	CLOSED	CLOSED
4.2.6.2	Aerodynamic effects	Informative		
4.2.6.2.1	Slipstream effects on passengers on platform and on workers trackside	Not applicable		
4.2.6.2.2	Head pressure pulse	Not applicable		
4.2.6.2.3	Maximum pressure variations in tunnels	Not applicable		
4.2.6.2.4	Cross wind	580543	CLOSED	CLOSED
4.2.6.2.5	Aerodynamic effect on ballasted tracks	Not applicable		
4.2.7. External lights & visible and audible warning devices				
4.2.7.1	External lights	580544	CLOSED	CLOSED

4.2.7.1.1	Head lights	580544	CLOSED	CLOSED
4.2.7.1.2	Marker lights	580544	CLOSED	CLOSED
4.2.7.1.3	Tail lights	580544	CLOSED	CLOSED
4.2.7.1.4	Lamp controls	580544	CLOSED	CLOSED
4.2.7.2	Horn (audible warning device)		Header	
4.2.7.2.1	General	580544	CLOSED	CLOSED
4.2.7.2.2	Warning horn sound pressure levels	580544	CLOSED	CLOSED
4.2.7.2.3	Protection	580544	CLOSED	CLOSED
4.2.7.2.4	Horn control	580544	CLOSED	CLOSED
4.2.8. Traction and electrical equipment				
4.2.8.1	Traction performance		Header	
4.2.8.1.1	General	580560	CLOSED	CLOSED
4.2.8.1.2	Requirements on performance	580560	CLOSED	CLOSED
4.2.8.2	Power supply		Header	
4.2.8.2.1	General		Informative	
4.2.8.2.2	Operation within range of voltages and frequencies	580560	CLOSED	CLOSED
4.2.8.2.3	Regenerative brake with energy to the overhead contact line	580560	CLOSED	CLOSED
4.2.8.2.4	Maximum power and current from the overhead contact line	580560	CLOSED	CLOSED
4.2.8.2.5	Maximum current at standstill for DC systems	580560	CLOSED	CLOSED
4.2.8.2.6	Power factor		Not applicable	
4.2.8.2.7	System energy disturbances for AC systems		Not applicable	
4.2.8.2.8	On-board energy measurement system	580560	CLOSED	CLOSED
4.2.8.2.9	Requirements linked to pantograph		Header	
4.2.8.2.9.1	Working range in height of pantograph		Header	
4.2.8.2.9.1.1	Height of interaction with contact wires (RST level)	580560	CLOSED	CLOSED
4.2.8.2.9.1.2	Working range in height of pantograph (IC level)	580560	CLOSED	CLOSED
4.2.8.2.9.2	Pantograph head geometry (IC level)	580560	CLOSED	CLOSED
4.2.8.2.9.2.1	Pantograph head geometry type 1 600 mm		Not applicable	
4.2.8.2.9.2.2	Pantograph head geometry type 1 950 mm	580560	CLOSED	CLOSED
4.2.8.2.9.2.3	Pantograph head geometry type 2 000/2 260 mm		Not applicable	
4.2.8.2.9.3	Pantograph current capacity (IC level)	580560	CLOSED	CLOSED
4.2.8.2.9.4	Contact strip (IC level)		Informative	

4.2.8.2.9.4.1	Contact strip geometry	Reference		
4.2.8.2.9.4.2	Contact strip material	580560	CLOSED	CLOSED
4.2.8.2.9.5	Pantograph static contact force (IC level)	580560	CLOSED	CLOSED
4.2.8.2.9.6	Pantograph contact force and dynamic behaviour	580560	CLOSED	CLOSED
4.2.8.2.9.7	Arrangement of pantographs (RST level)	580560	CLOSED	CLOSED
4.2.8.2.9.8	Running through phase or system separation section (RST level)	Not applicable		
4.2.8.2.9.9	Insulation of pantograph from the vehicle (RST level)	580560	CLOSED	CLOSED
4.2.8.2.9.10	Pantograph lowering (RST level)	580560	CLOSED	CLOSED
4.2.8.2.10	Electrical protection of the train	580560	CLOSED	CLOSED
4.2.8.3	Diesel and other thermal traction system	Not applicable		
4.2.8.4	Protection against electrical hazards	580560	CLOSED	CLOSED
4.2.9. Driver's cab and driver-machine interface				
4.2.9.1	Driver's cab	Header		
4.2.9.1.1	General	580542	CLOSED	CLOSED
4.2.9.1.2	Access and egress	Header		
4.2.9.1.2.1	Access and egress in operating conditions	580542	CLOSED	CLOSED
4.2.9.1.2.2	Driver's cab emergency exit	580542	CLOSED	CLOSED
4.2.9.1.3	External visibility	Header		
4.2.9.1.3.1	Front visibility	580542	CLOSED	CLOSED
4.2.9.1.3.2	Rear and side view	580542	CLOSED	CLOSED
4.2.9.1.4	Interior layout	580542	CLOSED	CLOSED
4.2.9.1.5	Driver's seat	580542	CLOSED	CLOSED
4.2.9.1.6	Driver's desk – Ergonomics	580542	CLOSED	CLOSED
4.2.9.1.7	Climate control and air quality	580542	CLOSED	CLOSED
4.2.9.1.8	Internal lighting	580542	CLOSED	CLOSED
4.2.9.2	Windscreen	Header		
4.2.9.2.1	Mechanical characteristics	580542	CLOSED	CLOSED
4.2.9.2.2	Optical characteristics	580542	CLOSED	CLOSED
4.2.9.2.3	Equipment	580542	CLOSED	CLOSED
4.2.9.3	Driver machine interface	Header		
4.2.9.3.1	Driver's activity control function	580542	CLOSED	CLOSED
4.2.9.3.2	Speed indication	Reference		

4.2.9.3.3	Driver display unit and screens	580542	CLOSED	CLOSED
4.2.9.3.4	Controls and indicators	580542	CLOSED	CLOSED
4.2.9.3.5	Labelling	580542	CLOSED	CLOSED
4.2.9.3.6	Radio Remote control function by staff for shunting operation	Not applicable		
4.2.9.4	Onboard tools and portable equipment	580542	CLOSED	CLOSED
4.2.9.5	Storage facility for staff personal effects	580542	CLOSED	CLOSED
4.2.9.6	Recording device	580542	CLOSED	CLOSED
4.2.10. Fire safety and evacuation				
4.2.10.1	General and categorisation	580546	CLOSED	CLOSED
4.2.10.2	Measures to prevent fire	Header		
4.2.10.2.1	Material requirements	580546	CLOSED	CLOSED
4.2.10.2.2	Specific measures for flammable liquids	Not applicable		
4.2.10.2.3	Hot axle box detection	Reference		
4.2.10.3	Measures to detect/control fire	Header		
4.2.10.3.1	Portable Fire extinguishers	580546	CLOSED	CLOSED
4.2.10.3.2	Fire detection systems	580546	CLOSED	CLOSED
4.2.10.3.3	Fire automatic fighting system for freight diesel units	Not applicable		
4.2.10.3.4	Fire containment and control systems for passenger rolling stock	Not applicable		
4.2.10.3.5	Fire spreading protection measures for freight locomotives and freight self-propelling units	Not applicable		
4.2.10.4	Requirements related to emergencies	Header		
4.2.10.4.1	Emergency lighting	580546	CLOSED	CLOSED
4.2.10.4.2	Smoke Control	580546	CLOSED	CLOSED
4.2.10.4.3	Passenger alarm and communication means	Reference		
4.2.10.4.4	Running capability	580546	CLOSED	CLOSED
4.2.10.5	Requirements related to evacuation	Header		
4.2.10.5.1	Passenger emergency exits	580546	CLOSED	CLOSED
4.2.10.5.2	Driver's cab emergency exits	Reference		
4.2.11. Servicing				
4.2.11.1	General	580556	CLOSED	CLOSED
4.2.11.2	Train exterior cleaning	Header		
4.2.11.2.1	Cleaning of driver’s cab windscreen	580556	CLOSED	CLOSED

4.2.11.2.2	Exterior cleaning through a washing plant	580556	CLOSED	CLOSED
4.2.11.3	Connection to Toilet discharge system	580556	CLOSED	CLOSED
4.2.11.4	Water refilling equipment	580556	CLOSED	CLOSED
4.2.11.5	Interface for water refilling	580556	CLOSED	CLOSED
4.2.11.6	Special requirements for stabling of trains	580556	CLOSED	CLOSED
4.2.11.7	Refuelling equipment	Not applicable		
4.2.11.8	Train interior cleaning — power supply	Not applicable		
4.2.12. Documentation for operation and maintenance				
4.2.12.1	General	Informative		
4.2.12.2	General documentation	580541	CLOSED	CLOSED
4.2.12.3	Documentation related to maintenance	Informative		
4.2.12.3.1	The maintenance design justification file	580541	CLOSED	CLOSED
4.2.12.3.2	The maintenance description file	580541	CLOSED	CLOSED
4.2.12.4	Operating documentation	580541	CLOSED	CLOSED
4.2.12.5	Lifting diagram and instructions	580541	CLOSED	CLOSED
4.2.12.6	Rescue related descriptions	580541	CLOSED	CLOSED

Checklist TSI PRM 1300/2014

Section	Aspect	Report Reference	Status 4-car trainset	Status 3-car trainset
4.2.2 Subsystem rolling stock				
4.2.2.1	Seats	Header		
4.2.2.1.1	Seats: General	580562	CLOSED	CLOSED
4.2.2..1.2	Priority seats	Header		
4.2.2.1.2.1	Priority seats: General	580562	CLOSED	CLOSED
4.2.2.1.2.2	Priority seats: Uni-directional seats	580562	CLOSED	CLOSED
4.2.2.1.2.3	Priority seats: Facing seats arrangement	580562	CLOSED	CLOSED
4.2.2.2	Wheelchair spaces	580562	CLOSED	CLOSED
4.2.2.3	Doors	Header		
4.2.2.3.1	Doors: general	580562	CLOSED	CLOSED
4.2.2.3.2	Exterior doors	580562	CLOSED	CLOSED
4.2.2.3.3	Interior doors	580562	CLOSED	CLOSED

4.2.2.4	Lighting	580562	CLOSED	CLOSED
4.2.2.5	Toilets	580562	CLOSED	CLOSED
4.2.2.6	Clearways	580562	CLOSED	CLOSED
4.2.2.7	Customer Information	Header		
4.2.2.7.1	Customer Information: General	580562	CLOSED	CLOSED
4.2.2.7.2	Customer Information: Signage, pictograms and tactile information	580562	CLOSED	CLOSED
4.2.2.7.3	Customer Information: Dynamic visual information	580562	CLOSED	CLOSED
4.2.2.7.4	Customer Information: Dynamic audible information	580562	CLOSED	CLOSED
4.2.2.8	Height changes	580562	CLOSED	CLOSED
4.2.2.9	Handrails	580562	CLOSED	CLOSED
4.2.2.10	Wheelchair Accessible sleeping accommodation	Not applicable		
4.2.2.11	Step position for vehicle access and egress	Header		
4.2.2.11.1	Step position for vehicle access and egress: General requirements	580562	CLOSED	CLOSED
4.2.2.11.2	Step position for vehicle access and egress: Access/egress steps	Not applicable		
4.2.2.12	Boarding aids	Header		
4.2.2.12.1	Boarding aids. Movable step and bridging plate	580562	CLOSED	CLOSED
4.2.2.12.2	Boarding aids. On-board ramp	Not applicable		
4.2.2.12.3	Boarding aids. On-board lift	Not applicable		

Checklist TSI NOI 1304/2014

Section	Aspect	Report Reference	Status 4-car trainset	Status 3-car trainset
4.2 Functional and technical specifications of the subsystems				
4.2.1	Limits for stationary noise	580563	CLOSED	CLOSED
4.2.2	Limits for starting noise	580563	CLOSED	CLOSED
4.2.3	Limits for pass-by noise	580563	CLOSED	CLOSED
4.2.4	Limits for the driver's cab interior noise	580563	CLOSED	CLOSED

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Sprinter Next Generation

DeBo Technical File
3-car trainset & 4-car trainset

for Construcciones y Auxiliar de Ferrocarriles S.A.

May 7th, 2019

Reference: SNG.DeBo.TechnicalFile (03-667596)

Issue: 8.0

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Document history and authorisation

Issue	Date	Changes
0.1	June, 15th 2017	Initial draft
1.0	August 2nd, 2017	Version for ISV for track testing in The Netherlands
2.0	June 13th, 2018	Version for certification of single composition (open points axle counter derogation & brake)
3.0	July 3rd, 2018	Version for certification of single composition (open point axle counter derogation)
4.0	July 13th, 2018	Version for certification of single composition (tracks with axle counters excluded from the scope)
5.0	September 21st, 2018	Version for certification up to triple composition (open points axle counter derogation & derogation AC component and ICD settings)
6.0	October 11th, 2018	Version for certification up to triple composition (tracks with axle counters excluded from the scope)
7.0	October 12th, 2018	Version which includes updated assessments of the SNG ATP system (tracks with axle counters excluded from the scope)
8.0	May 7th, 2019	Version which includes a derogation regarding axle counter compatibility with applied magnetic brakes.

Compiled by:

10 2 e

Signed: 10 2 e Date: 07-05-2019

Verified by:

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Signed: 10 2 e Date: 07-05-2019

Approved by:

10 2 e

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Glossary of Abbreviations and Acronyms

Applicant	The body responsible for making the application for authorisation. This may be the contracting entity or the manufacturer (or their authorised representative within the Community).
Assessment Module	An assessment procedure defined in a TSI or other EC document that is used to assess an interoperability subsystem or constituent.
Assessment Report	A detailed review of the design and production processes (undertaken by the notified body) to confirm that they meet the TSI requirements.
Authorisation	Authorisation to place into service granted by a National Safety Authority, as defined in Interoperability Directive.
CCO	Control Command & Signalling Onboard subsystem.
CCS TSI	Control Command and Signalling Technical Specification for Interoperability (2012/88/EU) (as amended)
Certification Plan	A document setting out the strategy for conformity assessment certification.
DeBo	Body designated by a Member State for the assessment of conformity of subsystems to notified national technical rules.
EN	EuroNorm
ETCS	European Train Control System
GSM-R	Global System for Mobile communications - Railway
ILT	Inspectie Leefomgeving en Transport. National Safety Authority in The Netherlands.
Interoperability Constituent	An elementary component of a subsystem, as defined in a specific TSI.
Interoperability Directive	Directive 2008/57/EC of The European Parliament and of the Council of 17 June 2008 on the interoperability of the rail system within the Community (Recast) (as amended)
ISV	Intermediate Statement of Verification
LOC&PAS TSI	Conventional Rail Rolling Stock (Locomotives and Passenger Carriages) Technical Specification for Interoperability (1302/2014)
NB-Rail	Coordination group of NoBos for railway products and systems
NOI TSI	Conventional Rail “Rolling Stock – Noise” Technical Specification for Interoperability (1304/2014)
NoBo	Body which is responsible for assessing the conformity or suitability for use of the interoperability constituents or for appraising the ‘EC’ procedure for verification of the subsystems
NS	Nederlandse Spoorwegen. Operator.
Open Point	Any technical aspects corresponding to the essential requirements that could not be explicitly covered in a TSI and clearly identified in an annex to the TSI.
Operator	The Transport Undertaking responsible for operating the units
PRM TSI	Persons of Reduced Mobility Technical Specification for Interoperability (1300/2014)

RIS	Regeling indiensstelling spoorvoertuigen, published by the Ministry of Infrastructure and Environment. National regulation for the Netherlands.
RFU	Recommendation For Use: a document produced by NB-Rail setting out a common European approach to conformity assessment
SRT TSI	Safety in Railway Tunnels Technical Specification for Interoperability (2008/163/EC) (as amended)
Subsystem	A division of the whole rail system, as defined in the Interoperability Directives – in this document, the term “subsystem” refers to both the rolling stock and control command onboard subsystems.
NoBo/DeBo Technical File	A document that is produced by the notified body and designated body, which supports the certification and summarises the means by which compliance has been demonstrated.
TSI	Technical Specification for Interoperability: a European Specification relating to an interoperable subsystem of the Trans-European rail network.

Summary

This DeBo Technical File applies to the **Sprinter Next Generation 3-car and 4-car trainsets** manufactured by **Construcciones y Auxiliar de Ferrocarriles S.A.** (hereinafter CAF).

This Technical File has been structured to meet the standardised requirements of the European NoBo co-ordination group, NB-Rail (RFU-STR-011 Issue 07 dated 14/06/2018).

This version of the Technical File is issued to support the authorisation of the trainsets running in single, double and triple composition in the Netherlands

Ricardo Certification B.V. is designated as a Designated Body in the Netherlands.

Ricardo Certification Limited is designated as a Notified Body for the EU interoperability directive 2008/57/EC.

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1. Actors

1.1 Notified Bodies

The following certification bodies are involved in the conformity assessment of the CAF SNG train sets:

Ricardo Certification Limited

Edward Lloyd House, 8 Pinnacle Way, Pride Park

Derby, DE24 8ZS

United Kingdom

NoBo Identification number 2673.

Ricardo Certification Limited is the Notified Body for the conformity assessment of the subsystem rolling stock (TSI LOC&PAS, TSI PRM, TSI NOI and TSI SRT).

CETREN

Pº de la Castellana, 91 – Planta 10

28046 Madrid

Spain.

CETREN is the Notified Body for the conformity assessment of the on-board control-command and signalling subsystem (TSI CCS).

1.2 Designated Body

Ricardo Certification B.V.

Catharijnesingel 33-J

P.O. Box 2248, 3500 GE Utrecht

The Netherlands

1.3 Applicant

Construcciones y Auxiliar de Ferrocarriles S.A.

José Miguel Iturrioz, 26.

20.200 Beasain (Guipúzcoa).

Spain

2. Certificates

2.1 Designated Body Certificates

This technical file supports the following Designated Body (DeBo) certificates by Ricardo Certification:

Certificate	Certificate number
EC Type Examination Certificate Sprinter Next Generation 3-car trainset	DEBO/1/SB/2018/RST/EN/D20180185 (03-706701 Issue 4)
EC Certificate of Verification Sprinter Next Generation 3-car trainset	DEBO/6/SD/2018/RST/EN/D20180186 (03-706702 Issue 4)
EC Type Examination Certificate Sprinter Next Generation 4-car trainset	DEBO/1/SB/2018/RST/EN/D20180187 (03-706706 Issue 4)
EC Certificate of Verification Sprinter Next Generation 4-car trainset	DEBO/6/SD/2018/RST/EN/D20180188 (03-706710 Issue 4)
Quality Management System Approval (combined with NoBo)	2673/4/SD/2018/RST/EN/N20180391 (03-706722 Issue 4)

Table 1. DeBo certificates.

2.2 Notified Body Certificates – Rolling Stock

The following certificates are issued for TSI LOC&PAS, NOI, SRT and PRM by Ricardo Certification:

Certificate	Certificate number
EC Type Examination Certificate Sprinter Next Generation 3-car trainset	2673/1/SB/2018/RST/EN/N20180388 (03-706751 Issue 4)
EC Certificate of Verification Sprinter Next Generation 3-car trainset	2673/6/SD/2018/RST/EN/N20180390 (03-706758 Issue 4)
EC Type Examination Certificate Sprinter Next Generation 4-car trainset	2673/1/SB/2018/RST/EN/N20180389 (03-706761 Issue 4)
EC Certificate of Verification Sprinter Next Generation 4-car trainset	2673/6/SD/2018/RST/EN/N20180392 (03-706762 Issue 4)
Quality Management System Approval	2673/4/SD/2018/RST/EN/N20180391 (03-706722 Issue 4)

Table 2. NoBo certificates Rolling Stock.

2.3 Notified Body Certificates – Command, Control & Signalling

The following certificates have been issued by CETREN for the subsystem CCS:

Certificate	Certificate number
EC Type Examination Certificate	0986/1/SB/2018/CCO/ES-EN/044 (03-716352)
EC Certificate of Verification	0986/6/SD/2017/CCO/ES-EN/046 (03-716355)
Quality Management System Approval	0986/4/SD/2018/CCO/ES-EN/045 (03-716354)
Voluntary Certificate for additional functions and change requests	032-2017-CAF Signalling (EN-ES)_rev3 (03-716350)

Table 3. NoBo certificates CCS.

3. Conditions and Limits of use

This chapter contains a summarizing overview of all the applicable limits and Conditions and Limits of use of the RIS assessment and other assessments.

3.1 Conditions and Limits of use – RIS

In this paragraph, the Conditions and Limits that result from the assessment against the Dutch national rules (RIS) in addition to the limits from the TSI assessment, are summarised.

1. The trainsets are not allowed on tracks with Jade train detection systems.
2. The maximum platform height above rail level for the Netherlands where the trainsets can be used with open doors, is 1050 mm.
3. The trainsets can run at the following infrastructure in the Netherlands:
    - 1,5 kV DC catenary system
    - Signalling systems
        - ATB-EG with Vv-functionality, or
        - Hanzelijn: ERTMS/ETCS Level 2 and Level NTC (ATB),
        - Amsterdam-Utrecht: ERTMS/ETCS Level NTC (ATB).
4. The trainsets are classified for category C2 lines according EN15528.
5. The maximum train composition is 3 trainsets with 6-traction installations.
6. After March 31, 2020 the trainsets are not allowed to drive on track sections at which train detection is performed by means of axle counters, or where GRS is supported by axle counters. This is not including shunting and stationary areas.

3.2 Conditions and Limits of use – TSI LOC&PAS, PRM, SRT and NOI

7. This Technical File applies for the 3-car and 4-car trainsets with software versions defined in the Software Configuration List, reference C.I4.96.006.01 M of 25-04-2019 (03-738019).
8. The SNG trainsets are not allowed to pass over rail brakes and other activated shunting and stopping devices.
9. The SNG trainsets are not allowed to run over contact ramps.
10. The SNG trainsets are compatible with the platform heights 0,55 and 0,76 m +TOR as defined in TSI INF 2014/1299 section 4.2.9.2 When national rules or platform information are available, other platform heights may be demonstrated to the NSA. Refer to item 3 of the Conditions and Limits of use – RIS.
11. Assessed minimum horizontal curve radius 150 m.
12. Vmax = 160 km/h.
13. Cant deficiency ≤130 mm.
14. Access to serviceable equipment on the roof of the train is only allowed after execution of the proper grounding procedures using the HV safety keys as per the CAF instructions in the applicable manuals.
15. The Energy Measurement Function unit has to be sent back to factory after 10 years in service for current and voltage measurements accuracy verification as per the CAF instructions in the applicable manuals.

16. The driver shall be informed that the service brake effort can be limited automatically when slip is detected. Additionally, the service brake distances can increase with an extra 10% when the ED-brake is partially unavailable during sliding conditions.

3.3 Conditions and Limits of use – TSI CCS

Conditions and Limits resulting from the assessment against the TSI CCS are listed in chapter 3 of the technical file drafted by NoBo Cetren with reference TF01SUBS-AC-PR-16/24, version 1.0, 14-02-2018, hyarchis reference 03-695100.

4. Project Scope and Definition

Construcciones y Auxiliar de Ferrocarriles S.A. (CAF) has received an order for the supply of 118 trainsets of the type “Sprinter Next Generation” (SNG).

The Sprinter Next Generation (SNG) will be composed of 118 trainsets consisting of 68 short trainsets versions (3-car trainset) and 50 middle trainset versions (4-car trainset).

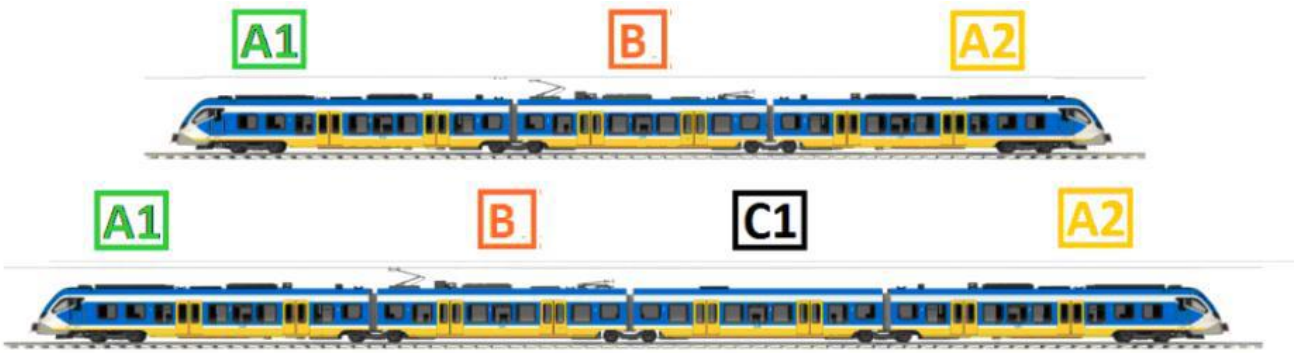

Figure 1. Trainsets configuration (3-car and 4-car).

The general technical specification of these train sets is described in document “Vehicle Description” (C.I4.94.600.00 – 605618).

4.1 General project information

CAF has to obtain the authorizations from the Dutch National Safety Authority (ILT) to allow NS to operate the SNG train sets on the Dutch railway network. For this, the SNG train sets must be certified according to the applicable standards and legislations.

As set out in the Request for Proposal by CAF, the following assurance processes must be covered for these train sets:

- NoBo (Notified Body) process – implying the assessment against the relevant applicable Technical Specifications of Interoperability (TSI’s) as linked with the Railway Interoperability Directive 2008/57/EC.
- DeBo (Designated Body) process – implying the assessment against the relevant applicable National Notified Technical Rules (NNTR’s).

This DeBo Technical File convers the results of the assessment against the NNTR’s and refers to the TSI assessments by Ricardo Certification and CETREN.

4.2 Technical scope and interfaces

The Trainsets Sprinter Next Generation are part of the CIVITY platform of EMU trains developed by CAF for the European market.

The trains are single deck, electrical multiple units with cabins on both ends. The cars of the trainsets all have 2 doors per side.

The sprinter next generation (SNG) will be composed of 118 trainsets consisting of 68 short trainsets versions (3-car trainset) and 50 middle trainset versions (4-car trainset). Cars are linked by means of intercommunicating gangway, at both ends in intermediate cars and at rear ends in front cars.

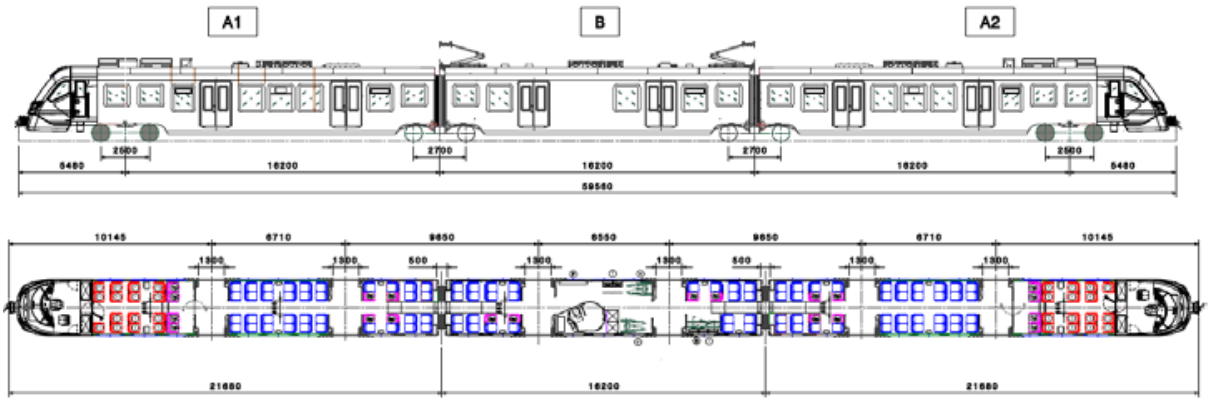

Figure 2. 3-car trainset layout.

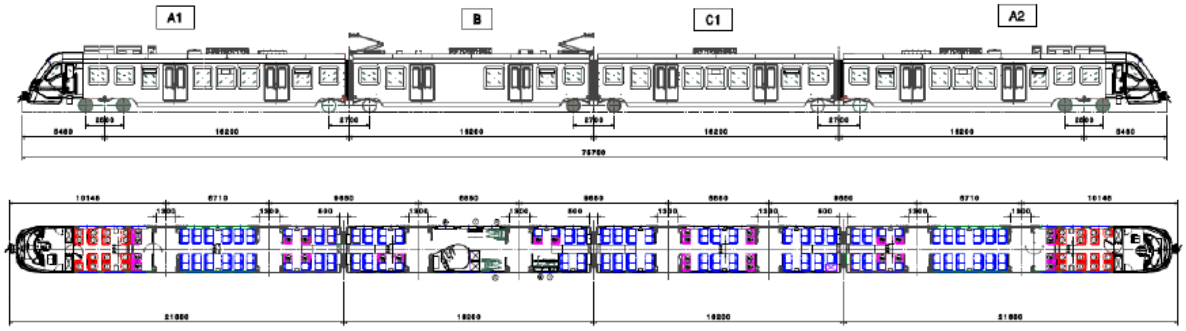

Figure 3. 4-car trainset layout.

- A1 and A2 cars: They are the end-cars in all train configurations. They both have the same interior arrangement, but some differences exist in terms of on-board equipment for communications.
- B car: It is the intermediate car with the current collector system, multi-functional area with wheelchair spaces and the universal toilet.
- C1 car: It is an intermediate car.

The same type of end car or intermediate car of a trainset version is exchangeable with the end car or intermediate car of the same type of the other trainset version. Therefore, A1 car of any trainset version can be exchanged with the A1 car of any other train configuration. The same applies respectively to the A2, B and C1 car type.

The main equipment is installed on the roof. Power supply is given by catenary through pantographs.

The main dimensions of the SNG trainsets are specified in Table 4:

	A1 and A2	B	C1
Body length	21.650	16.200	16.200
Length between coupler faces		59.500 (3 car trainset) 75.700 (4-car trainset)	
Maximum width	2.880	2.880	2.880
Roof height above rail level	808	808	808
Distance between bogie centers	16.200	16.200	16.200
Front overhang	5.450	0 (Jacobs bogie)	0 (Jacobs bogie)
Rear overhang	0 (Jacobs bogie)	0 (Jacobs bogie)	0 (Jacobs bogie)

Table 4. Main dimensions in mm.

Table 5 presents some of the interface characteristics with the infrastructure:

Characteristic	Value
Maximum track speed	160 km/h
Maximum design speed	176 km/h
Nominal track gauge	1.435 mm
Cant ramp	4 mm/m
Maximum track slope	65 ‰
Maximum slope	80 ‰
Platform height above rail level per TSI requirements	760, +30, -35 mm
Platform height above rail level for the Netherlands	1050 mm
Distance from platform edge to track center	Min 1650mm; Max 1735mm
Catenary height	Limited to 5860 + top of rail
Gauge reference document	G2
Catenary voltage	1500 Vdc

Table 5. Infrastructure interface.

Table 6 shows the environmental conditions:

Characteristic	Value
Minimum temperature	-25 ºC
Maximum temperature	40 ºC
Initial operating temperature	-25 ºC
Relative humidity	100%

Table 6. Environmental conditions.

Application areas for train protection systems:

Track section	Operation
Conventional track sections (no ERTMS)	
Whole network	Yes
Overlay - tracks	
Amsterdam — Utrecht en Hanzelijn with ATB-EG	Yes
Border sections with class B systems	
border NL-D	No
border NL-B	No
ERTMS Sections	
HSL-Zuid (L1+L2)	No
Betuweroute A15 (L2)	No
Zevenaar Oost (L2)	No
Kijfhoek en Havenspoorlijn in. Maasvlakte II (L1)	No
Amsterdam — Utrecht (L2 overlay)	No
Hanzelijn (L2 overlay)	Yes
Border sections with ERTMS	
border NL-D	No
border NL-B	No

Table 7. Area of operation.

4.3 Project plan

An overview of CAF's Authorisation Plan is provided in "Authorisation Plan - Sprinter Next Generation – Civity NS" (C.I4.96.002.00 - 653095). The Key dates in this project are as follows:

Milestone	Estimated date
Appoint Notified, Designated & Assessment Bodies	March 2015
Begin manufacture of the first train (4-car unit)	November 2015
Begin manufacture of the first train (3-car unit)	April 2016
Begin factory tests (4-car unit)	January 2017
Begin factory tests (3-car unit)	May 2017

Begin testing of coupled compositions at the Velim test track	May 2017
Begin testing of the first train at the Velim test track (4-car unit)	July 2017
Begin testing of the first train at the Velim test track (3-car unit)	July 2017
Begin running dynamics on-track testing in the Czech Republic (4-car unit)	August 2017
Begin on-track testing of first train in The Netherlands (4-car unit)	October 2017
Begin on-track testing of first train in The Netherlands (3-car unit)	October 2017
Authorization and customer acceptance of the first train (4-car unit)	Mid 2018
Authorization and customer acceptance of the first train (3-car unit)	Mid 2018

Table 8. Project key dates.

4.4 Derogations and Limitations of RIS and TSI application

For the RIS the following derogations has been applied for:

- Axle counter compatibility with applied magnetic brakes
  ILT dossier: ILT/127386
  Application forms: 3-car 03-700968; 4-car 03-700969
  Motivation Letter CAF: C.I4.HOM.ILT.008 (03-707284)
  Motivation Letter CAF update: C.I4.HOM.ILT.008 (03-738013)
  DeBo statement: 03-703673
  ILT derogation RIS Annex 4, belonging to 17.4: ILT-2019/25044 (03-738548)

The validity of the derogation for axle counter compatibility with the magnetic brakes is limited to March 31, 2020. In order for the operator to continue operation with the SNG trainsets in the Netherlands, it has been decided to exclude track sections at which train detection is performed by means of axle counters from the scope of operation after March 31, 2020. This leads to the following restriction:

- **After March 31, 2020 the trainsets are not allowed to drive on track sections at which train detection is performed by means of axle counters, or where GRS is supported by axle counters. This is not including shunting and stationary areas.**

- AC component
  ILT dossier: ILT/128203
  Application forms: 3-car 03-703574; 4-car 03-703575
  Motivation Letter CAF: C.I4.HOM.ILT.012 (03-716475)
  DeBo statement: 03-712560 V2
  ILT derogation RIS article 17.1a: ILT-2018/61695 (03-718717)

- Interference current detector settings
  ILT dossier: ILT/128203
  Application forms: 3-car 03-703574; 4-car 03-703575
  Motivation Letter CAF: C.I4.HOM.ILT.010 (03-712558)
  DeBo statement: 03-712561
  ILT derogation ICD settings: ILT-2018/61695 (03-718717)

For the TSI LOC&PAS, NOI, SRT or PRM no derogations are applicable.

For the TSI CCS 2016/919/EU CAF has applied for Derogation against the application of TSI CCS – 2016/919/EU based “upon advanced stage of development” according to article 4 and ILT has issued a decision that the TSI CCS – 2016/919/EU does not have to be taken into account, ILT letter ILT-2017/56605 (03-707278).

4.5 List of specific cases

There are no specific cases for trainsets operating in The Netherlands according to TSI LOC&PAS, SRT, NOI, PRM and CCS.

5. Project documentation

The following sub-headings contain or reference all of the technical documentation supplied to the DeBo by the applicant and used during verification activities.

5.1 Applied Standards / Technical Specification / Alternative Solutions

The following certification framework for the SNG train sets is being used for the Notified National Technical Rules

Reference	Title	Date
2008/57/EG	Directive on the European parliament and the council on the interoperability of the rail system within the community, amended by directives 2009/131/EC, 2011/18/EU, 2013/9/EU, 2014/38/EU and 2014/106/EU.	17.06.2008
2010/713/EU	COMMISSION DECISION of 9 November 2010 on modules for the procedures for assessment of conformity, suitability for use and EC verification to be used in the technical specifications for interoperability adopted under Directive 2008/57/EC of the European Parliament and of the Council	09.11.2010
National regulations		
RIS	Regeling Indienststelling Spoorvoertuigen (RIS) IENM/BSK-2012/28591 including changes until 14-02-2017 (See also chapter 6.1 for RIS delta analysis 03-689613)	14-02-2017

Table 9. Applicable regulations.

The certification frame work for the TSI LOC&PAS, NOI, SRT and PRM are included in the NoBo Technical File of Ricardo Certification.

The certification frame work for the TSI CCS is included in the NoBo Technical File of CETREN.

5.2 Design evidence

For this project all information is stored in the Ricardo Certification B.V. document database Hyarchis under project number 04940.

The documentation that has been supplied to Ricardo Certification to enable assessment of the design is listed in each one of the correspondent Assessment Reports.

The scope of the assessment includes software versions up to the versions for the individual systems in the trainset as listed in the CAF software configuration list C.I4.96.006.01 M of 25-04-2019 (03-738019).

CAF has provided non-regression reports for software which has been changed from software of the technical file for single traction, which was the basis for the ISV to start testing in the Netherlands. The software updates and non-regression reports are included in the software version assessment overview (03-706858).

5.3 Evidence related to quality management system

The Quality system implemented by CAF during the manufacturing stage (SD assessment module) of 118 Sprinter Next Generation trainsets has been assessed and audited by Ricardo Certification as a Notified Body the production of Sprinter Next Generation of CAF according to TSI LOC&PAS, PRM, NOI & SRT.

Ricardo Certification took into account the existing CAF's ISO 9001 certification, especially by limiting the quality documentation that has to be requested, and by performing an on-site audit of two days. Therefore, a TSI/SD and RIS audit of the production quality management system CAF has been performed on 15th – 16th November 2016 in CAF's factory at Beasain, Spain.

The observations raised during the audit have been captured and managed in The Assessment Record 01.

Ricardo Certification has advised that CAF is competent to produce the Sprinter Next Generation in accordance to the RIS, and TSI/SD.

Ricardo Certification shall carry out periodic audits to verify that CAF maintains and applies the quality management system and shall provide the applicant with an audit report. The frequency of the periodic audits shall be at least once every 2 years.

The audit report and related documentation is referred in Table 10 and included as part of this Technical File. Ricardo Certification has performed a surveillance audit on 27th September 2018 to verify that CAF maintains and applies the quality management system. Details from the audit have been recorded in the Surveillance Audit Report referred in Table 9 included as part of this Technical File. The observations raised during the audit have been captured and managed in The Assessment Record 01.

Document	Reference	Issue
Sprinter Next Generation - Audit Report	1304 SD Audit Report (673962)	2.0
Assessment Record 01 – SD Audit for SNG trainset production	1304 Record 01	4.0
Sprinter Next Generation – Surveillance Audit Report	750083 – Surveillance Audit Report	2.0

Table 10. Evidence related to Quality Management System.

5.4 List of manufacturers and main subcontractors

The production is performed by Construcciones y Auxiliar de Ferrocarriles S.A. at Beasain factory in Spain. The main subcontractors are:

Manufacturer / Subcontractor	Scope of production
10 1 c	Traction system Traction motor
	Access door Access ramp & PMR Elevator

10 1 c	HSCB
	Grounding Device
	Gear Unit
	Carbody Break & WSP System
	Bogie Brake System
	Air Production System (PTA)
	Passenger HVAC
	CAB HVAC
	Auxiliary Converter & Battery Charge (CVS)
	WC PMR
	Pantograph
	BIOREACTOR
artikel 10 lid 1 onder c	ERTMS & ATB
	TCMS
	Coupler
	Brake Resistors
	Master controller
	Event Recorder
	CCTV
	Energy Measurement System
	On Board ITE Platform (OBITP)
	PA System
	Gangway
	Battery
	Radio GSMR

Table 11. List of manufacturers and main sub-contractors.

5.5 Provisions for operation

The operating manual or any other documentation related to operation are assessed as part of the NoBo assessment per TSI.

5.6 Provisions for maintenance

The maintenance manual or any other documentation related to maintenance are assessed as part of the NoBo assessment per TSI.

5.7 Interoperability Constituents

Not applicable for RIS.

6. DeBo verification process information

The certification assessment is being carried out by employees of Ricardo Certification, under the accreditation from Ricardo Certification B.V.

The method of certification examination is based on the conformity assessment procedures (modules) as described in Chapter 6 of the TSI and in Decision 2010/713/EU. For this project the combination of the modules SB + SD was chosen, where:

- SB module – EC Type Examination.
- SD module – EC verification based on quality management system of the production process.

The assessed documentation consists of calculations, analyses, drawings, schemes, reports and declarations of conformity. All the documentation has been assessed to determine to what extend the specific requirements have been satisfied.

The design and development phase consists of a design review and type tests.

The results of the assessments are recorded in the Assessment Reports (section 6.1). Furthermore, the review covers such things as inspections, audits and factory visits.

All authorisation relevant aspects (defined in Appendix A) have been assessed by Ricardo Certification based on the provided documentation delivered by CAF.

All the assessed documentation, including assessment reports and issued certificates is put together in one file. This file is called the Technical File.

6.1 Overview of DeBo assessments

RIS requirements are grouped in different Assessment Reports. Ricardo Certification has prepared the assessment reports listed in Table 12. Assessment Reports are part of this Technical File and are included in Appendix A.

Section	Subject	Reference	Issue
RIS §2	Train protection systems	598170	15
RIS §2, art. 3-1d)	ETCS Train-Track integration Appendix 2, chapter 2, §2.4 per RLN00295	664963	3
RIS §3 and §4	Detection	706724	21
RIS §4	Pantographs	598165	5
RIS §4	Braking	598166	8
RIS §2 and §4	Electrical installation	598167	13
RIS §4	Gauging	598168	5
RIS §4	Running gear	598169	13

Table 12. Overview of DeBo assessments.

The assessment reports are based on RIS 2016. In addition Ricardo Certification has performed a delta-analysis for RIS 2017 (689613) and concluded that the changes do not have an impact for the SNG trainsets, or, CAF has provided an compliance argument or additional evidence documentation demonstrating compliance to the corresponding standard.

6.2 Conformity Process Information

The CAF SNG train sets are being assessed against the applicable requirements of the RIS.

The trail of assessments is contained within the clause-by-clause Assessment Reports produced by Ricardo Certification. Note that, where greater than one iteration of submissions was required to demonstrate compliance, only the outcome of the final iteration has been included in this technical file. A record of all iterations is maintained by Ricardo Certification.

Table 12 identifies the assessment Ricardo Certification has undertaken against the applicable RIS requirements.

A checklist of the status of the RIS requirements is included at Appendix A.

ATB

Evidence of correct installation and functioning of the STM ATB together with the ETCS on the trainsets has been delivered.

ETCS

Evidence of the correct installation and functioning of the ETCS on the trainsets is delivered by CAF and CETREN.

ETCS train-track integration

The train-track integration tests per RLN00295 have been performed during the on-track an lab-test program in the Netherlands.

The following tracks have been assessed:

- Hanzelijn ERTMS/ETCS Level 2 and Level NTC (ATB);
- Amsterdam-Utrecht ERTMS/ETCS Level NTC (ATB).

Track compatibility (interference, detection, etc.)

The CAF SNG 3-car and 4-car trainsets comply with the requirements of the RIS §3 article 7 and §4 article17, except for 2 requirements:

- The CAF SNG 3-car and 4-car trainset in single and multiple configurations, does not comply to Art 17.1.a.; the 50 A limit for the effective value of the AC-component within a DC line current without external 50 Hz injection amounts for a train composition for frequencies over 5 Hz, is exceeded. For this a derogation has been applied for by CAF, refer to paragraph 4.4 of this technical file

- The tests of the disturbance of axle counters by an activated magnetic track brake were not fully compliant. For this a derogation has been applied for by CAF, refer to paragraph 4.4 of this technical file.

The total number of points for detection complies with appendix 5 of RIS (minimum is 49 for the 3-car trainset). Furthermore, the measured short-circuit values in a measuring section remain below the monthly norm for both the 3-car and 4-car SNG trainsets.

The impedance between pantograph and wheels complies with the RIS requirements.

The interference current detector has been developed conform the RIS and has been tested in a test lab and on a trainset. The interference current detector uses measured DC link voltage (filter voltage) as input. There are 2 interference detectors per trainset (1 per traction installation).

A trip threshold of 8,1 V DC link voltage per detector/traction installation cuts out the traction installation.

Additionally, a warning threshold of 2,4 V DC link per detector/traction installation has been implemented as agreed by CAF and NSR. When the warning level is exceeded, a message will be stored in the TCMS and can be used for further analysis and maintenance.

The approval of the implementation of the interference current detector has been requested to ILT combined with the request for derogation of the 50 A limit for the effective value of the AC-component.

CAF has supplied calculation and simulation data for the 50 Hz injection requirements of the RIS, which demonstrates compliance with the RIS.

The detection by the Jade system has not been tested or analysed.

- **The trainsets are not allowed on tracks with Jade train detection systems**

Pantograph

The contact wire temperature at standstill complies with the RIS.

Braking

The trainsets are equipped with a wheel slide protection system, and magnetic track brakes. The WSP system is able to effectively counters the locking of wheels. The conditions under which the magnetic track brakes are activated comply with the RIS.

Electrical Installation

The line current regulation at low voltage has been measured three coupled trainsets with each 2 traction installations at the Dutch railway network and complies with the RIS.

- **The maximum train composition is 3 trainsets with 6-traction installations**

Gauge

The trainset meets the RIS requirements for gauge.

In addition CAF has demonstrated compliance for the requirements of EN 15273-2:2013 Chapter A.3.14 regarding the opening of the doors and the doors in open position for a maximum platform height up to 1,05 m.

- **The trainsets are not allowed to pass over rail brakes and other activated shunting and stopping devices.**
- **The trainsets are not allowed to run over contact ramps (Belgian Memor crocodiles).**

Running gear

A horizontal curve with a radius of 190 m and above, and a vertical curve with a radius of 2000 m and above can handled by the trainsets.

The maximum measured value is 38.33 kN where 60 kN is the limit value. The requirement for Yqst is met.

- **The trainset may not be gravity shunted (from a hump).**

ProRail and ILT have requested to include the line classification according to EN 15528 in the DeBo Technical File. (See MoM 695690, item 54.). This classification is NoBo Assessment record 03-580552:

- **The trainsets are classified for category C2 lines according EN15528**

RIS article 27

CAF provided information about the minimum acceleration times and distances of the SNG trainsets. The acceleration in the 4-car trainsets is higher than in the 3-car trainsets, this is because the 4-car trainsets have 6 gears and the 3-car trainsets have 4 gears. Therefore, CAF provided data about the acceleration of the 4-car trainsets, which is considered to be worst case (document *C.I4.96.007.00-Declaration acceleration_deceleration table*, hya 03-686463). With this information, CAF demonstrates that the trains comply to the Rks requirements for acceleration times and distances that are mentioned in Rks article 27.

RIS article 4.1 annex 3 2.10 Safety items

Each drivers cabin has a cabinet with short circuit cable, emergency signal light, fire extinguisher, first aid kit, gloves & foil kit and red flag (hya 03-716592, 03-709486, 03-709488).

6.3 Audits and Inspections

The Quality system implemented by CAF during the manufacturing stage (SD assessment module) of 118 Sprinter Next Generation trainsets has been assessed and audited by Ricardo Certification as a Notified Body the production of Sprinter Next Generation of CAF according to TSI LOC&PAS, PRM, NOI & SRT and RIS.

Details of the audit can be found in Section 5.3 of this Technical File.

A type inspection has been performed to the SNG trainsets. Inspection report a Table 13 presents the results of the inspection. The trainsets were in good order and conform the assessed documentation.

Document	Reference	Issue
Sprinter Next Generation – Type Inspection	OC/JBO/04940/03-676676	1.0

Table 13. Type inspection report.

At 12-06-2018 the DeBo 10 2 e accompanied ILT in a visit to the workshop Zaanstraat where trainset 2301 was presented. This visit confirmed the results of 03-676676.

6.4 Tests attendance

Ricardo Certification has witnessed as DeBo some of the type tests at origin performed so far in relation with the SNG project.

Test attendance reports have been generated. References are included in Table 14.

Scope of tests	Reference
Signalling system installation	1304 - Signalling system installation verification tests attendance (03-667770)
Signalling system tests	1304 - Signalling system tests attendance (03-667772)
STM ATB test attendance	1304 - STM ATB test attendance (03-667773)
ETCS Train-track integration tests (RLN00285)	Test witnessing report (03-687136)

Table 14. DeBo related tests attendance reports.

Appendix A Checklist of RIS Requirements

Closed
Open
Not compliant
N.A./Information/Reference/No requirements/Header

Checklist RIS

Note: the articles marked as OPEN closed for all aspects except for the pending derogation requests.

RIS Article	Aspect	Report Reference	Status 4-car unit	Status 3-car unit
§ 2. National regulations for the implementation of essential requirements				
3	Train protection systems	Header		
3.1a	ATB-EG	598170	CLOSED	CLOSED
3.1b	ATB-NG	Not Applicable		
3.1c	STM ATB	598170	CLOSED	CLOSED
3.1d	ERTMS	598170	CLOSED	CLOSED
3.1d –app2	ETCS Train-Track integration RLN00295	664963	CLOSED	CLOSED
3.1e	Recording device	598170	CLOSED	CLOSED
3.2	Track sections Germany	Not Applicable		
3.3	Track sections Belgium	Not Applicable		
3.4	ATB-vv	598170	CLOSED	CLOSED
4	Non-TSI Rail vehicles	Not Applicable		
5	On track machines	Not Applicable		
5a	Safety earthing circuit	598167	CLOSED	CLOSED
5b	Braking – wheel locking	598166	CLOSED	CLOSED
§3 National regulations for the interpretation of open points in TSI's				
6	National rules for Open points	Information		
7	Open points TSI CCS	Reference		
8	Deleted	Deleted		
9	Deleted	Deleted		

10	Open points TSI LOC&PAS	Header		
10.1	Explanation	Information		
10.2	Eddy current brake	Not Applicable		
11	Deleted	Deleted		
§ 4. National regulations for compatibility with non-TSI-compliant infrastructure				
12	Explanation	Information		
13	Gauge	Header		
13.1	Kinematic gauge compliance G2	598168	CLOSED	CLOSED
13.2	Kinematic gauge larger than G2	Not Applicable		
13.3	Reference gauge for underside of rail vehicles	598168	CLOSED	CLOSED
14	Section 14 axle load, curving and running characteristics	Header		
14.1	Axle load/wheel diameter ratio of a wheelset	Not Applicable		
14.2	Restrictions for vehicles with a wheel diameter smaller than 730 mm	Not Applicable		
14.3	A horizontal curve with a radius of 190 m and above	598169	CLOSED	CLOSED
14.4	A vertical curve with a radius of 2000 m and above	598169	CLOSED	CLOSED
14.5	A vertical crest curve of 250 m and above	598169	CLOSED	CLOSED
14.6	Quasi-static guide force Y_{qst}	598169	CLOSED	CLOSED
15	Braking	Header		
15.1	Magnetic braking device	598166	CLOSED	CLOSED
15.2	Eddy current brake device	Not Applicable		
16	Wheel-flange lubricating devices	Not Applicable		
17	Detection	Header		
17.1.a	Effective value of the AC-component within a DC-current (incl. RIS appendix 5)	706724	CLOSED	CLOSED
17.1.b	Psophometric component	706724	CLOSED	CLOSED
17.1.c	Detection quality (incl. RIS appendix 5)	706724	CLOSED	CLOSED
17.1.d	AC interference current (incl. RIS appendix 6)	706724	CLOSED	CLOSED
17.1.e	Impedance between pantograph and wheels at a frequency of 75 ± 3 Hz	706724	CLOSED	CLOSED
17.1.f	The impedance between the pantograph and the wheels at a frequency of 50 Hz	706724	CLOSED	CLOSED
17.1.g	Effective value of the AC-component within DC-power line with external 50 Hz injection	706724	CLOSED	CLOSED
17.1.h	AC-interference current component within the DC-power line (incl. RIS appendix 6)	706724	CLOSED	CLOSED

17.1.i	Electromagnetic compatibility	706724	CLOSED	CLOSED
17.1.j	Interference current detector (incl. RIS appendix 6)	706724	CLOSED	CLOSED
17.2	Explanation	Information		
17.3.a	Detection quality (incl. RIS appendix 5)	706724	CLOSED	CLOSED
17.3.b	AC interference current	706724	CLOSED	CLOSED
17.4a	Metal free space around wheels (incl. RIS appendix 4)	706724	CLOSED	CLOSED
17.4b	Magnetic fields (incl. RIS appendix 4)	706724	CLOSED	CLOSED
17.5	Detection characteristics	706724	CLOSED	CLOSED
18	Deleted	Deleted		
19	Traction installation 1500 V DC	598167	CLOSED	CLOSED
20	Pantographs 1500 V DC	Header		
20a	Current collection	598165	CLOSED	CLOSED
20b	Maximum distance	598165	CLOSED	CLOSED
20c	Maximum height	598165	CLOSED	CLOSED
21	System energy disturbances for AC systems — harmonics and dynamic effects compatibility study	Not Applicable		
22	Pantographs 25kV AC	Not Applicable		
23.1	Border sections for Belgium	Not Applicable		
23.2	Border sections for Belgium	Not Applicable		
24	Rail vehicles at border crossing sections	Not Applicable		

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Conformity assessment

Certification 'Sprinter Next Generation' for CAF

System / Component

Strength and Crashworthiness

The system/component that is subject for assessment applies to SNG 3 cars trainsets and SNG 4 cars trainsets affected by the under frame ballast modification as well as for the non-modified trainsets.

COMMISSION REGULATION (EU) No 1302/2014 of 18 November 2014 concerning a technical specification for interoperability relating to the 'rolling stock — locomotives and passenger rolling stock' subsystem of the rail system in the European Union

Reference	Requirement
TSI LOC&PAS § 4.2.2.4	Strength of vehicle structure
TSI LOC&PAS § 4.2.2.5	Passive safety
TSI LOC&PAS § 4.2.2.6	Lifting and jacking
TSI LOC&PAS § 4.2.2.7	Fixing of devices to car body structure

Relevant standards

1.	BS EN 12663-1:2010, Part 1: Locomotive and passenger rolling stock (alternative method for freight wagons)
2.	BS EN 15227:2008+A1:2010: Crashworthiness requirements for railway vehicle bodies
3.	BS EN 16404:2014: Re-railing and recovery requirements for railway vehicles
4.	BS EN 15877-2:2013, Marking of railway – Part 2: External markings on coaches, motive power units, locomotives and on track machines

Assessed documentation (part of information file)

	Reference	Date	Title
[1]	C.I4.92.195.00_A_H1	22-01-2016	TYPE/DESIGN QUALIFICATION TEST AT ORIGIN
[2]	C.I4.92.195.00_A_H2	-	CRASH MODULES TEST
[3]	C.I4.92.195.00_A_H3	23-12-2015	Energy Absorbing Module Crash Test Procedure
[4]	C.I4.92.196.00_A_H1	22-01-2016	ANTICLIMBER TEST
[5]	C.I4.92.196.00_A_H2	-	ANTICLIMBER TEST
[6]	C.I4.92.196.00_A_H3	16-12-2015	Anticlimber Crash Test Procedure
[7]	C.I4.92.197.00_A_H1	22-01-2016	FRONT BODYEND TEST

[8]	C.I4.92.197.00_A_H2	-	FRONT BODYEND TEST
[9]	C.I4.92.197.00_A_H3	17-12-2015	Front Bodyend Crash Test Procedure
[10]	C.I4.93.010.00_B	08-02-2016	CRASHWORTHINESS REQUIREMENTS SPECIFICATION
[11]	C.I4.93.011.01_C	23-09-2016	Crashworthiness Analysis Report. Scenario 1
[12]	C.I4.93.011.02_C	23-09-2016	Crashworthiness Analysis Report. Scenario 2
[13]	C.I4.93.011.03_C	23-09-2016	Crashworthiness Analysis Report. Scenario 3
[14]	C.I4.93.011.04_C	23-09-2016	Crashworthiness Analysis Report. Scenario 4
[15]	C.I4.93.011.05_C	23-09-2016	Crashworthiness Analysis Report. Scenario 5
[16]	C.I4.92.175.00_0_H1 / H2 / H3 / HP	16-03-2016	Extensiometric sensors mounting
[17]	C.I4.92.177.00_E_H1	15-11-2016	Test Procedure. Carbody Structure
[18]	C.I4.92.177.00_E_H2	-	Safety test data/certification sheet (Origin test). Carbody structure.
[19]	C.I4.92.177.00_E_H3	10-11-2016	Test Specification. Carbody Structural Test According EN 12663:2010.
[20]	C.I4.93.001.00_F	01-09-2016	CARBODY STRUCTURAL ANALYSIS. SPECIFICATION.
[21]	C.I4.93.003.00_F	28-10-2016	CAB CARBODY STRESS ANALYSIS. REPORT- CABIN CAR
[22]	C.I4.93.004.00_D	25-10-2016	INTERMEDIATE CARBODY STRESS. ANALYSIS REPORT
[23]	C.I4.93.009.00_A	15-03-2016	CARBODY STRESS ANALYSIS & TEST. CORRELATION PROCEDURE
[24]	C.I4.93.110.01_F	12-06-2017	WEIGHT REPORT
[25]	C.I4.97.352.00_B	03-02-2016	CARBODY DESCRIPTION
[26]	C.I4.34.001	19-02-2016	Lifting & Jacking Pads - A
[27]	C.I4.34.054	22-07-2015	Lift Plate
[28]	C.I4.34.055	22-07-2015	Lift Plate Assembly
[29]	C.I4.34.056	22-07-2015	Lift Plate
[30]	C.I4.97.351.00	22-3-2016	Lifting and rerailing
[31]	C.I4.97.351.20	22-03-2016	Clearance for lifting
[32]	C.I4.97.351.30	27-11-2015	Clearance for rerailing
[33]	C.I4.34.301	19-02-2016	Lifting & Jacking Pads – B,C
[34]	C.I4.97.087.17	11-11-2016	TSI Exterior Signage
[35]	C.I4.57.017	17-02-2016	Rerailment point
[36]	C.I4.57.018	22-08-2016	Lifting point pictures

[37]	C.I4.57.019	17-02-2016	Rerailment point
[38]	C.I4.25.123.01_A_H1	25-05-2015	PLATE. DRAWING
[39]	C.I4.25.123.01_A_HP	25-05-2015	PLATE. LIST
[40]	C.I4.90.010.00_B	16-02-2016	BODY BOLSTER: WELDING N.D.T. CONTROL
[41]	C.I4.90.020.00_B	16-02-2016	“A” UNDERFRAME: WELDING N.D.T. CONTROL
[42]	C.I4.90.021.00_B	16-02-2016	“B/C” UNDERFRAME: WELDING N.D.T. CONTROL
[43]	C.I4.90.040.00_B	16-02-2016	HEADSTOCK: WELDING N.D.T. CONTROL
[44]	C.I4.90.060.00_B	16-02-2016	“A” CARSHELL: WELDING N.D.T. CONTROL
[45]	C.I4.90.061.00_B	16-02-2016	“B,C” CARSHELL: WELDING N.D.T. CONTROL
[46]	C.I4.90.063.00_B	16-02-2016	FRONT END STRUCTURE: WELDING N.D.T. CONTROL
[47]	C.I4.93.550.00_F_H1	29-04-2016	DYNAMICS CALCULATIONS
[48]	C.I4.93.550.00_F_H2	-	DYNAMICS CALCULATIONS. ANNEX H:
[49]	EN 15085-2_SLV_CAF-Vehicles_Beasain_EN	23-06-2015	CERTIFICATE
[50]	X.25.01411.01_0_H1	13-07-2015	PERFIL LARGUERO PABELLON ZONA PUERTA. DRAWING
[51]	X.25.01411.01_0_H2	07-05-2015	PERFIL LARGUERO PABELLON ZONA PUERTA. DRAWING
[52]	X.25.01411.01_0_P	08-07-2015	PERFIL LARGUERO PABELLON ZONA PUERTA. LIST
[53]	C.I4.93.074.00_C_H1	16-11-2016	Bolt calculation main interior equipment
[54]	C.I4.93.074.00_C_H2	-	Annexes
[55]	C.I4.93.075.00_0_H1	01-06-2016	Bolt calculation main exterior devices
[56]	C.I4.93.075.00_0_H2	-	Annexes
[57]	C.I4.93.012.00_0	04-8-2016	15 ton truck validation, Large deformable obstacle validation according to EN 15227, hay 03-636233
[58]	C.I4.21.201.01_B_H1	01-04-2016	AIR SUPPLY UNIT – CAPSULED (drawing 1/1)
[59]	C.I4.21.201.01_B_HP	01-04-2016	AIR SUPPLY UNIT – CAPSULED (list of materials)
[60]	C.I4.35.001.00_E_H1	06-06-2016	EXTERIOR DOORS MOUNTING – A car (drawing 1/2)
[61]	C.I4.35.001.00_E_H2	06-06-2016	EXTERIOR DOORS MOUNTING – A car (drawing 2/2)
[62]	C.I4.35.001.00_E_HP	06-06-2016	EXTERIOR DOORS MOUNTING – A car (list of materials)
[63]	C.I4.35.301.00_E_H1	06-06-2016	EXTERIOR DOORS MOUNTING – B and C cars (drawing 1/2)
[64]	C.I4.35.301.00_E_H2	06-06-2016	EXTERIOR DOORS MOUNTING – B and C cars (drawing 2/2)

[65]	C.I4.35.301.00_E_HP	06-06-2016	EXTERIOR DOORS MOUNTING – B and C cars (list of materials)
[66]	C.I4.37.102.01_A_H1	08-02-2016	FACELIFT DRIVE MECHANISM (drawing 1/3)
[67]	C.I4.37.102.01_A_H2	08-02-2016	FACELIFT DRIVE MECHANISM (drawing 2/3)
[68]	C.I4.37.102.01_A_H3	08-02-2016	FACELIFT DRIVE MECHANISM (drawing 3/3)
[69]	C.I4.37.102.01_A_HP	08-02-2016	FACELIFT DRIVE MECHANISM (list of materials)
[70]	C.I4.37.150.01_C_H1	14-07-2016	SHORT STROKE SLIDINGSTEP (drawing 1/3)
[71]	C.I4.37.150.01_C_H2	14-07-2016	SHORT STROKE SLIDINGSTEP (drawing 2/3)
[72]	C.I4.37.150.01_C_H3	14-07-2016	SHORT STROKE SLIDINGSTEP (drawing 3/3)
[73]	C.I4.37.150.01_C_HP	14-07-2016	SHORT STROKE SLIDINGSTEP (list of materials)
[74]	C.I4.37.152.01_C_H1	14-07-2016	LONG STROKE SLIDINGSTEP (drawing 1/3)
[75]	C.I4.37.152.01_C_H2	14-07-2016	LONG STROKE SLIDINGSTEP (drawing 2/3)
[76]	C.I4.37.152.01_C_H3	14-07-2016	LONG STROKE SLIDINGSTEP (drawing 3/3)
[77]	C.I4.37.152.01_C_HP	14-07-2016	LONG STROKE SLIDINGSTEP (list of materials)
[78]	C.I4.43.001.00_D_H1	13-06-2015	SLIDING STEP MOUNTING – A car (drawing 1/2)
[79]	C.I4.43.001.00_D_H2	13-06-2015	SLIDING STEP MOUNTING – A car (drawing 2/2)
[80]	C.I4.43.001.00_D_HP	13-06-2016	SLIDING STEP MOUNTING – A car (list of materials)
[81]	C.I4.43.301.00_D_H1	13-06-2016	SLIDING STEP MOUNTING – B car (drawing 1/2)
[82]	C.I4.43.301.00_D_H2	13-06-2016	SLIDING STEP MOUNTING – B car (drawing 2/2)
[83]	C.I4.43.301.00_D_HP	13-06-2016	SLIDING STEP MOUNTING – B car (list of materials)
[84]	C.I4.43.501.00_D_H1	14-06-2016	SLIDING STEP MOUNTING – C car (drawing 1/2)
[85]	C.I4.43.501.00_D_H2	14-06-2016	SLIDING STEP MOUNTING – C car (drawing 2/2)
[86]	C.I4.43.501.00_D_HP	13-06-2016	SLIDING STEP MOUNTING – C car (list of materials)
[87]	C.I4.52.001.00_E_H1	02-05-2016	PASSENGER SEATS MOUNT. - A1-A2 (drawing 1/2)
[88]	C.I4.52.001.00_E_H2	02-05-2016	PASSENGER SEATS MOUNT. - A1-A2 (drawing 2/2)
[89]	C.I4.52.001.00_E_HP	02-05-2016	PASSENGER SEATS MOUNT. - A1-A2 (list of materials)
[90]	C.I4.52.012.01_0_H1	03-11-2015	SEAT B (drawing 1/2)
[91]	C.I4.52.012.01_0_H2	03-11-2015	SEAT B (drawing 2/2)
[92]	C.I4.52.012.01_0_HP	03-11-2015	SEAT B (list of materials)
[93]	C.I4.59.011.00_A_H1	22-02-2016	BIO-REACTOR DEP. (drawing 1/1)
[94]	C.I4.59.011.00_A_HP	22-02-2016	BIO-REACTOR DEP. (list of materials)
[95]	C.I4.59.012.00_A_H1	22-02-2016	FRESH WATER TANK (drawing 1/3)

[96]	C.I4.59.012.00_A_H2	22-02-2016	FRESH WATER TANK (drawing 2/3)
[97]	C.I4.59.012.00_A_H3	22-02-2016	FRESH WATER TANK (drawing 3/3)
[98]	C.I4.59.012.00_A_HP	22-02-2016	FRESH WATER TANK (list of materials)
[99]	C.I4.59.306.00_C_H1	15-04-2016	WC TANKS ASSEMBLY (drawing 1/1)
[100]	C.I4.59.306.00_C_P	15-04-2016	WC TANKS ASSEMBLY (list of materials)
[101]	C.I4.64.101.01_B_H1	03-03-2016	SALOON HVAC (drawing 1/1)
[102]	C.I4.64.101.01_B_HP	03-03-2016	SALOON HVAC (list of materials)
[103]	C.I4.64.151.01_B_H1	03-03-2016	CAB HVAC (drawing 1/1)
[104]	C.I4.64.151.01_B_HP	03-03-2016	CAB HVAC (list of materials)
[105]	C.I4.72.001.00_B_H1	05-11-2015	UF BRAKE PANNELS MOUNT – A (drawing 1/1)
[106]	C.I4.72.001.00_B_HP	15-06-2016	UF BRAKE PANNELS MOUNT – A (list of materials)
[107]	C.I4.72.020.00_0_H1	18-09-2015	SUPPORT EPC (drawing 1/1)
[108]	C.I4.72.020.00_0_HP	09-10-2015	SUPPORT EPC (list of materials)
[109]	C.I4.73.001.00_D_H1	02-05-2016	HVAC UNIT MOUNTING A1-A2 (drawing 1/1)
[110]	C.I4.73.001.00_D_HP	13-10-2015	HVAC UNIT MOUNTING A1-A2 (list of materials)
[111]	C.I4.73.003.00_C_H1	02-05-2016	TRACT. EQU. MOUNTING A1-A2 (drawing 1/1)
[112]	C.I4.73.003.00_C_HP	22-03-2016	TRACT. EQU. MOUNTING A1-A2 (list of materials)
[113]	C.I4.73.004.00_A_H1	30-01-2015	APS MOUNTING A1-A2 (drawing 1/1)
[114]	C.I4.73.004.00_A_HP	23-10-2015	APS MOUNTING A1-A2 (list of materials)
[115]	C.I4.73.005.00_E_H1	23-10-2015	BATTERY BOX MOUNTING A1-A2 (drawing 1/1)
[116]	C.I4.73.005.00_E_HP	23-10-2015	BATTERY BOX MOUNTING A1-A2 (list of materials)
[117]	C.I4.73.301.00_B_H1	23-10-2015	HVAC UINT MOUNTING B (drawing 1/1)
[118]	C.I4.73.301.00_B_HP	23-10-2015	HVAC UINT MOUNTING B (list of materials)
[119]	C.I4.73.302.00_E_H1	16-08-2016	HV SUPPLY EQ. MOUNT-B (drawing 1/1)
[120]	C.I4.73.302.00_E_HP	04-08-2016	HV SUPPLY EQ. MOUNT-B (list of materials)
[121]	C.I4.73.304.00_B_H1	23-10-2015	AIR SUPPLY MOUNTING B (drawing 1/1)
[122]	C.I4.73.304.00_B_HP	01-12-2015	AIR SUPPLY MOUNTING B (list of materials)
[123]	C.I4.73.501.00_C_H1	29-01-2016	HVAC UNIT MOUNTING C (drawing 1/1)
[124]	C.I4.73.501.00_C_HP	29-01-2016	HVAC UNIT MOUNTING C (list of materials)
[125]	C.I4.76.101.01_E_H1	07-06-2016	TRACTION INVERTER (drawing 1/2)
[126]	C.I4.76.101.01_E_H2	07-06-2016	TRACTION INVERTER (drawing 2/2)
[127]	C.I4.76.101.01_E_HP	07-06-2016	TRACTION INVERTER (list of materials)

[128]	C.I4.76.102_C_H1	07-06-2016	FILTER INDUCTOR (drawing 1/5)
[129]	C.I4.76.102_C_H2	07-06-2016	FILTER INDUCTOR (drawing 2/5)
[130]	C.I4.76.102_C_H3	07-06-2016	FILTER INDUCTOR (drawing 3/5)
[131]	C.I4.76.102_C_H4	07-06-2016	FILTER INDUCTOR (drawing 4/5)
[132]	C.I4.76.102_C_H5	07-06-2016	FILTER INDUCTOR (drawing 5/5)
[133]	C.I4.76.102_C_HP	07-06-2016	FILTER INDUCTOR (list of materials)
[134]	C.I4.76.151.01_C_H1	07-06-2016	BRAKE RESISTORS (drawing 1/1)
[135]	C.I4.76.151.01_C_HP	07-06-2016	BRAKE RESISTORS (list of materials)
[136]	C.I4.76.251.01_A_H1	25-01-2016	CIRCUIT BREAKER (drawing 1/1)
[137]	C.I4.76.251.01_A_HP	25-01-2016	CIRCUIT BREAKER (list of materials)
[138]	C.I4.76.301.01_C_H1	14-06-2016	PANTHOGRAPH WBL (drawing 1/1)
[139]	C.I4.76.301.01_C_HP	14-06-2016	PANTHOGRAPH WBL (list of materials)
[140]	C.I4.83.005.00_D_H1	02-08-2016	BATTERIES & CONTROL BOX (drawing 1/1)
[141]	C.I4.83.005.00_D_HP	02-08-2016	BATTERIES & CONTROL BOX (list of materials)
[142]	C.I4.85.101.01_C_H1	07-06-2016	AUXILIARY CONVERTER+BATTERY CHARGER (drawing 1/1)
[143]	C.I4.85.101.01_C_HP	07-06-2016	AUXILIARY CONVERTER+BATTERY CHARGER (list of materials)
[144]	C.I4.93.001.00_G	25-10-2016	CARBODY STRUCTURAL ANALYSIS SPECIFICATION
[145]	C.I4.93.075.00-A	05-09-2016	Bolt calculation main exterior devices
[146]	C.I4.93.074.00_B_H1	05-09-2016	Bolt calculation main interior equipment
[147]	APPENDIX 2_CI4_Seat	-	Equipment DATA: C.I4.52.012 SEAT
[148]	APPENDIX 3_CI4_door drive	-	Equipment DATA: C.I4.37.102.01 DOOR MECHANISM
[149]	APPENDIX 4_CI4_short sliding step	-	Equipment DATA: C.I4.37.150.01 SHORT SLIDING STEP
[150]	APPENDIX 5_CI4_long sliding step	-	Equipment DATA: C.I4.37.150.01 SHORT SLIDING STEP
[151]	APPENDIX 6_CI4_bioreactor	-	Equipment DATA: C.I4.59.011.00 BIOREACTOR
[152]	APPENDIX 7_CI4_fresh water tank	-	Equipment DATA: C.I4.59.012.00 DEPÓSITO AGUAS LIMPIAS
[153]	C.I4.92.177.50_A_H1	15-11-2016	Test report. Carbody Test.
[154]	C.I4.92.177.50_A_H2	14-09-2016	Safety test data / Certification sheet. Carbody Structure.
[155]	C.I4.92.177.50_A_H3	10-11-2016	Test report. Carbody Structural test according to EN 12663:2010

[156]	C.I4.93.020.00_A	03-03-2017	CARBODY STRESS ANALYSIS & TEST CORRELATION
[157]	C.I4.93.014.00_A	18-11-2016	Cabin survival space
[158]	C.I4.93.015.00_0	20-11-2016	Crashworthiness Analysis Validation. Absorption Module crash test
[159]	C.I4.93.016.00_0	21-11-2016	Crashworthiness Analysis Validation. Anticlimber crash test
[160]	C.I4.93.017.00_0	20-11-2016	Crashworthiness Analysis Validation. Front body-end crash test
[161]	C.I4.92.195.50_A_H3	06-07-2016	CETEST, Test report Energy Absorbing Module Crash Test Report.
[162]	C.I4.92.196.50_A_H3	06-07-2016	CETEST, Test report Anticlimber Crash Test Report.
[163]	C.I4.92.197.50_A_H3	06-07-2016	CETEST, Test report Front Bodyend Crash Test Report.
[164]	C.I4.97.075.26_B	06-04-2018	UNDER FRAME BALLAST MODIFICATION
[165]	C.I4.92.198.00_0_H1	15-12-2017	DYNAMIC CRASH TEST, Test Procedure
[166]	C.I4.92.198.00_0_H2	-	DYNAMIC CRASH TEST, safety results certification (origin test)
[167]	C.I4.92.198.00_0_H3	13-09-2017	CETEST: Test Procedure, Dynamic Crash test according EN 15227
[168]	C.I4.92.198.50_0_H1	15-12-2017	TEST REPORT DYNAMIC CRASH
[169]	C.I4.92.198.50_0_H2	15-12-2017	DYNAMIC CRASH TEST, safety results certification (origin test)
[170]	C.I4.92.198.50_0_H3	07-12-2017	TÜV SÜD: Test Report, Dynamic test of front structure
[171]	C.I4.92.198.50_0_H4	16-11-2017	Pictures, IMG_0511 to IMG_0544
[172]	C.I4.92.198.50_0_H5	17-11-2017	Movies:2017-11-16_CAF-Group_Front-Structure_34-3kmh_HS (top/top_slow/left/right/GoPro_short)
[173]	C.I4.93.019.00_0_H1	06-12-2017	Crashworthiness Analysis Validation, Dynamic crash test
[174]	C.I4.93.019.00_0_H2	15-12-2017	AVI movie, FEA Crash movie
[175]	C.I4.93.019.00_0_H3	15-12-2017	AVI movie FEA + test movie

Grounds for approval

Notification on compliance

The CAF SNG 3-car and 4-car trainsets comply to § 4.2.2.4, § 4.2.2.5, § 4.2.2.6 and § 4.2.2.7 of the TSI LOC&PAS.

Exported constraints

None.

Technical summary

The structure of SNG vehicles complies with the structural requirements of EN 12663-1:2010. SNG trainsets are classified as Category P-II (Fixed units and coaches). Proof of the strength of the vehicle body has been demonstrated by calculations and by testing, according to the conditions set up in the specification referenced in EN 12663-1:2010.

SNG units comply with the detailed crashworthiness requirements specified in the specification referenced in EN 15227:2008+A1:2011 related to crashworthiness design category C-I. The four scenarios described in EN 15227:2008+A1:2011 have been considered.

It is possible to safely lift or jack each vehicle composing the SNG unit, for recovery purposes and for maintenance purposes. Suitable vehicle body interfaces (lifting/jacking points) are provided, which permit the application of vertical or quasi-vertical forces. The vehicle is designed for complete lifting or jacking, including the running gear. It is also possible to lift or jack any end of the vehicle with the other end resting on the remaining running gear(s).

Jacking/Lifting points are located such as to enable the safe and stable lifting of the vehicle.

The structure is designed with consideration of the loads specified in the specification referenced in EN 12663-1:2010.; proof of the strength of the vehicle body has been demonstrated by calculations and testing.

Jacking and lifting diagram and corresponding instructions have been provided.

Fixed devices including those inside the passenger areas are attached to the carbody structure in a way that prevents these fixed devices becoming loose and presenting a risk of passenger injuries or lead to a derailment. To this aim, attachments of these devices have been designed according to EN 12663-1:2010, considering P-II for passenger rolling stock.

The modification described in [164] related to the introduction of weight in cars A1 and A2 to improve the levelling of the trainsets has impact in requirement 4.2.2.7. A calculation has been performed for static loads and fatigue loads for new equipment (ballast) in combination with total weight of the equipment. Calculation results show that in all the load cases the stresses obtained around the attachment of the ballast equipment are very low. The stress values are far from the limits of the material of the area.

Reference to other ARs used

Point 6, TSI clause *4.2.2.4 Load conditions and weighed* mass has been assessed in the assessment report reference 580548.

Point 16 of Annex III: APPENDIX D – Assessment of EN12663-1:2010, TSI clause *4.2.2.2.2 Inner coupling* has been assessed in the assessment report 580540.

Point 27, TSI clauses *4.2.12.5 Lifting diagram and instructions* and *4.2.12.6 Rescue related descriptions* have been assessed in the assessment report reference 580541

Software versions assessed

None.

Applicable derogations

None.

Revision history		
Revision	**Date**	**Changes**
1	28-03-2016	Assessment performed according to CAF's documentation [1] to [15] for requirement 4.2.2.5. Passive safety.
2	25-04-2016	Assessment performed according to CAF's documentation [16] to [25] for requirement 4.2.2.4. Strength of vehicle structure.
3	18-05-2016	Assessment performed according to CAF's documentation [26] to [32] plus [21], [22] and [23] for requirement 4.2.2.6 Lifting and jacking.
4	24-06-2016	Assessment performed according to CAF's documentation for requirement 4.2.2.6 Lifting and jacking.
5	15-07-2016	Assessment performed according to CAF's documentation [11] to [15] for requirement 4.2.2.5. Passive safety.
6	14-07-2016	- Re-assessment performed according to CAF's documentation for requirement 4.2.2.4. Strength of vehicle structure. - Assessment performed according to CAF's documentation for requirement 4.2.2.7 Fixing of devices.
7	07-09-2016	Updat point 4.2.2.5. Assessment of reaction CAF and new document [57]
8	30-09-2016	Update of point 4.2.2.7. Assessment of reaction CAF and new documents [58] to [152].
9	10-10-2016	Requirement 4.2.2.4 has been reassessed with updated documents [20], [21], [22] and new documents [153], [154], [155]
10	09-11-2016	Requirement 4.2.2.5 has been reassessed with updated documents [11], [12], [13], [14] and [15]
11	04-01-2017	Requirement 4.2.2.6 has been reassessed with updated documents [34] and [153] to [155]. Requirement 4.2.2.4 has been reassessed with CAF´s answer and with updated documents [17], [18], [19], [21], [22] and [144] and new documents [153], [154], [155] and [156]. Requirement 4.2.2.7 has been reassessed with CAF´s answer and with updated documents [53] and [54].
12	16-01-2017	Requirement 4.2.2.5 has been reassessed
13	21-03-2017	Requirement 4.2.2.5 has been reassessed
14	27-03-2017	Requirement 4.2.2.4 has been assessed with CAF's answers and updated document [156].
15	10-04-2017	Requirement 4.2.2.4 has been assessed with CAF's answers to AR V14.
16	08-11-2017	Requirements 4.2.2.4 and 4.2.2.7 have been reassessed with new document Ref. [164].
17	12-01-2018	Requirement 4.2.2.5 has been reassessed with new documents Ref. [164] till [175].

18	01-02-2018	Version rewritten according to checklist based on Authorization 2.0 experiences
19	19-03-2018	Update following 2.0 specialist meeting MoM 695690.
20	03-04-2018	Requirement 4.2.2.7 has been reassessed with CAF answers. Update of document [164].
21	10-04-2018	Requirement 4.2.2.7 has been reassessed with CAF answers. Update of document [164].

Assessment						
Rev.	**Carried out by**			**Checked by**		
	Name	**Signature**	**Date**	**Name**	**Signature**	**Date**
1	10 2 e	10 2 e	*31-03-2016*	10 2 e		
2			*25-04-2016*		10 2 e	*04-05-2016*
3			*18-05-2016*			*18-05-2016*
4			*09-06-2016*			*24-06-2016*
5			*11-07-2016*			*15-07-2016*
6			*14-07-2016*			*04-08-2016*
7			*02-09-2016*			*06-09-2016*
8			*19-09-2016*			*30-09-2016*
9			*10-10-2016*			*11-10-2016*
10			*12-10-2016*			*09-11-2016*
11			*04-01-2017* *20-12-2016*			*04-01-2017*
12			*19-01-2017*			*19-01-2017*
13			*20-03-2017*			*20-03-2017*
14			*22-03-2017*			*27-03-2017*
15			*03-04-2017*			*10-04-2017*
16			*02-11-2017*			*08-11-2017*
17			*10-01-2018*			*12-01-2018*
18			*07-02-2018*			*08-02-2018*
19			*08-03-2018*			*13-03-2018*
20			*20-03-2018*			*3-4-2018*
21			*09-04-2018*			*10-04-2018*

Annex I: clause by clause ground for approval

Nr	Reference	Description requirement	Status
	Comments		
§ 4.2.2.4	**Strength of vehicle structure**		
1	§ 4.2.2.4	This clause applies to all units except OTMs	
	Information.		Information
2	§ 4.2.2.4	For OTMs, alternative requirements to those expressed in this clause for static load, category and acceleration are set out in Appendix C, clause C.1.	
	This requirement is not applicable for the SNG units.		Not applicable
3	§ 4.2.2.4	The static and dynamic strength (fatigue) of vehicle bodies is relevant to ensure the safety required for the occupants and the structural integrity of the vehicles in train and in shunting operations. Therefore, the structure of each vehicle shall comply with the requirements of the specification referenced in Appendix J-1, index 7. The rolling stock categories to be taken into account shall correspond to category L for locomotives and power head units and categories PI or PII for all other types of vehicle within the scope of this TSI, as defined in the specification referenced in Appendix J-1, index 7, clause 5.2.	
	Requirements of Appendix J-1, index 7 (12663-1:2010) *(5.1) General. "The capability of the railway vehicle body to sustain required loads without permanent deformation and fracture shall be demonstrated by calculation and/or testing as described by the validation program in Clause 9."* Refer to the calculations performed for Cabin Car [21] and Intermediate Car [22]. Provided Test Procedure [19] for Cabin Car. Provided Correlation Procedure [23] to validate Cabin Car FEM calculation. Methodology used is compliant to clause 9. *(5.1) General. "The requirements of this European Standard are based on the use of metallic materials and requirements defined in 5.4.2, 5.4.3 and 5.6 and Clause 7 and Clause 8 are specifically applicable only to such materials."* Refer to [25], section 4.1: SNG trains are made of metallic materials (aluminum and steel). EN 12663-1:2010 is fully applicable to SNG trains. Documents [21] and[22] chapter 4 show the used material *(5.2) Categories of railway vehicles* Refer to [20][21], Section 1: "Calculation and testing will be done according to the requirements of the normative EN 12663 classifying the vehicle as type P-II." Category P-II. (Fixed units and coaches) is the correct classification. *(5.3) Uncertainties in railway design parameters; 5.3.1 Allowance for uncertainties; 5.3.2 Loads; 5.3.3 Material; 5.3.4 Dimensional tolerances; 5.3.5 Manufacturing process; 5.3.6 Analytical accuracy.* Refer to [21] and [22]:		Compliant

5.3.1. Safety factors used at each load case are compliant to standard EN 12663-1:2010. Safety factors are reduced for those load cases that will be checked by testing. Compliant to standard EN 12663-1:2010.

5.3.2. Load cases defined in EN 12663-1:2010, Clause 6, have been used for calculation. Compliant to standard EN 12663-1:2010.

5.3.3. Considerations have been taken for welded areas by reducing yield and ultimate strength. Compliant to standard EN 12663-1:2010.

Requirements 5.3.1, 5.3.2 and 5.3.3 of EN 12663-1:2010 are compliant.

Static Load:

"(5.4.1) It shall be demonstrated by calculation and/or testing, that no significant permanent deformation or fracture of the structure as a whole, of any individual element or of any equipment attachments, will occur under the prescribed design load cases. The requirement shall be achieved by satisfying the yield or proof strength (according to 5.4.2). If the design is limited by the ultimate strength and/or the stability condition (according to 5.4.3 and/or 5.4.4) these shall be satisfied as well. The validation process is described in Clause 9."

"(5.4.2) Yield or proof strength. Where the design is verified only by calculation, S1 shall be 1,15 for each individual load case. S1 may be taken as 1,0 where the design load cases are to be verified by test and/or correlation between test and calculation has been successfully established."

"(5.4.3) Ultimate failure. Usually S2 = 1,5, but a value of S2 = 1,3 can be used where the design load cases are to be verified by test and/or correlation between test and calculation has been successfully established."

Correct methodology used according standard EN 12663-1:2010.

Correct combination of forces, masses and constrains have been considered for each load case with exceptions commented at appendix EN 12663-1:2010.

Conformance to safety factors considered (S1, S2 and S3) with exceptions as commented at appendix EN 12663-1:2010. Safety factors considered at load cases are reduced in case of checking by testing in compliance to standard EN 12663-1:2010.

"(5.4.4) Instability."

Results show acceptable values (U<1) for yield strength and ultimate value. Utilization values should be calculated. As written at this clause: "Local instability, in the form of elastic buckling, is permissible provided alternative load paths exist and the yield or proof criteria are met." An explanation has been added in the documents. It is demonstrated that Lcb>S3Lc. Therefore, the condition of U<1 is met (even that the exact value of U is given, which is not directly required in the standard). Refer to [20], clause 3.5. Correct.

"(5.5) Demonstration of stiffness. Any specific requirements and the means for demonstration of stiffness shall be part of the specification."

The Car body structural analysis specification [20] includes the following information:

Stiffness limits are defined in terms of the following maximum allowable deflections and displacements for the loads defined in the following chapter:

- Door opening diagonals: 12mm.
- Window opening diagonals: 7mm.
- Transversal deflection: 10mm (outwards), 30mm (inwards).
- Maximum vertical deflection sidesill: 25mm.
- Maximum vertical deflection sidesill (ends): +/- 15mm.
- Maximum longitudinal compression: 30mm.
- Maximum longitudinal traction: 20mm.

These stiffness limits are common values for EMU type cars and based on CAF's experience. They are also compatible with the door and window assembly.

Stiffness limits above are included in the reports [21] and [22] and also comparison between the allowable values and the calculated values for each load case.

Stiffness result tables checked at every load case. Stiffness results are below admissible values.

(6) Design load cases. Clauses 6.1 to 6.5.

Ricardo Certification assessment: See Annex III: APPENDIX D – Assessment of EN12663-1:2010

6.5.3 Proof load cases for joints of articulated units.

6.7.5 Fatigue load cases for joints of articulated units

These clauses has been assessed at requirement § 4.2.2.2.2 Inner coupling, in the Assessment Report with reference 580540.

Fatigue:

(5.6) Demonstration of fatigue strength"

"The identification of these critical features is essential. Detailed examination of local features can be necessary."

Refer to the fatigue analysis of [21] and [22], section 11.2.1. CAF has identified critical parts of the structure and has performed specific analysis.

(7.3) Fatigue strength

Fatigue strength shall be evaluated using S-N-curves derived in accordance with the following:

- *a survival probability of at least 97,5 %;*
- *classification of details according to the component or joint geometry (including stress concentration);*

Refer to [20], section 7.2: The S-N curves exhibit a survival probability of 97.7% and 95% confidence level.

"The fatigue strength shall be demonstrated. One of the following methods should be used:

d) endurance limit approach.

e) cumulative damage approach."

"Other established methods of carrying out life assessment can be used in the design and validation processes when appropriate."

Refer to [20], section 7.2. The methodology for fatigue calculation is explained. Cumulative damage approach is used.

6.6 General fatigue load cases for the vehicle body

6.7 Fatigue loads at interfaces

6.8 Combination of fatigue load cases

Ricardo Certification assessment: See Annex III: APPENDIX D – Assessment of EN12663-1:2010.

6.9 Modes of vibration

Ricardo Certification assessment: Annex III: APPENDIX D – Assessment of EN12663-1:2010

General assessment for all load cases [21] [22]

1. Stress Results. Maximum stress values around singular points. Document [22], Figure 11-11: Load Case LC6.1 A. Justification has been given for each singular point. Enough explanation is given. OK.
2. Stress Results:
    - Document [21], section 11.1.1.3.2. Stress Results: "113 MPa located at a cab end reinforcement." The piece corresponds to skech C.I4.25.123, made in AW 5083 H24. Therefore, the limit for the weld is 150 MPa. Document [21], Table 4-2 and documents [38] and [39] checked. OK.
    - Document [21], section 11.1.7.3.2. Stress Results: "182 MPa located at the front door upper corner." The piece corresponds to skech X.25.01411.01, and the material is 6005A T6, so the limit for the plain material is 215 MPa. Document [21], Table 4-2 and documents [50] to [52] checked. OK.

    More detail of type of component is provided at:

    - Document [21], section 11.1.2.3.2. Stress Results: "110 MPa located at Rear bolster.
    - Document [21], section 11.1.3.3.2. Stress Results: "110 MPa located at Rear door bottom corner

    Both details correspond to the weld between the rear bolster and it's closing plate, being the stress in the closing plate, which is made of aluminum alloy AW 5083 H24. The utilization factor is determined in documents [21] and [22].

    - Document [21], section 11.1.17.3.2. Stress Results: "93 MPa located at Underframe reinforcement"
    - Document [22], section 11.1.4.3.1. Stress Results: "99 MPa located at Side sill".

	Documents [21] and [22] include the alloy type to the stress details in order to avoid doubts. Checked [21], section 11.1.17.3.2. and [22], section 11.1.4.3.1. and considered correct.		
4	§ 4.2.2.4	Proof of the strength of the vehicle body may be demonstrated by calculations and/or by testing, according to the conditions set up in the specification referenced in Appendix J-1, index 7, clause 9.2.	
	Ricardo Certification assessment: See Annex III: APPENDIX D – Assessment of EN12663-1:2010.		Reference
5	§ 4.2.2.4	In case of a unit designed for higher compressive force than those of the categories (required above as a minimum) in the specification referenced in Appendix J-1, index 7, this specification does not cover the proposed technical solution; it is then permissible to use for compressive force other normative documents that are publicly available. In that case it shall be verified by the notified body that the alternative normative documents form part of a technically consistent set of rules applicable to the design, construction and testing of the vehicle structure. The value of compressive force shall be recorded in the technical documentation defined in clause 4.2.12.	
	No higher compressive force is considered by CAF.		Not applicable
6	§ 4.2.2.4	The load conditions considered shall be consistent with those defined in clause 4.2.2.10 of this TSI.	
	This point has been assessed at requirement *§ 4.2.2.10 Load conditions and weighed mass*, in the Assessment Report with reference 580548.		Reference
7	§ 4.2.2.4	The assumptions for aerodynamic loading shall be those described in clause 4.2.6.2.2 of this TSI (passing of 2 trains).	
	Not applicable. Requirement only applicable for trains with a V_{max} > 160 km/h.		Not applicable
8	§ 4.2.2.4	Joining techniques are covered by the above requirements. A verification procedure shall exist to ensure at the production phase that defects that may decrease the mechanical characteristics of the structure are controlled.	
	Verification procedure is done through welding NDT (Non Destructive Tests) which are carried out to the following main assemblies, as well as inspections according to the EN 15085-5: ○ Body bolster ○ Headstock ○ Underframe ○ Front cab end frame ○ Car shell In addition, all welding is done by homologated procedures (WPQR-Welding Procedure Qualification Record and WPS- Welding Procedure Specification) and qualified welders (WPQ-Welder Procedure Qualification) which guarantees the mechanical characteristics of the joint. Certificate provided in LRR.0031. The provided verification sheets for the welding have been checked: ○ C.I4.90.010 body bolster ○ C.I4.90.020 underframe car A ○ C.I4.90.021 underframe car B/C ○ C.I4.90.040 rear headstock ○ C.I4.90.060 car shell A ○ C.I4.90.061 car shell B/C		Compliant

	○ C.I4.90.063 front cab end frame EN 15085-5 certification is in force (until 22-06-2018). OK.		
§ 4.2.2.5 Passive safety			
9	§ 4.2.2.5	The requirements specified in this clause apply to all units, except to units not intended to carry passengers or staff during operation and except to OTMs.	
	This clause is applicable to SNG 3 and SNG 4 cars trains.		Information
10	§ 4.2.2.5	For units designed to be operated on the 1520 mm system, the requirements on passive safety described in this clause are of voluntary application. If the Applicant chooses to apply the requirements on passive safety described in this clause, this shall be recognised by Member States. Member States may also require application of those requirements.	
	Not applicable		Not applicable
11	§ 4.2.2.5	For locomotives designed to be operated on the 1524 mm system, the requirements on passive safety described in this clause are of voluntary application. If the Applicant chooses to apply the requirements on passive safety described in this clause, this shall be recognised by Member States.	
	Not applicable		Not applicable
12	§ 4.2.2.5	Units which cannot operate up to the collision speeds specified under any of the collision scenarios below are exempted from the provisions related to that collision scenario.	
	This clause is applicable to SNG 3 and SNG 4 cars trains. Operation speed for these trains is 160 km/h. Minimum collision speed scenario according EN 15227:2008+A1:2010, section 5, table 2, is 36 km/h.		Information
13	§ 4.2.2.5	Passive safety is aimed at complementing active safety when all other measures have failed. For this purpose, the mechanical structure of vehicles shall provide protection of the occupants in the event of a collision by providing means of: • limiting deceleration • maintaining survival space and structural integrity of the occupied areas • reducing the risk of overriding • reducing the risk of derailment • limiting the consequences of hitting a track obstruction. To meet these functional requirements, units shall comply with the detailed requirements specified in the specification referenced in Appendix J-1, index 8 related to crashworthiness design category C-I (as per the specification referenced in Appendix J-1, index 8, Table 1 section 4), unless specified otherwise below. The following four reference collision scenarios shall be considered: • scenario 1: A front end impact between two identical units; • scenario 2: A front end impact with a freight wagon; • scenario 3: An impact of the unit with a large road vehicle on a level crossing; • scenario 4: An impact of the unit into a low obstacle (e.g. car on a level crossing, animal, rock etc.) These scenarios are described in the specification referenced in Appendix J-1, index 8, Table 2 of section 5.	
	<u>Standard EN 15227:2008+A1:2010 specifies 5 requirements for this point:</u> 1. *Limiting deceleration. (Detail of requirement at point 6.4.1.)* 2. *Maintaining survival space and structural integrity of the occupied areas (Detail of requirement at point 6.3.1.)* 3. *Reducing the risk of overriding (Detail of requirement at point 6.2.1.)*		Compliant

	4. Reducing the risk of derailment (Detail of requirement at point 6.2.1.) *5. Limiting the consequences of hitting a track obstruction (general and 6.5.1 for obstacle deflector).* **CAF´s results and Ricardo Certification assessment regarding requirements 1 to 5 above:** **1. Limiting deceleration:** **CAF´s evidence:** - References [11], [12], [15], point 5.3.: Mean deceleration for all cars are below 5g for all segments of time. (scenario 1 and 2) - Reference [13], point 5.3.: Mean deceleration for all cars are below 7.5g for all segments of time. (scenario 3) **RC assessment:** Procedure followed to obtain mean deceleration results is compliant to standard EN 15227:2008+A1:2010. Results are Compliant to Standard EN 15227:2008+A1:2010.	
	2. Maintaining survival space and structural integrity of the occupied areas: **CAF´s evidence:** - References [11], [12], [13] and [15], point 5.2 show results for survival space at each scenario. Table 5.2.1 summarizes results at each document. **RC assessment:** The procedure followed to obtain survival space results is compliant to standard EN 15227:2008+A1:2010. Survival space results at every car for every scenario are compliant to standard EN 15227:2008+A1:2010 with the following observations: o Survival space can be demonstrated by two approaches. CAF has chosen to demonstrate that adjacent to the main seating position a space is maintained with a length and width of at least 0,75 m and at least 80% of the original height between the nominal floor and ceiling levels; o Scenario 1 and 2 documents [11], [12], [15], table 5.2. give the results of the evaluation of the survival space “Main seating”. No deformation observed. Document [11], figure 5.2.1.4.1 shows the box representing the survival space. In the documents [11], [12], [13], [14] and [15] the dimensions of the box representing the survival space have been verified. o Scenario 3 document [13], table 5.2. gives the results of the evaluation of the survival space “Main seating”. The survival space is represented by a box. A picture of this box is given in for instance figure 5.2.11.4.1 of document [13]. In documents [11], [12], [13], [14] and [15] figures are given with deformed cabin and undeformed driver desk. In figure 5.2.1.4.3 in document [11] top view of the cabin is given. Drawing [157] shows the cabin of the train. Added is the box representing the survival space (750x750x1560 mm). The box is positioned behind the driver seat in front of the door to the passenger’s area.	Compliant

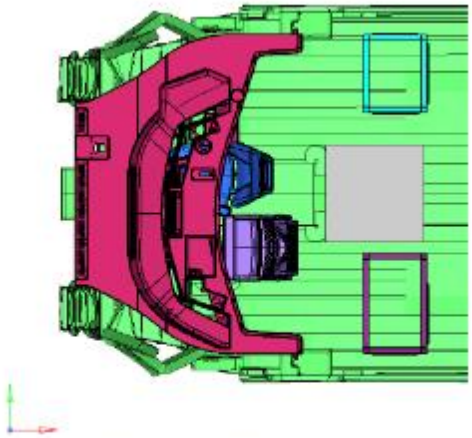


Fig.5.2.1.4.3 Deformed structure with the interiors superimposed. Upper view

The driver should always leave his chair in case of an event defined in scenario 3.

Part A (document [57], figure 5-4) has been modelled using a cover sheet of 10mm thickness. As the area of the cover sheet is 5.022E7mm2 and the mass has to be 9.375 T so that the CoG is at 1750mm high, the density of the sheet is 1.867e-08 T/mm3.
Part B has been modelled using a cover sheet of 8mm. As the area of the cover sheet is 1.760E7mm2 and the mass has to be 5.625 T so that the CoG is at 1750mm high, the density of the sheet is 3.995e-08T/mm3.

Document [13] figure 5.2.1.4.3 shows that the anti-climber will come in contact with part B of the large obstacle. During the collision, the obstacle will rotate as a result of the high centre of gravity. This will lead to a moment action on the anti-climber resulting in a rotation upward of the absorber.

Document [57] shows that the large deformable obstacle complies to the requirements of EN 15227 Annex C.3. Document [13] chapter 5.1.3 shows the energy conversion for this scenario. Only a small part of the total energy is dissipated in plastic energy. About 3,9 MJ by the large obstacle and 1,6 MJ in the train set.

The principle of the validation tests for the combined method, as described in the EN 15227 chapter 7, is to perform dynamic tests and calibrate the numerical model. Quasi-static tests are part of a reduced validation program. It is only permitted to use a reduced validation program if the key features of the design have been previously validated.

From the information we have received we conclude this reduced validation program is not applicable. Therefore, Ricardo Certification concludes that dynamic tests shall be used to calibrate the numerical models of the absorbing devices and crumple zones.

CAF´s evidence test procedure validation program:

- References [165], [166] and [167] show the test procedure of the dynamic crash test.
- References [168], [169], [170], [171] and [172] show the results of the dynamic crash test.

RC assessment:

Compliant

Document [165], main document with 2 appendixes. Appendix 1 [166] is a template of the result sheet, to be signed by CAF. Document [167] describes the test procedure made by CETEST.

Document [168] is the main document with 4 appendixes. Appendix 1, [169], is the signed document with the test results of the dynamic test. Stated is that the test results are OK.

Appendix 2, [170], is the test report made by test institute TÜV SÜD. Document gives information about the test set-up and gives the results of the test.. Appendix 4, [171], are pictures of the test set up and the full-scale test model (before and after the crash). Appendix 4 [172] are videos of the crash (several view points)

CAF´s evidence analysis validation:

- References [173], [174] and [175] show the analysis of the validation of the full size test.

RC assessment:

Document [173] describes the validation of the numerical model. Documents [174] and [175] are movies of the crash test (FEA and full-scale test).

Requirement	**FEA result**	**Test result**	**Difference / result**
Test shall absorb 80% of the maximum energy	1,81 MJ	1,64 MJ	90%
Impact speed 50% of 36 km/h	36 km/h	34,3 km/h	95%
Same sequence of event	Movie [175]	Movie [175]	similar
Level of energy within 10%	1671 kJ	1689 kJ	1,1%
Overall displacement within 10%	780,4 mm	785 mm	0,6%
Mean force within 10% (first event)	1569 kN	1437 kN	8,4%
Mean force within 10% (second event)	3420 kN	3690 kN	7,9%

The full-scale test is used to validate the numerical model used for the crash simulation. Comparison of the results of the FEA with the full-scale test show that they comply with criteria mentioned in EN 15227 paragraph B.2.1. It is demonstrated that the numerical model reproduces correctly the behavior of the energy absorbing mechanisms.

3. and 4. Reducing the risk of overriding and derailment:

Compliant

CAF´s evidence:

- Reference [15], point 5.4. displays result for his point: “The maximum vertical displacement measured in the wheelsets is 19.1 mm. This wheelset belongs to the front bogie of the Obstacle A2 car.”

RC assessment:

Procedure followed to obtain overriding results is compliant to standard EN 15227:2008+A1:2010.

	Drawing M.J5.01.010.01 Shows that the height of the flange is Sh=28 mm. The allowable value is 0,75*28=21 mm. The maximum vertical displacement of 19,1 mm is smaller than 21 mm. This means that the requirement is met.	
	5. Limiting the consequences of hitting a track obstruction: ***General*:** **CAF´s evidence:** - References [11], [12], [13] and [15], point 5.1.4 and table 5.1.4.1 show results for absorbed energy for each section of the train at each scenario. **RC assessment:** Total absorbed energy is focused mainly at components designed to this task (front cab structure and front energy absorption components) limiting this way deformation and deceleration in passenger areas. compliant to standard EN 15227:2008+A1:2010.	Compliant

	Point 6.5.1 of standard ref (2): Scenario 4 "Train unit impact into low obstacle."
	
	CAF´s evidence:
	
	- Reference [14]:
	  ○ Point 3.1. shows Crash scenario definition.
	  ○ Point 4. Shows requirements taken into account.
	  ○ Point 5.1 shows results.
	  ▪ There are no significant permanent deformations in the obstacle deflector or carbody structure.
	  ▪ Deflector dissipates 36kJ (300 kN * 120 mm) when the obstacle's displacement is about 130 mm. At that instant, the deflector is deformed in such a way that it does not become detached and plastic deformation is concentrated in the deflector's area.
	
	RC assessment:
	
	The deformation over a distance of 130 mm is accepted because deflector is deformed in such a way that it does not become detached and plastic deformation is concentrated in the deflector's area.
	
	Crash scenario definition, requirements taken into account and result are compliant to standard EN 15227:2008+A1:2010.
	
	RC assessment. Additional general comments:
	
	Collision mass according EN 15227 is design mass in working order plus the mass of 50% of seated passengers. RC has calculated this value according Mass calculation report [24] and obtained 209.462 kg (taking into account CAF´s additional percentage of 3%). CAF´s value at document [10] is 215.844 kg. This value is higher than estimated.
	
	CAF has used a higher mass than strictly applicable for the SNG project. The higher mass leads to higher impact energies. This means that the calculations are conservative.
		Compliant

	All the rotations in the articulation of the intermediate couplers are allowed in the model. This explanation is included in the document [10],[11], [12], [13] and [15] paragraph 3.1.3. From figure 5.2.2.1.3 document [11], it is clear that there are parts with plastic strain but the location and the amount of plastic strain is limited (max 0,05). Validation of simulations performed at documents [11] to [15] takes place once performed real tests of large deformable components and checked against corresponding software simulations.		
14	§ 4.2.2.5	Within the scope of the present TSI, 'Table 2 application rules' in the specification referenced in point (5) above are completed by the following: the application of requirements related to scenarios 1 and 2 to locomotives: • fitted with automatic end centre buffer couplers; • and capable of a traction effort higher than 300 kN is an open point. Note: such high traction effort is required for heavy haul freight locomotives.	
	Not applicable.		Not applicable
15	§ 4.2.2.5	Due to their specific architecture, it is permitted for locomotives with single "central cab" as an alternative method to demonstrate compliance against the requirement of scenario 3 by demonstrating compliance with following criteria: • the frame of the locomotive is designed according to the specification referenced in Appendix J-1, index 8 cat L (as already specified in clause 4.2.2.4 of this TSI). • the distance between buffers and windscreen cab is at least 2,5 m.	
	Not applicable.		Not applicable
16	§ 4.2.2.5	The present TSI specifies crashworthiness requirements applicable within its scope; therefore, the Annex A of the specification referenced in Appendix J-1, index 8 shall not apply. The requirements of the specification referenced in Appendix J-1, index 8 section 6 shall be applied in relation to the above given reference collision scenarios.	
	Assessment carried out at point 13 to applicable sections.		Reference
17	§ 4.2.2.5	To limit the consequences of hitting a track obstruction, the leading ends of locomotives, power heads, driving coaches and trainsets shall be equipped with an obstacle deflector. The requirements with which obstacle deflectors shall comply are defined in the specification referenced in Appendix J-1, index 8, table 3 of section 5 and section 6.5.	
	Obstacle deflector assessed at document [14]. In document [14], chapter 5.1 is written that the safety factor is S=1.15. The strength of the obstacle deflector is also determined for scenario 4.. For steel S355 a conservative yield stress of 320 MPa is used. Utilization factor is smaller than 1. OK.		Compliant
§ 4.2.2.6 Lifting and jacking			
18	§ 4.2.2.6	This clause applies to all units.	
	Informative.		Information
19	§ 4.2.2.6	Additional provisions concerning the lifting and jacking of OTMs are specified in Appendix C, clause C.2.	
	Not Applicable		Not Applicable
20	§ 4.2.2.6	It shall be possible to safely lift or jack each vehicle composing the unit, for recovery purposes (following derailment or other accident or incident), and for maintenance purposes. To this purpose, suitable vehicle body interfaces (lifting/jacking points) shall be provided, which permit the application of vertical	

		or quasi-vertical forces. The vehicle shall be designed for complete lifting or jacking, including the running gear (e.g. by securing/attaching the bogies to the vehicle body). It shall also be possible to lift or jack any end of the vehicle (including its running gear) with the other end resting on the remaining running gear(s).	
		Document [30] describes the lifting and jacking procedure for the SNG units. The lifting of the complete unit will run on four lifting plates per car. It is possible to lift a complete unit with all bogies hanging. Section 2.2 describes the procedure for independent carbody lifting with and without bogies. Section 2.3 describes the re-railing procedure for end bogie or intermediate bogie. Lifting pads positions are defined in drawing [26] for the cabin car. Lifting pads positions are defined in drawing [33] for cars B and C. Document [20] presents the methodology that will be used to carry out the structural calculations using Finite Element Methods (FEM). With regards to lifting and jacking, loads to be analysed are described in Section 3.4. Calculations have been done according to the requirements of the normative EN 12663 classifying the vehicle as type P-II. Specified loads considered are (m_1 = Design mass in working order without bogies / m_{2a} = Motor end-bogie mass / m_{2b} = Motor shared-bogie mass): For rerailment of E1 in tare. Cab car: Fz = 1,1 x (m_1 + m_{2a}) x g. Correct, in accordance with EN 12663, Table 10 For rerailment of one end in tare. Intermediate car: Fz = 1,1 x (m_1 + 0.5*m_{2b}) x g. This is in accordance with EN 12663, Table 10 as shared bogie is involved (half of it mass considered). For rerailment of e2 in tare. Cab car: Fz = 1,1 x (m_1 + 0.5*m_{2b}) x g. This is in accordance with EN 12663, Table 10 as shared bogie is involved (half of it mass considered). For lifting the whole vehicle in tare. Cab car: Fz = 1,1 x (m_1 + m_{2a} + 0.5*m_{2b}) x g. This is in accordance with EN 12663, Table 11 as shared bogie is involved (half of it mass considered). For lifting the whole vehicle in tare. Intermediate car: Fz = 1,1 * (m_1 + 0,5*m_{2b} + 0.5*m_{2b}) * g. This is in accordance with EN 12663, Table 11 as shared bogies are involved (half of their mass considered). For lifting the whole vehicle at the specified lifting position in tare with one support displaced. One of the lifting point is displaced 10mm vertically relative to the plane of the other three points. This is correct according EN 12663, 6.3.3. Conclusion is that EN 12663, 6.3.2 and 6.3.3 are complied. According to application guide of TSI Loc&Pas, section 6.3.4 of EN 12663 is also applicable. EN 12663, 6.3.4: *The re-railing and recovery scenarios set out in EN 16404 require that the vehicle body and lifting points have sufficient strength to ensure that these operations can be conducted safely.* Document [21] presents the stress analysis for the for the Civity NS units' carbody shell and body mounted modules, in accordance with the Carbody Structural Specification [20]. Results of the analysis, regarding lifting and jacking are presented in:	Compliant

	11.1.11 Load Case LC6.4 A E1A , Rerailment of E1 in Tare (Option A) 11.1.12. Load Case LC6.4 A E1B, Rerailment of E1 in Tare (Option B) 11.1.13. Load Case LC6.4 A E2A, Rerailment of E2 in Tare (Option A) 11.1.14. Load Case LC6.4 A E2B, Rerailment of E2 in Tare (Option B) 11.1.15. Load Case LC6.4 B, Vehicle Elevation in Tare 11.1.16. Load Case LC6.4 C, Lifting with displaced support The results of the static load cases confirm that the carbody structure design achieves stresses and deflections within the admissible limits. Document [22] presents the stress analysis of the intermediate car for the Civity NS units' carbody shell and body mounted modules, in accordance with the Carbody Structural Specification [20] in accordance with EN 12663. Results of the analysis regarding lifting and jacking are presented in are presented in: 11.1.5. Load Case LC6.4 A E2A, Rerailment of E2 in tare 11.1.6. Load Case LC6.4 B E2B, Rerailment of E2 in tare 11.1.7. Load Case LC6.4 B, Vehicle elevation in tare 11.1.8. Load Case LC6.4 C, Lifting with displaced support The results of the static load cases confirm that the carbody structure design achieves stresses and deflections within the admissible limits. CAF has delivered Test specification [17], [18], [19] for the Carbody Structural Test According EN 12663:2010. Document [19] describes the tests to be performed. Due to the considerable similarities among different cars the testing will be carried out for the structure of cabin car A1/A2. Section 2 defines the weights that will be used to define the load cases. Section 3 defines that strains, applied forces and displacements will be measured. Section 4 defines the allowable stresses. Section 5 defines the load cases that the structure will undergo. For lifting and jacking, section 5 defines the load cases applied. • Rerailment of the leading bogie at the specified lifting positions in tare. 10% overloaded. (Option A). • Rerailment of the leading bogie at the specified lifting positions in tare. 10% overloaded. (Option B). • Rerailment of the rear bogie at the specified lifting positions in tare. 10% overloaded. (Option A). • Rerailment of the rear bogie at the specified lifting positions in tare. 10% overloaded. (Option B). • Lifting the carbody on tare with both bogies hanging. 10% overloaded. Four lifting points. (Option A). • Lifting the carbody on tare with both bogies hanging. 10% overloaded. Four lifting points. (Option B). • Lifting the carbody on tare with both bogies hanging and one lifting point displaced 10mm vertically. 10% overloaded. Four lifting points.	

	Load cases considered are correct according EN 12663:2010. Document [155] is the test report of the structural tests performed from 12/05/2016 to 17/06/2016 on the carbody "A2-001-E2" designed and manufactured by CAF for the Civity NS project. Tests were performed by CETEST, accredited laboratory against EN 17025, according EN 12663:2010 and test procedure [19]. Load cases described in the test procedure [19] have been applied. Results are shown in Annex A1.10 to Annex A1.16. Section 6.3.4 shows summaries of the stresses and displacements at the most relevant measured points due to the different load cases. In all cases, the residual stresses after unloading have proved to be below the established limits. No permanent deformation has taken place under these load cases. Visual inspections were done after the completion of the test and no permanent deformations were found. Test results are correct. It has been demonstrated that carbody is suitable for lifting and jacking purposes.		
21	§ 4.2.2.6	It is recommended to design jacking points so that they can be used as lifting points with all the running gears of the vehicle linked to the underframe of the vehicle.	
	Document [30] describes the lifting and jacking procedure for the SNG units. The lifting of the complete unit will run on four lifting plates per car. It is possible to lift a complete unit with all bogies hanging. Section 2.2 describes the procedure for independent carbody lifting with and without bogies. Section 2.3 describes the re-railing procedure for end bogie or intermediate bogie. Lifting pads positions are defined in drawing [26] for the cabin car. Lifting pads positions are defined in drawing [33] for cars B and C.		Compliant
22	§ 4.2.2.6	Jacking/Lifting points shall be located such as to enable the safe and stable lifting of the vehicle; sufficient space shall be provided underneath and around each jacking point to allow an easy installation of rescue devices. Jacking/Lifting points shall be designed such that staff is not exposed to any undue risk under normal operation or when using the rescue equipments.	
	Drawing [26] shows the lifting and jacking pads position at car A. Lifting pads positions are defined in drawing [33] for cars B and C. Document [31] describes the clear space and position of lifting brackets to be used for lifting cars or unit for the new units for Civity NS, similar to the lifting brackets available in the depot of Leidschendam and Haarlem. The clear space to introduce the lifting brackets is showed in the Annex. It is proved that free space underneath and around jacking points is suitable for maintenance operations at Leidschendam and Haarlem depots. Document [32] describes the clear space and position of rerailing equipment to be used for rerailing cars for rescuing the new units for Civity NS. Annex shows the clearance for rerailing. Space envelope for rerailing has been considered according EN 16404. This is correct.		Compliant
23	§ 4.2.2.6	When the lower structure of the bodyshell does not allow the provision of permanent built-in jacking/lifting points, this structure shall be provided with fixtures which permit the fixation of removable jacking/lifting points during the re-railing operation.	
	Not Applicable.		Not Applicable

24	§ 4.2.2.6	The geometry of permanent built-in jacking/lifting points shall be compliant with the specification referenced in Appendix J-1, index 9, clause 5.3; the geometry of removable jacking/lifting points shall be compliant with the specification referenced in Appendix J-1, index 9, clause 5.4.	
	EN 16404, Section 5.4: *Where lifting brackets are used, standard lifting bracket geometric requirements and their interfaces are defined in Annex B and Annex C.* Delivered are drawings [27], [28], [29] showing the lift plate geometry and lift plate assembly. Please refer to sections 31 and 32 of this report for the assessment of this clause.		Reference
25	§ 4.2.2.6	Marking of lifting points shall be made by signs compliant with the specification referenced in Appendix J-1, index 10.	
	Please refer to sections 33 to 36 of this report for the assessment of this clause.		Reference
26	§ 4.2.2.6	The structure shall be designed with consideration of the loads specified in the specification referenced in Appendix J-1, index 11, clauses 6.3.2 and 6.3.3; proof of the strength of the vehicle body may be demonstrated by calculations or by testing, according to the conditions set up in the specification referenced in Appendix J-1, index 11, clause 9.2. Alternative normative documents may be used under the same conditions as defined in clause 4.2.2.4 above.	
	Document [20] presents the methodology that will be used to carry out the structural calculations using Finite Element Methods (FEM). With regards to lifting and jacking, loads to be analysed are described in Section 3.4. Calculations have been done according to the requirements of the normative EN 12663 classifying the vehicle as type P-II. According to table 10 of EN 12663, section 6.3.2, mass taken into account shall be 1,1 x g x (m_1 + m_2) for lifting and jacking at one end of the vehicle. According to table 11 EN 12663, section 6.3.2 mass taken into account shall be 1,1 x g x (m_1 + 2 x m_2) for lifting and jacking of the whole vehicle. Specified loads considered are (m_1 = Design mass in working order without bogies / m_{2a} = Motor end-bogie mass / m_{2b} = Motor shared-bogie mass): For rerailment of E1 in tare. Cab car: Fz = 1,1 x (m_1 + m_{2a}) x g. Correct, in accordance with EN 12663, Table 10 For rerailment of one end in tare. Intermediate car: Fz = 1,1 x (m_1 + 0.5*m_{2b}) x g. This is in accordance with EN 12663, Table 10 as shared bogie is involved (half of it mass considered). For rerailment of e2 in tare. Cab car: Fz = 1,1 x (m_1 + 0.5*m_{2b}) x g. This is in accordance with EN 12663, Table 10 as shared bogie is involved (half of it mass considered). For lifting the whole vehicle in tare. Cab car: Fz = 1,1 x (m_1 + m_{2a} + 0.5*m_{2b}) x g. This is in accordance with EN 12663, Table 11 as shared bogie is involved (half of it mass considered). For lifting the whole vehicle in tare. Intermediate car: Fz = 1,1 * (m_1 + 0,5*m_{2b} + 0.5*m_{2b}) * g. This is in accordance with EN 12663, Table 11 as shared bogies are involved (half of their mass considered).		Compliant

	For lifting the whole vehicle at the specified lifting position in tare with one support displaced. One of the lifting point is displaced 10mm vertically relative to the plane of the other three points. This is correct according EN 12663, 6.3.3. Conclusion is that EN 12663, 6.3.2 and 6.3.3 are complied. According to application guide of TSI Loc&Pas, section 6.3.4 of EN 12663 is also applicable. EN 12663, 6.3.4: *The re-railing and recovery scenarios set out in EN 16404 require that the vehicle body and lifting points have sufficient strength to ensure that these operations can be conducted safely. This objective shall be satisfied by compliance with the following requirements.* Document [21] presents the stress analysis for the for the Civity NS units' carbody shell and body mounted modules, in accordance with the Carbody Structural Specification [20]. Results of the analysis, regarding lifting and jacking are presented in: 11.1.11 Load Case LC6.4 A E1A , Rerailment of E1 in Tare (Option A) 11.1.12. Load Case LC6.4 A E1B, Rerailment of E1 in Tare (Option B) 11.1.13. Load Case LC6.4 A E2A, Rerailment of E2 in Tare (Option A) 11.1.14. Load Case LC6.4 A E2B, Rerailment of E2 in Tare (Option B) 11.1.15. Load Case LC6.4 B, Vehicle Elevation in Tare 11.1.16. Load Case LC6.4 C, Lifting with displaced support The results of the static load cases confirm that the carbody structure design achieves stresses and deflections within the admissible limits. The most critical areas have been defined in the fatigue load cases and the main stresses on the welded joints have been thoroughly analysed. The obtained results are within the admissible limits. Document [22] presents the stress analysis of the intermediate car for the Civity NS units' carbody shell and body mounted modules, in accordance with the Carbody Structural Specification [20] in accordance with EN 12663. Results of the analysis regarding lifting and jacking are presented in are presented in: 11.1.5. Load Case LC6.4 A E2A, Rerailment of E2 in tare 11.1.6. Load Case LC6.4 B E2B, Rerailment of E2 in tare 11.1.7. Load Case LC6.4 B, Vehicle elevation in tare 11.1.8. Load Case LC6.4 C, Lifting with displaced support The results of the static load cases confirm that the carbody structure design achieves stresses and deflections within the admissible limits. The most critical areas have been defined in the fatigue load cases and the main stresses on the welded joints have been thoroughly analysed. The obtained results are within the admissible limits. CAF has delivered Test specification [17], [18], [19] for the Carbody Structural Test According EN 12663:2010.	

	Document [19] describes the tests to be performed. Due to the considerable similarities among different cars the testing will be carried out for the structure of cabin car A1/A2. Section 2 defines the weights that will be used to define the load cases. Section 3 defines that strains, applied forces and displacements will be measured. Section 4 defines the allowable stresses. Section 5 defines the load cases that the structure will undergo. For lifting and jacking, section 5 defines the load cases applied. • Rerailment of the leading bogie at the specified lifting positions in tare. 10% overloaded. (Option A). • Rerailment of the leading bogie at the specified lifting positions in tare. 10% overloaded. (Option B). • Rerailment of the rear bogie at the specified lifting positions in tare. 10% overloaded. (Option A). • Rerailment of the rear bogie at the specified lifting positions in tare. 10% overloaded. (Option B). • Lifting the carbody on tare with both bogies hanging. 10% overloaded. Four lifting points. (Option A). • Lifting the carbody on tare with both bogies hanging. 10% overloaded. Four lifting points. (Option B). • Lifting the carbody on tare with both bogies hanging and one lifting point displaced 10mm vertically. 10% overloaded. Four lifting points. Load cases considered are correct according EN 12663:2010. Document [155] is the test report of the structural tests performed from 12/05/2016 to 17/06/2016 on the carbody "A2-001-E2" designed and manufactured by CAF for the Civity NS project. Tests were performed by CETEST, accredited laboratory against EN 17025, according EN 12663:2010 and test procedure [19]. Load cases described in the test procedure [19] have been applied. Results are shown in Annex A1.10 to Annex A1.16. Section 6.3.4 shows summaries of the stresses and displacements at the most relevant measured points due to the different load cases. In all cases, the residual stresses after unloading have proved to be below the established limits. It can be considered that no permanent deformation has taken place under these load cases. Visual inspections were done after the completion of the test and no permanent deformations were found. Test results are correct. It has been demonstrated that the structure is suitable for lifting and jacking purposes according to the loads specified in section 6.3.2 and 6.3.3 of EN 12663:2010.	
27	§ 4.2.2.6	For each vehicle of the unit, a jacking and lifting diagram and corresponding instructions shall be provided in the documentation as described in clauses 4.2.12.5 and 4.2.12.6 of this TSI. Instructions shall be given as far as feasible by pictograms.	
	Document [30] describes the lifting and jacking procedure for the SNG units. Interfaces are described in document [30]: Lifting equipment (Section 3), Wheel skate (Section 5), Other RS (Section 6). Clauses 4.2.12.5 and 4.2.12.6 are assessed in the Assessment Report reference 580541.		Compliant
§ 4.2.2.7 Fixing of devices to carbody structure			

28	§ 4.2.2.7	This clause applies to all units, except to OTMs.	
	Applicable to 3 and 4 cars SNG trains.		Information
29	§ 4.2.2.7	Provisions concerning the structural strength of OTMs are specified in Appendix C, clause C.1.	
	Not applicable.		Not applicable
30	§ 4.2.2.7	Fixed devices including those inside the passenger areas, shall be attached to the car body structure in a way that prevents these fixed devices becoming loose and presenting a risk of passenger injuries or lead to a derailment. To this aim, attachments of these devices shall be designed according to the specification referenced in Appendix J-1, index 12, considering category L for locomotives and category P-I or P-II for passenger rolling stock. Alternative normative documents may be used under the same conditions as defined in clause 4.2.2.4 above.	
	Assessment of stresses produced at carbody structure by equipment attachments according <*EN 12663-1:2010 clause 6.5.2. Proof load cases for equipment attachments*> has been carried out at requirement § 4.2.2.4 (Sections 1 to 8). Refer to this section for assessment of stresses at carbody structure due to equipment´s reactions. CAF´s documentation references [53] to [56] have been assessed here. These documents provide results for stress status at bolted joins for each equipment. The following comments arise from assessment: ○ Methodology used is according EN 12663-1:2010 clause 6.5.2. and 6.7.3 (regarding Static and Fatigue Load cases considered). OK. ○ Axial and shear effort per connection has been calculated at each equipment. OK. ○ Safety margins for each bolted connection has been calculated. OK. ○ Document [145] refers to mounting drawings (documents [58], [59], [101] to [143]). ○ Carbody - equipment connection has been checked and deemed compliant. OK. ○ Document [145], clause 3, and document [146], clause 3, explain that calculations of bolted unions have been carried out according to standard VDI2230, using MDESIGN software. - Input parameters for calculation in MDESIGN: - Forces: e.g.: Reference [54] Appendix 2_CI4_SEAT_P; AXIAL & SHEAR EFFORT PER CONNECTION (N). OK. - Friction coefficients, e.g.: Reference [54] Appendix 2_CI4_SEAT_P; Input data. Bolted joint loads. Minimum coefficient of friction. OK. - Materials: e.g.: Reference [54]. Appendix 2_CI4_SEAT_P; Specification of clamped parts. OK. - Values of outputs: - Tightening torque: e.g.: Reference [54]. Appendix 2_CI4_SEAT_P; Tightening torque: OK. - Safety factor for contact pressure: e.g.: Reference [54]. Appendix 2_CI4_SEAT_P; Static Load Analysis. Safety margin against slipping and shearing of the bolt. OK.		Compliant for trainsets without under frame ballast modification

- Safety factor for fatigue strength: e.g.: Reference [54]. Appendix 2_CI4_SEAT_P; Fatigue Load Analysis. Safety margin against slipping and shearing of the bolt. OK

- This list with exterior equipment is given in reference [20] Clause 5 EQUIPMENTS. Some of the elements of the document [144] are introduced to cover possible future configurations of the train (for example the transformer). The document [145] contains all the elements that are present on the train. The exterior equipment have been considered at references [55] and [56].

- Masses (kg) considered for each equipment at references [55] and [56] do not match exactly to what considered at reference [20] Clause 5. EQUIPMENTS (ej: Battery Box mass= 543 kg at reference [56] and 400 kg at reference [20]).

    - Traction inverter.
    - Cab HVAC.
    - Passenger's department HVAC.
    - Filter inductor.
    - Battery box.
    - APS.
    - Braking resistors.
    - Pantograph
    - Main Circuit Breaker
    - Air Supply Unit
    - Brake Panel Support

  Some of the weights have been updated. However other weights do not match because for the [144] the weights considered are some times higher than the real ones, with the intention of covering possible future configurations. In the document [144] CAF has put a sentence explaining that the weights used for the calculations are in some cases higher than the real weight of the equipment.

  Clause 2 in document [144] includes a reference to the increased weights used for calculation. OK.

- Documents [59], [62], [65], [69], [73], [77], [80], [83], [86], [89], [92], [94], [98], [100], [102], [104], [106], [108], [110], [112], [114], [116], [118], [120], [122], [124], [127], [133], [135], [137], [139], [141] and [143] include the list of materials indicating the weight of the relevant equipment.

    - Seat Document [92].
    - Door Drive – Carbody Document [62].
    - Short Sliding Step Document [73].
    - Long Sliding Step Document [77].
    - Toilet Tanks – Bioreactor Document [94].

	▪ Toilet Tanks – Fresh Water Tank Document [98].	
	The modification described in [164] related to the introduction of weight in cars A1 and A2 to improve the levelling of the trainsets has impact on the requirement. Calculation has been performed for static loads and fatigue loads for new equipment (ballast) in combination with total weight of the equipment. The calculation included in [164], section 5.3.1 considers the 8 ballast plates (8x50kg). Figure 5 at [164] shows the scheme of load cases considering the 8 ballast plates (8x50kg). The results of the static analysis for the areas around ballast anchorage are detailed in the tables in Figures 6 and 7 at [164]. Results for fatigue analysis for the areas around ballast anchorage are detailed in Figures 8 and 9 at [164]. Calculation results show that in all the load cases the stresses obtained around the attachment of the ballast equipment are very low. The stress values are far from the limits of the material of the area. Regarding galvanic corrosion, the ballast is attached to the carbody by means of 8 inserts and M8 zinc plated bolts (DELTAPROTECT). These bolts are connected to zinc plated inserts located in the aluminum frame. Before riveting the inserts, a primer coat is applied to its exterior surface which will be in contact with the aluminum frame to avoid corrosion. The bolt itself does not require any special treatment as it is not in contact with the aluminum structure. Furthermore, in order to prevent any corrosion issue at contact ballast-underframe, all the surface of ballast parts are painted and sealed to avoid any contact with the aluminum underframe (which is also painted). A zinc o fix film is installed between the L profile and the underframe.	Compliant for trainsets with under frame ballast modification

Annex II: APPENDIX C - Special provisions for on track machines (OTM). (Not Applicable)

Nr	Reference	Description requirement	Status
	Comments		
§ C.1	**Strength of vehicle structure**		
1	§ C.1	The requirements of the clause 4.2.2.4 of this TSI are complemented as follow: The machine frame shall be able to withstand either the static loads of the specification referenced in Annex J-1, index 7 or the static loads according to the specification referenced in Annex J-1, index 102 without exceeding the permissible values given there in.	
	Not applicable		Not applicable
2	§ C.1	The corresponding structural category of the specification referenced in Annex J-1, index 102 is as follows: • for machines not permitted to be loose shunted or hump shunted: F-II; • for all other machines: F-I.	
	Not applicable		Not applicable
3	§ C.1	The acceleration in x-direction according to the specification referenced in Annex J-1, index 7, Table 13 or to the specification referenced in Annex J-1, index 102, Table 10 shall be ±3 g.	
	Not applicable		Not applicable
§ C.2	**Lifting and jacking**		
4	§ C.2	The machine body shall incorporate lifting points by which the whole machine is capable of being safely lifted or jacked. The location of the lifting and jacking points shall be defined.	
	Not applicable		Not applicable
5	§ C.2	To facilitate the work during repair or inspection or when on-tracking the machines, the machines shall be provided on both long sides with at least two lifting points, at which the machines can be lifted in empty or loaded condition.	
	Not applicable		Not applicable
6	§ C.2	To allow positioning of jacking devices, clearances shall be provided under the lifting points which shall not be blocked by the presence of non- removable parts. The load cases shall be consistent with the ones chosen in Appendix C.1 of this TSI and shall apply for lifting and jacking under workshop and servicing operations.	
	Not applicable		Not applicable

Annex III: APPENDIX D – Assessment of EN12663-1:2010

EN 12663-1:2010			
1	§ 5.2	Categories of railway vehicles	
	CAF evidence: Reference [21]. Section 1: "Calculation and testing will be done according to the requirements of the normative EN 12663 classifying the vehicle as type P-II." **RC assessment**: Category P-II. (Fixed units and coaches). Correct classification.		Compliant
2	§ 6.1	Design load cases – general This clause defines the load cases to be used for the design of railway vehicle bodies. It contains static loads representing exceptional and fatigue conditions as defined in 5.1. Nominal values for each load case are given in the associated tables for each category of vehicle. The load values for freight wagons given in the following tables and associated explanatory text are extracted from EN 12663-2. The values represent the normal minimum requirements. The vehicle masses to be used for determining the design load cases are defined in Table 1.	
	CAF evidence: Reference [21], Reference [22], clause 5. Calculation Data. Weights. **RC assessment:** Reference [21]: proper masses have been used for calculation (m1, m2a, m2b, m3 and m4) according reference [24] and additional considerations of operation conditions (snow load). Reference [22]: Correct methodology used according EN 12663. Ok.		Compliant
3	§ 6.2.1	Longitudinal static loads for the vehicle body, General The loads defined in Table 2 to Table 8 shall be considered in combination with the load due to 1 *g* vertical acceleration of the mass m_1.	
	Table 2 — Compressive force at buffers and/or coupler attachment. **CAF evidence:** Reference [21], Reference [22], LC6.1 A; Reference [21], LC6.1 B. *Table 3: Not applicable (related to freight wagons only).* *Table 4: Not applicable (related to freight wagons only).* *Table 5 — Tensile force at coupler attachment* **CAF evidence:** Reference [21], Reference [22] LC6.1 C. *Table 6 — Compressive force 150 mm above the top of the structural floor at head stock* **CAF evidence:** Reference [21] LC6.1 D. *Table 7 — Compressive force at the height of the window sill* **CAF evidence:** Reference [21] LC6.1 E. *Table 8 — Compressive force at the height of the cant rail*		Compliant

	CAF evidence: Reference [21] LC6.1 F. *"Distribution of the vertical load due to design mass in working order (m1·g) along the underframe and the roof of the car. 1/3 of the tare is applied on the roof whereas the remaining 2/3 on the underframe."* **RC assessment**: The loads defined in Table 2 to Table 8 have been considered in combination with the load due to 1 g vertical acceleration of the mass m1. OK.		
4	§ 6.2.2	Longitudinal forces in buffers and/or coupling area Table 2 — Compressive force at buffers and/or coupler attachment Table 3 — Compressive force below buffer and/or coupling level Table 4 —Compressive force applied diagonally at buffer attachment (if side buffers are fitted at one or both ends of a single vehicle) Table 5 — Tensile force at coupler attachment	
	Table 2 — Compressive force at buffers and/or coupler attachment. **CAF evidence**: Reference [21], Reference [22] LC6.1 A; Reference [21] LC6.1 B. *Table 3: Not applicable.* *Table 4: Not applicable.* *Table 5 — Tensile force at coupler attachment* **CAF evidence**: Reference [21], Reference [22] LC6.1 C. **RC assessment**: Correct methodology used according EN 12663.		Compliant
5	§ 6.2.3	Compressive forces in end wall area The compressive force specified in Table 6, Table 7 and Table 8 shall be reacted at coupler/buffer level at the opposite end of the vehicle body. If the structure incorporates a crashworthy design according to EN 15227 it is permitted to apply the loads to the vehicle end wall structure either in front or behind the designated collapse areas. Table 6 — Compressive force 150 mm above the top of the structural floor at head stock Table 7 — Compressive force at the height of the waistrail (window sill) Table 8 — Compressive force at the height of the cant rail	
	Table 6 — Compressive force 150 mm above the top of the structural floor at head stock **CAF evidence**: Reference [21] LC6.1 D. *Table 7 — Compressive force at the height of the window sill* **CAF evidence**: Reference [21] LC6.1 E. *Table 8 — Compressive force at the height of the cant rail*		Compliant

	CAF evidence: Reference [21] LC6.1 F. **RC assessment**: The structure incorporates a crashworthy design according to EN 15227 (see Req. 4.2.2.5). Loads have been applied to the vehicle end wall structure in front the designated collapse areas. OK		
6	§ 6.3.1	Maximum operating load The maximum operating load as defined in Table 9 corresponds to the exceptional payload of the vehicle. Table 9 — Maximum operating load	
	Table 9 — Maximum operating load **CAF evidence**: Reference [21], Reference [22] LC6.2 1; LC6.2 2. **RC assessment**: Correct methodology used according EN 12663.		Compliant
1	§ 6.3.2	Lifting and jacking The forces in Table 10 and Table 11 represent the lifted masses. The equations are given for a two-bogie vehicle. The same principle shall be used for railway vehicles with other suspension configurations. The mass to be lifted is based on the vehicle mass without payload (except for freight wagons which are lifted in the laden condition). It may not include bogies or the full payload in some operational requirements. In such cases, the value m_2 and/or m_3 in the following tables shall be set to zero or reduced to the specified value. When it is necessary to lift vehicles of class P-I to P-V with payload, this shall be part of the specification. Table 10 — Lifting and jacking at one end of the vehicle at the specified positions Table 11 — Lifting and jacking the whole vehicle at the specified positions	
	Table 10 — Lifting and jacking at one end of the vehicle at the specified positions **CAF evidence:** Reference [21], LC6.4 A E1A; LC6.4 A E1B; Reference [21], Reference [22] LC6.4 A E2A; LC6.4 A E2B. *Table 11 — Lifting and jacking the whole vehicle at the specified positions* **CAF evidence**: Reference [21], Reference [22] LC6.4 B. **RC assessment**: Correct methodology used according EN 12663.		Compliant
2	§ 6.3.3	Lifting and jacking with displaced support The load case of Table 11 shall be considered with one of the lifting points displaced vertically relative to the plane of the other three supporting points. For this analysis the amount of vertical displacement of the fourth lifting point relative to the other three lifting points shall be considered to be 10 mm or to be equal to the offset which just induces a lift off of one of the lifting points which ever is smaller. If necessary a higher degree of offset shall be part of the specification.	
	6.3.3 Lifting and jacking with displaced support		Compliant

	CAF evidence: Reference [21], Reference [22] LC6.4 C. **RC assessment**: Correct methodology used according EN 12663.		
3	§ 6.4	Superposition of static load cases for the vehicle body In order to demonstrate a satisfactory static strength, as a minimum the superposition of static load cases as indicated in Table 12 shall be considered. Each part of the structure shall satisfy the criteria of 5.4 under the worst combination of the load cases specified in 6.2 and Table 12. Table 12 — Superposition of static load cases for the vehicle body	
	Table 12 — Superposition of static load cases for the vehicle body **CAF evidence:** Reference [21], Reference [22] LC6.3 A; LC6.3 B. **RC assessment:** Correct methodology used according EN 12663.		Compliant
4	§ 6.5.1	Proof load cases for body to bogie connection The body to bogie connection shall sustain the loads due to 6.3.1 and 6.3.2. It shall also sustain separately, in combination with those due to a 1 *g* vertical acceleration of the vehicle body mass m_1, the loads arising from: a) the maximum bogie acceleration in the x-direction according to the corresponding category of Table 13, in case of motor bogies, the minimum acceleration for category P-I is 3 *g*. In case of vehicles shunted under heavy conditions (e.g. hump hill) higher values shall be considered; b) the lateral force per bogie corresponding to the exceptional transverse force as defined in EN 13749 or 1 *g* applied on the bogie mass m_2 whichever is the greater.	
	6.5.1. Proof load cases for body to bogie connection **CAF evidence:** Reference [21], LC6.5 A +X; 11.1.18. Load Case LC6.5 A –X. **RC assessment**: Transverse force used as defined in EN 13749. Bogie masses differ to what shown at doc. Reference [24] clause 3.3 Bogies (but in a conservative way). OK. Correct methodology used according EN 12663.		Compliant
5	§ 6.5.2	Proof load cases for equipment attachments In order to calculate the forces on the equipment attachments during operation of the vehicle, the masses of the components shall be multiplied by the specified accelerations in Table 13, Table 14 and Table 15. The load cases shall be applied individually. As a minimum additional requirement the loads, resulting from the accelerations defined in Table 13, Table 14, and Table 15 shall be separately considered in combination with the maximum loads which the equipment itself may generate. The accelerations defined in Table 13 and Table 14 shall be considered in combination with the load due to 1 g vertical acceleration. The load defined in Table 15 includes the dead weight of the equipment. If the mass of the equipment,	

		or its method of mounting, is such that it may modify the dynamic behaviour of the vehicle, then the suitability of the specified accelerations shall be investigated. Table 13 — Accelerations in x-direction Table 14 — Accelerations in y-direction Table 15 — Accelerations in z-direction	
	Regarding to body structure attachment points (Req. § 4.2.2.4. Strength of vehicle structure). *6.5.2 Proof load cases for equipment attachments* **CAF evidence:** Reference [21], Study performed for each one of possible configurations (15kV_AC equipment configuration, 1500V_DC equipment configuration; Bitension 1500-3000 equipment configuration). Reference [21], Reference [22] LC 8.1A; Reference [21], LC 8.1B, LC 8.1C, **RC assessment:** correct safety factors used; correct methodology; conformance to results output. Regarding to equipment attachments see requirement. § 4.2.2.7 at this document.		Compliant
6	§ 6.5.4	Proof load cases for specific components on freight wagons The proof load cases for the design of specific components on freight wagons are given EN 12663-2.	
	Not applicable.		Not applicable
7	§ 6.6.1	Sources of load input All sources of cyclic loading which can cause fatigue damage shall be identified. The following specific inputs shall be considered in carrying out the fatigue damage assessment of the vehicle structure.	
	CAF´s evidence: Reference [21], Reference [22] 7 and 8.2 **RC assessment**: sources of cyclic loading which can cause fatigue damage have been identified. OK		Compliant
8	§ 6.6.2	Payload spectrum Where the payload does not change significantly, the normal design payload m3 may be used over the entire operational life for categories P-I to P-V, F-I and F-II. Where the payload changes significantly, the payloads and the proportion of time spent at each level shall be defined in the specification and be made available in an appropriate form for calculation purposes. Changes in payload are likely to be significant in rapid transit/metro and some freight applications. For these applications it may be necessary to specify more than one design payload (based on m3 and/or m4) corresponding to separate distinct periods of operation. For other types of vehicle, it is usually sufficient to assume a constant payload over the entire operational life. Payload levels should be expressed in terms of fractions of m3 or m4 as appropriate. Changes in the	

		distribution of payload at different mass states shall be taken into account where relevant.	
	CAF´s evidence: Reference [21], Reference [22] 7.1 to 7.3 **RC assessment**: normal design payload m3 has been used. Changes in payload are not likely to be significant. OK		Compliant
9	§ 6.6.3	Load/unload cycles The load/unload cycles should be determined and represented in a suitable manner for analysis purposes. Fatigue damage due to load/unload cycles is likely to be significant if vehicles have a high payload to tare weight ratio and there are frequent payload changes.	
	RC assessment: Fatigue damage due to load/unload cycles has not been considered. No frequent payload changes have been considered. OK.		Compliant
10	§ 6.6.4	Track induced loading Induced loading resulting from vertical, lateral and twist irregularities of the track may be determined from: a) dynamic modelling (from data relating to the track geometry and irregularities); b) measured data over the intended or similar route; or represented by c) empirical data (accelerations, displacements, etc.). The nature of the data will differ depending on whether a cumulative damage or endurance limit approach tofatigue design is being used. If a set of fatigue load cases has proved successful for a particular type of vehicle in previous applications then these load cases should be taken as the starting point in a subsequent design. Alternative load cases should be used only if there is a clear justification for the change. Table 16 and Table 17 give empirical vertical and lateral acceleration levels, suitable for an endurance limit approach, consistent with normal European operations, which shall be adopted if no more suitable (asindicated above) data are available. In some applications higher values may be defined in the specification and the effect of track twist may also have to be considered. The equivalent dynamic loading in a cumulative damage analysis may be represented accordingly by taking the acceleration levels in Table 16 and Table 17 and assuming they act for 107 cycles each. Table 16 — Acceleration in y-direction Table 17 — Acceleration in z-direction	
	6.6 General fatigue load cases for the vehicle body *Table 16 — Acceleration in y-direction* *Table 17 — Acceleration in z-direction* **CAF evidence:** Reference [21], Reference [22] LC 7.2, 7.3, Structure Fatigue.		Compliant

	RC assessment: conformity to methodology used. Conformity to critical parts of structure studied. Results: conformity to reference details used (Reference [21], Reference [22] table 4-4, 4-5) and calculated damage for each critical part of structure. Use of load input conform table 16 and 17, is accepted.		
11	§ 6.6.5	Aerodynamic loading Significant aerodynamic loads arise in the following circumstances: a) trains passing at high speed; b) tunnel operations; c) exposure to high cross winds. The relevance of such loads shall be considered and a suitable representation of the effects for analysis purposes shall be developed if necessary.	
	CAF evidence: Reference [21], Reference [22] LC 7.7, Structure Fatigue. **RC assessment**: conformity to methodology used. Conformity to critical parts of structure studied. Results: conformity to reference details used (Reference [21], Reference [22] table 4-4, 4-5) and calculated damage for each critical part of structure.		Compliant
12	§ 6.6.6	Traction and braking In general, the number and magnitude of load cycles due to start/stops shall be determined in the specification. Unscheduled stops shall be taken into consideration. If no specific data are available the acceleration levels in Table 18, acting for 107 cycles, shall be used. In the case of vehicles equipped with magnetic rail brakes the maximum acceleration values used in case of emergency braking shall be considered as a proof load case. The presence of longitudinal accelerations due to dynamic vehicle interactions shall be assessed and their effects incorporated if significant load inputs are generated. Table 18 — Acceleration in x-direction	
	6.6 General fatigue load cases for the vehicle body *Table 18 — Acceleration in x-direction* **CAF evidence**: Reference [21], Reference [22] LC 7.1, Structure Fatigue. **RC assessment**: conformity to methodology used. Conformity to critical parts of structure studied. Results: conformity to reference details used (Reference [21], Reference [22] table 4-4, 4-5) and calculated damage for each critical part of structure. Regarding load case for magnetic braking: Standard EN 12663 in chapter 6.6 about fatigue states: In the case of vehicles equipped with magnetic rail brakes the maximum acceleration values used in case of emergency braking shall be considered as a proof load case.		Compliant

	maximum acceleration values used in case of emergency braking are considered as a proof load case. According to Brake performance calculation report [20] chapter 2.6 maximum acceleration value is 1,46 m/s2 for the 3 car configuration and 1,41 m/s2 for the 4 car configuration. F_X = +/- 1,46· m4 ·g (only applies to the end bogies where magnetic brakes are mounted) This force is lower than the proof load case of longitudinal acceleration of +/-3·g, so the effect of the emergency braking is covered by the calculation. EN 16207 about Magnetic Track Brake systems for use in railway rolling stock states that magnetic brake force is 0,4 times magnetic attraction force; according to Brake performance calculation report [20] magnetic attraction force is 84.000N, so magnetic brake force is 33.600N per end bogie (where magnetic brakes are mounted). EN 16207 standard also defines a maximum of 150.000 cycles. This has been added in the fatigue chapter to the calculation specification [20]. Calculation reports [21] and [22] show that this does not affect the result because the bogie longitudinal load is 30.000N at 10e7 cycles and damage is equivalent to zero.		
13	§ 6.7.1	General requirements It shall be ensured that all relevant interface loads are incorporated in a meaningful manner, including the appropriate number of cycles. The following clauses define the most important interface loads.	
	6.7 Fatigue loads at interfaces **CAF evidence**: Reference [21] LC 7.4, Body to bogie longitudinal fatigue load; LC 7.5, Body to bogie transversal fatigue load; LC 7.6 A, Body-bogie connection supports fatigue load. Anti-yaw damper; LC 7.5 B, Body-bogie connection supports fatigue load. Vertical damper; LC 7.5 C, Body-bogie connection supports fatigue load. Anti-roll bar **RC assessment**: conformity to methodology used. Results: conformity to reference details used (Reference [21] table 4-4, 4-5) and calculated damage for each critical part of structure. Relevant interface loads have been incorporated in a meaningful manner, including the appropriate number of cycles. OK.		Compliant
14	§ 6.7.2	Body/bogie connection The main fatigue load inputs arise from traction and braking and vehicle dynamic interactions. The loads shall be determined using the methods of 6.6.4 and from the performance characteristics of suspension components (e.g. dampers, anti-roll bars).	
	See previous point 13.		Reference
15	§ 6.7.3	Equipment attachments Equipment attachments shall withstand the loading caused by accelerations due to vehicle dynamics plus any additional loading resulting from the operation of the equipment itself. Acceleration levels may be determined as described in 6.6.4. For normal European operations, empirical acceleration levels for items of equipment which follow the motion of the body structure are given in Table 16, Table 17 and Table 18. The number of load cycles shall be 107 each.	

	6.7.3 Equipment attachments. Fatigue loads. **CAF evidence**: Reference [21] 11.3.1.4. Load Case LC 8.2, **RC assessment**: conformity to loads and constrains, methodology used, combination of load cases and results. OK		Compliant
16	§ 6.7.4	Couplers Cyclic loads in coupling attachments resulting from the specified operational requirements shall be assessed if fatigue damage can occur.	
	RC assessment: This point has been assessed at Requirement § 4.2.2.2.2 Inner coupling in assessment report 580540.		Reference
17	§ 6.8	Combination of fatigue load cases The relevant combinations of fatigue load cases shall be identified and it shall be ensured that the design requirements are achieved in these cases. In some applications, it may be necessary to incorporate global loadings due to traction and braking cycles (see 6.6.6) and other loads due to longitudinal (x-direction) induced accelerations with those acting vertically (z-direction) and transversely (y-direction). An endurance limit analysis shall include load cases representing realistic combinations of the individual loads identified in 6.6 and 6.7. When considered in combination, the magnitudes of the individual load cases may be reduced from those given in the Table 16 to Table 18.	
	6.6 General fatigue load cases for the vehicle body *6.8 Combination of fatigue load cases* *Table 18 — Acceleration in x-direction* *Table 16 — Acceleration in y-direction* *Table 17 — Acceleration in z-direction* **CAF evidence**: Reference [21], Reference [22] LC 7.1, 7.2, 7.3 and 7.7, Structure Fatigue. **RC assessment**: conformity to methodology used. Conformity to critical parts of structure studied. Results: conformity to reference details used (Reference [21], Reference [22] table 4-4, 4-5) and calculated damage for each critical part of structure. OK		Compliant
18	§ 6.9.1	Modes of vibration, Vehicle body The natural modes of vibration of the vehicle body in working order (see Table 1) should be separated sufficiently, or otherwise decoupled, from the suspension frequencies, so as to avoid the occurrence of undesirable responses and to achieve an acceptable ride quality.	
19	§ 6.9.2	Modes of vibration, Equipment The fundamental modes of vibration of items of equipment, on their mountings and in all operation conditions, should be separated sufficiently, or otherwise	

	decoupled, from the modes of vibration of the body structure and suspension, so as to avoid undesirable responses.	
	6.9 Modes of vibration *6.9.1 Vehicle body* *The natural modes of vibration of the vehicle body in working order (see Table 1) should be separated sufficiently, or otherwise decoupled, from the suspension frequencies, so as to avoid the occurrence of undesirable responses and to achieve an acceptable ride quality.* *6.9.2 Equipment* *The fundamental modes of vibration of items of equipment, on their mountings and in all operation conditions, should be separated sufficiently, or otherwise decoupled, from the modes of vibration of the body structure and suspension, so as to avoid undesirable responses.* **CAF evidence**: Reference [21], Reference [22] Natural Frequencies Calculation Regarding natural modes of vibration of the vehicle body, as explained in section 2.3 of document [47], flexible modes are included in the dynamic model of the vehicle to represent different vibration modes of the carbodies. A flexible mode of vibration can be characterised dynamically by its frequency, modal mass and modal damping. The mode shape (amplitude and direction) characterises the geometric influence of the mode on the suspension connections and accelerometers. The first body bending mode, which generally has the most significant influence on ride comfort, is included. Ride comfort calculation results are included in section 3.9 of the document. Mean Comfort Index for all studied track sections and vehicle speeds up to 160 km/h does not exceed the limit of 2.5 established in Requirement SNG-3784 of the Functional Technical Specification. Therefore, it is considered that suspension and vehicle body modes are decoupled. **RC assessment:** Reference [47] Dynamics Calculations checked. - Reference [47] 2.3.1. Rigid solids. Conformance to modellization of ridig solids. OK. - Reference [47] 2.3.2. Suspension elements: Conformance to modellization of each suspension element. OK - Reference [47] 2.3.4.1. Rigid solids properties: Considerations regarding carbody and bogies weight. Bogies weight match to C.I4.93.110.01_C_WEIGHT REPORT. OK. - Reference [47] 2.3.4.2. Primary suspension, 2.3.4.3. Secondary suspension. 2.3.4.4. Dampers. All main characteristics for suspension have been taken into account. OK. - Reference [47] 2.4. MBS Model validation. Model has been validated with previous similar project. OK. - Reference [47] 3.1. Natural frequencies and damping analysis. Different vibration modes have been considered and calculation of Natural frequencies [Hz] and Damping Ratios [%]. Carbodies Natural frequencies and Bogies Natural frequencies do not coincide (difference at least of √2 between lowest frequencies). OK. The suspension modes included in tables 3.1 and 3.4 have been calculated with 0.04 equivalent conicities. For these low conicities there is no bogie yawing (hunting) but the bogie has a lateral moving mode usually combined with carbody rolling.	Compliant

	The vibration modes between 0 and 15 Hz are studied since these modes are the most important for the dynamic behaviour of the train. Expanding the range of analysis, it can be seen that the bogie roll modes' eigenfrequencies are around: 15.3 Hz (end bogies), 19.5 Hz (motor jacob bogies), 21.5 Hz (trailer jacob bogies). These frequencies are de-coupled from carbody roll. OK Regarding **natural modes of vibration of Equipment,** General equipment mounted on the carbody do not produce vibrations and are subjected to the trains vibrations and therefore tested according CEI61373. The following two equipment are mounted with silent-blocks: compressor and pantograph lifting compressor. • Compressor: o Natural frequencies of ASU (Air Supply Unit, air production box where the compressor is mounted) are over 30Hz o Silentblocks have natural frequencies below 30Hz and softened, so there is no risk of resonance. o It is mounted with double stage suspension. • Pantograph lifting compressor: it works from time to time/seldom when the train is started and when there is no air stored. Natural frequencies for main equipment do not coincide with carbody natural frequencies. OK		
20	§ 9.2.1	Validation programme for new design of vehicle body structures, General In order to prove the structural integrity of a newly designed vehicle body structure two major steps are significant: a) structural analyses; b) testing.	
	9.2 Validation programme for new design of vehicle body structures *9.2.1 General* *In order to prove the structural integrity of a newly designed vehicle body structure two major steps are* *significant:* *a) structural analyses;* *b) testing. 9.2.3.1 General Tests shall be performed for all newly designed vehicle body structures as defined in 8.1.* *8.1 Objectives* *Tests shall be performed as required by the specification in order to provide the demonstration of strength and stability as required in 5.1. It is not necessary to carry out tests if there are*		Compliant

appropriate verification data available from previous tests on a similar structure that can be shown to be still applicable or correlation between test and calculation methods has been established.

The specific objectives of the tests are:

- *to verify the strength of the structure when subjected to the maximum loads;*
- *to verify that no significant permanent deformation is present after removal of the maximum loads;*
- *to determine the strength of the structure under loading representing service load cases;*
- *to determine the stiffness of the structure.*

The tests shall comprise as appropriate:

- *static simulation of selected design load cases;*
- *measurement of strains/stresses with the aid of electric resistance strain gauges or other suitable techniques;*
- *measurement of the structural deformation under load.*

CAF evidence: Calculations performed for Cabin Car [21] and Intermediate Car [22]. Test Procedure [19] for Cabin Car. Provided Correlation Procedure [23] to validate Cabin Car FEM calculation. Simplifications performed at Intermediate Car Analysis. Provided drawings of Extensiometric sensors mounting for tests [16].

RC assessment: Methodology used is compliant to standard. Tests Results validate FEM calculations.

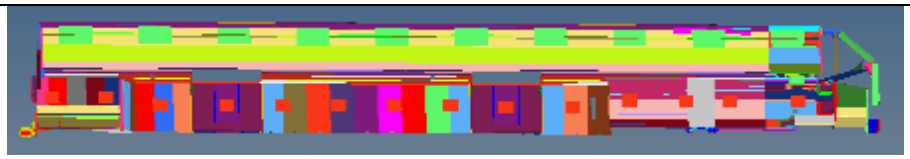
- Test Results [155] according Test Procedure [19]. Tests have been carried out according Test Procedure. OK.
- Checked Correlation Report [156].

- Displacements: Comparison Test/ FEM inside +-20% range (below 3 mm displacement this comparison is negligible); R>0.9 at all load cases analyzed up to date. OK, but with following Notes:

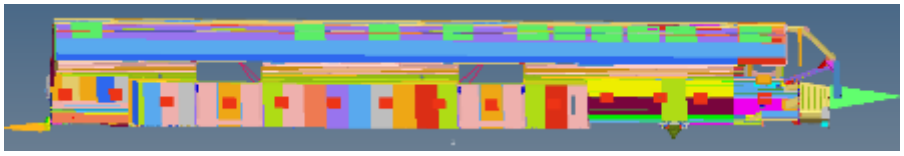
  - Note 1: [156] Figure 4-4 Load Case LC01, Vertical deflection comparison. FEM curve does no match to [21] Figure 11-4: Load Case LC6.1 A, Structure vertical deflection at point K. K value is around -4.5 mm at [21] and -3.5 mm at [156].

    For the correlation document [156], although the FEM model is the same as in Ref. [21], the areas in which the loads have been applied and the distribution of the loads have been slightly modified in the different load cases to reproduce as best as possible the tests that have been carried out.

    In the FEM Model used for the Document [21], a distributed load has been applied in the areas in green at the ceiling and in the areas in red at the body frame (see next image).



In the case of the FE Simulation used for the Document [156] although the model is the same, the application of the distributed vertical load has been done in the areas in green at the ceiling and in red at the body frame, shown in next image.



As it can be seen in these figures, in the model used for the correlation, the distributed load applied in the ceiling is not uniformly distributed in the length of the carbody, there is more load applied in the front part of the ceiling. Moreover, in the case of the body frame, although the areas in which the distributed load has been applied are the same in both cases, the 60% of the load has been applied at the front part of the carbody and the rest at the rear part in [156] meanwhile in [21], the distribution has been uniform along the length of the frame. These distribution of vertical loads of [156] has been implemented as it represents more accurately the real distribution of load along the unit (passengers + equipment).

In the document [156] this explanation has been included.

Deflection figures against Vertical deflection comparison figures and it is shown that it meets the requirements.

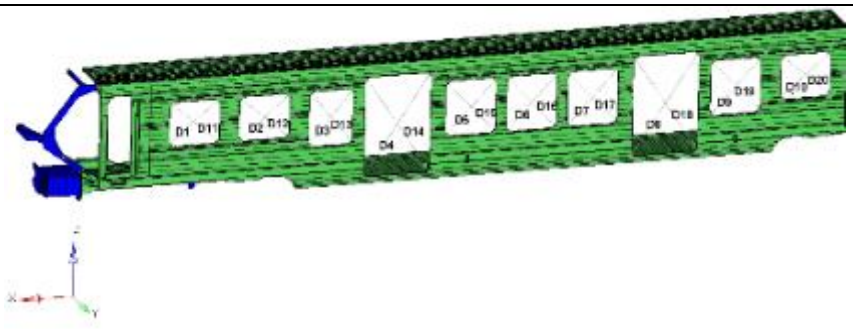
- Note 2: [156] clause 4.2. Comparison of the deflection in X direction: Side of the carbody structure displacement is -14.8 mm; According to [21] Figure 11-6: Load Case LC6.1 A, carbody longitudinal deflection (mm) (x50). Max displacement (side of carbody structure) is about -20 mm.

  Value -14.8 mm is calculated as the difference between the max displacement in X direction of the front side of the carbody and the rear side of the carbody structure.

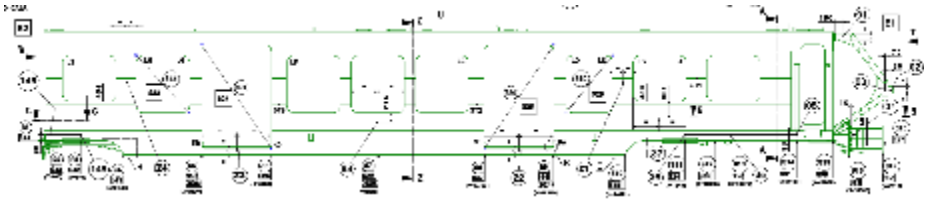
  According to [16], the value corresponds with the measure of S27-S44 for the left side of the carbody and S18-S1 for the right side.

- Note 3: [156] clause 4.3. Diagonal displacements of window and door openings.

  The diagonal displacements of window and door openings in [21] D1 to D20 can be seen in next figure.



In [156] the values of D1-D4, have been obtained from the measurements of displacement sensors in [16].



D1 is the average of S19 and S26; D2 is the average of S20 and S25; D3 is the value of S21; D4 is the average of S22 and S23.

Therefore, the correspondence between D1 to D4 of [156] and [21] D1 to D20 diagonals is:

D1 (S19-S26) = D13

D2(S20-S25) = D14

D3(S21) = D8

D4(S22-S23) = D9

- Strain/ stresses: Comparison Test/ FEM below 20% of the yield limit of the material where the strain gauge is located (for most gauges). OK, but with following comment: Some of them over 20%. It is the same welding seam in different windows.

Rest of Load Cases:

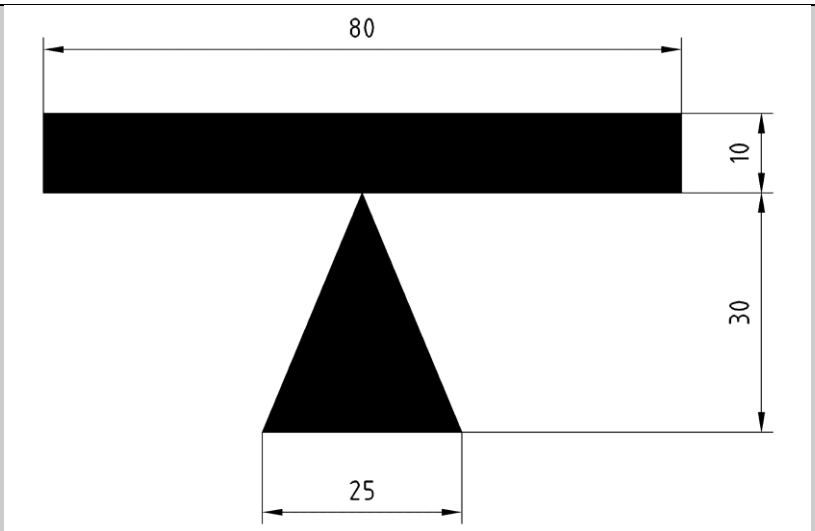
All load cases have been completed at [156]. All load cases from CARBODY STRESS ANALYSIS & TEST CORRELATION document [156] have been checked and it is shown that it meets the requirements. OK.

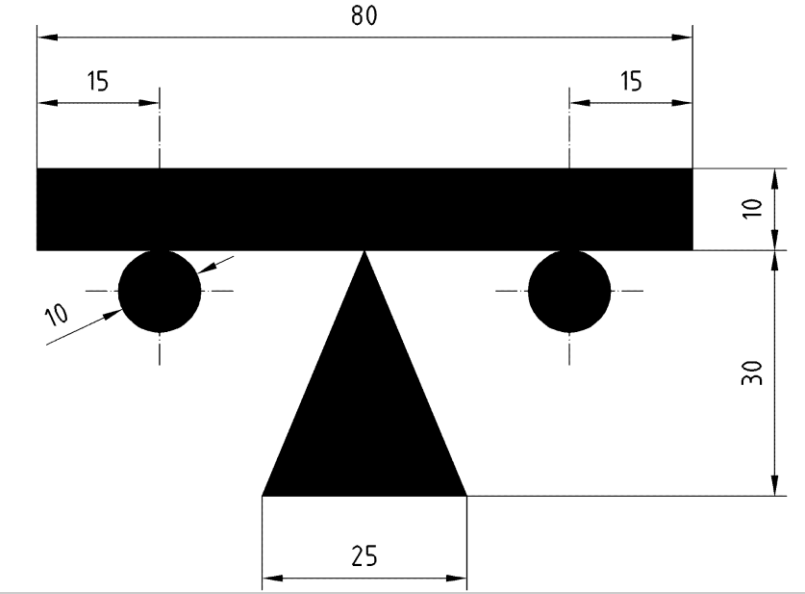
21	§ 9.2.2	Validation programme for new design of vehicle body structures, Structural analyses Numerical methods, such as finite element analyses, shall be used and may be supplemented as necessary by hand calculations. The analyses performed shall be based on the load cases as required by this European Standard. Based on the results of the structural analyses, the railway vehicle may be released for static testing, fatigue testing or service testing. It is acceptable that the structural analysis results of areas of the structure do not meet the requirements of this European Standard if it is shown by subsequent tests that	

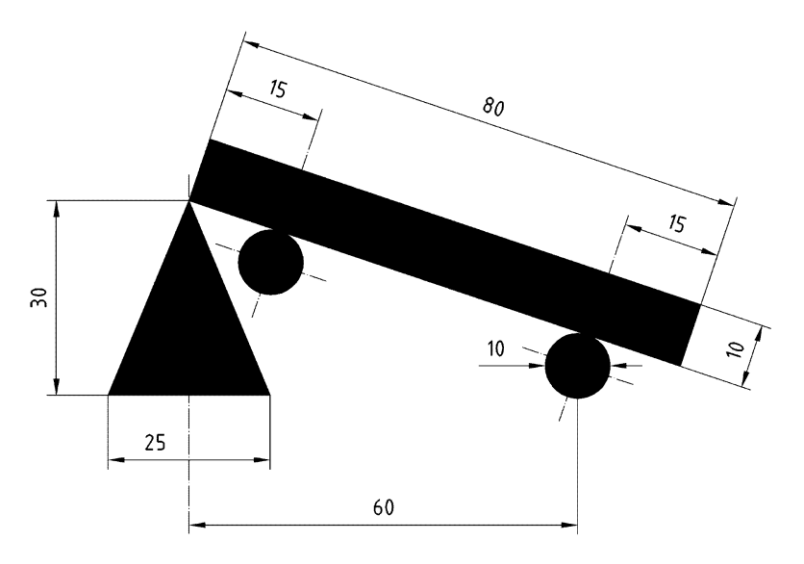
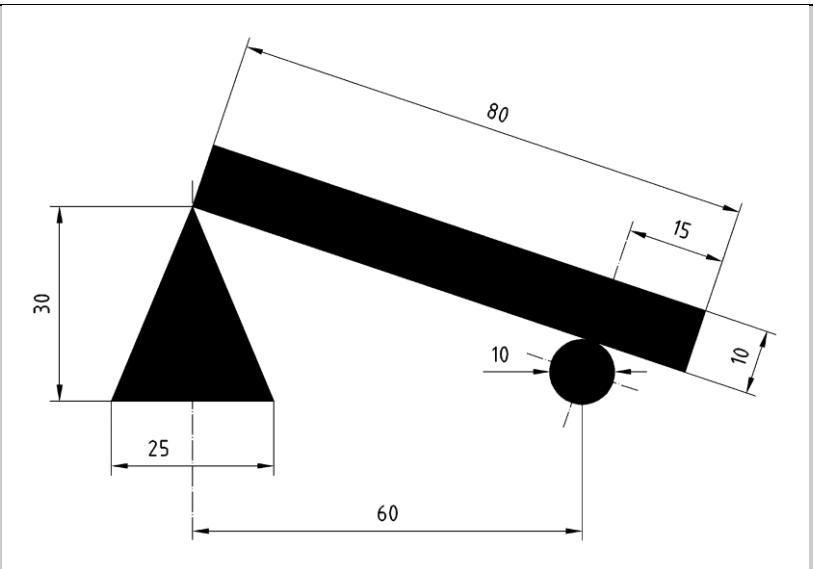
		the requirements of this European Standard are achieved in these areas under representative service conditions.	
	See previous point 20.		Reference
22	§ 9.2.3	Validation programme for new design of vehicle body structures, Testing 9.2.3.1 General Tests shall be performed for all newly designed vehicle body structures as defined in 8.1. 9.2.3.2 Static testing The characteristic vehicle body structures of the railway vehicle shall be tested for the quasi-static load cases defined in this European Standard (see 8.2.1). Strain gauges shall be applied at significant positions of the structure and at all critical areas according to the results of the structural analyses. The test results for the proof load cases shall meet the requirements given in this European Standard. 9.2.3.3 Fatigue testing It is not normal practice to carry out laboratory dynamic fatigue tests on full vehicle body structures but in some circumstances this may be appropriate. Fatigue tests may be performed on specific structural details to demonstrate compliance with the requirements of this European Standard. 9.2.3.4 Service testing In order to evaluate the fatigue strength, on-track service tests can be used to directly measure operating stresses and check fitness for purpose when analysis and static testing have not shown compliance with this European Standard or there is uncertainty in the applicable dynamic inputs. Strain gauges shall be applied at significant positions of the structure of the fully equipped railway vehicle (with normal design payload m3) to capture the structural response for representative service conditions. These positions shall cover all critical areas according to the results of the structural analyses and/or static test. Based on these measurements an assessment of the fatigue strength in the significant measurement positions and critical areas shall be performed according to 5.6 as final step of the proof of fitness for purpose.	
	See previous point 20.		Reference

EN 16404:2014			
31	§ 5.3 Lifting/jacking point geometry	The jack contact surface of a lifting/jacking point shall be: — flat and level, with a minimum jack contact surface area of 10 000 mm2; — not less than 80 mm in length or width. It is permissible for the jack contact surface to be grooved or otherwise patterned to increase effective levels of friction. If required, this shall be part	

		of the vehicle specification. In determining the contact surface area it is permissible for the effect of grooves or patterns to be discounted. Where jack contact surfaces are also intended to be used for maintenance purposes, it is permissible for a central location hole to be provided. If required, this shall be part of the vehicle specification.	
	Clearance for lifting: document [31], Section 4.1 describes that the lifting pads dimension, which are: 80x200mm (on the cab end) and 100x300mm (on the rear end). In addition, drawings [26] and [33] show dimensions and that the lifting points are flat and level. Dimensions are compliant. *Clearance for rerailing*: document [32], Section 3.1 describes that the rerailing pads dimensions are 80x200mm. In addition, drawings [26] and [33] show dimensions and that the rerailing points are flat and level. Dimensions are compliant.		Compliant
32	§ 5.4 Lifting brackets	Where lifting brackets are required (see 4.2.3 and 5.1.3), standard lifting bracket geometric requirements and their interfaces are defined in Annex B, Annex C, and Annex D. It is recommended that freight wagons are designed to not require the use of lifting brackets for re-railing and/or recovery. Non-standard lifting brackets are permissible and if required shall be part of the vehicle specification. Sets of any lifting/jacking brackets, pins or other accessories required for a particular vehicle type shall be either available to all re-railing and recovery teams in areas where the vehicles are to operate or the necessary items shall be carried on board. Lifting bracket structural design requirements are set out in 6.4.	
	No lifting brackets are required (see 4.23. and 5.1.3 of EN 16404).		Not applicable

EN 15877-2:2013			
33	§ 4.5.19.1 Lifting without running gear	 Position: At all designated points.	

		Meaning: Marking indicating where to place jacks, lifting devices, etc., in order to lift the whole vehicle excluding its running gear.	
	Not applicable.		Not applicable
34	§ 4.5.19.2 Lifting at 4 points simultaneously with or without running gear	 Position: At all designated points. Meaning: Marking indicating where to place jacks, lifting devices, etc. in order to lift the whole of the vehicle body, including the running gear where appropriate.	
	Delivered is TSI exterior signage document [34]. Section 3.1 refers to the lifting and jacking signs. Section 3.1.1 shows the positions of the signs at cars A1/A2, B and C1. All designated lifting points at all cars are marked with inscriptions according EN 15877-2:2013, 4.5.19. Compliance proved at document TSI exterior signage document [34]. Section 3.1.2 shows the signs used and their dimensions, also drawings [36] show the sign. Sign for the lifting at 4 points simultaneously is correct in document [34] and is corrected in drawing [36] in revision A (Appendix 3). Signage is correct.		Compliant

35	§ 4.5.19.3 Lifting or re-railing with or without running gear at one end	 Position: At the designated points. Meaning: Marking indicating where to place jacks, lifting devices, etc., in order to lift the whole of the vehicle body by one end, or close to the end, including the running gear where appropriate.	
	Delivered is TSI exterior signage document [34]. Section 3.1 refers to the lifting and jacking signs. Section 3.1.1 shows the positions of the signs at cars A1/A2, B and C1. All designated lifting points at all cars are marked with inscriptions according EN 15877-2:2013, 4.5.19. Compliance proved at document TSI exterior signage document [34]. Section 3.1.2 shows the signs used and their dimensions, also drawings [37] show the sign.		Compliant
36	§ 4.5.19.4 Lifting one end only without running gear	 Position: At the designated points. Meaning: Marking indicating where to place jacks, lifting devices, etc., in order to lift the whole of the vehicle body by one end, or close to the end, without the running gear.	

	Not applicable	Not applicable